NEYVELI LIGNITE CORPORATION LIMITED
(NLC LTD)

NEYVELI NEW THERMAL POWER PROJECT
2x500 MW LIGNITE FIRED UNITS AT NEYVELI
(SG PACKAGE)

PROJECT SPECIFIC
TECHNICAL SPECIFICATION FOR
SINGLE GIRDER EOT/HOT CRANE

SPECIFICATION NO.: PE-TS-400-524-A001

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERIING MANAGEMENT
NOIDA
INDIA

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SECTION – A

SCOPE OF ENQUIRY

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1.1 The specification is intended to cover design, engineering, manufacturing, inspection and testing, painting, supply/ delivery duly packed at FOR site including erection & commissioning spares, mandatory spares, maintenance tools & tackles, all accessories (isolating switch and power cable from isolating switch to DSL rails) including freight in line with drawings/ documents/ test procedures approved by BHEL/ Customer for SINGLE GIRDER CRANE.

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

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

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

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

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

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

1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

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

1.10 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.

SECTION B

PROJECT INFORMATION

SECTION - 2

2 GENERAL PROJECT INFORMATION

2.1 Introduction

The project site at Neyveli has distinct location advantages, being at pit-head distance from the source of lignite supply from Mines, making it convenient for transportation of lignite by belt conveyor. Water source is readily available from the nearby mines lake. Besides, other infrastructure such as access road, railway connection etc, already exist.

2.2 Power Plant Site

The power plant site is located at Neyveli, opposite to the now defunct Fertilizer and Briquetting & Carbonization Plant, near TPS-1 Expansion and TPS-II.

2.3 Project & Site Information

(i).	Owner/Purchaser	:	Neyveli Lignite Corporation Limited (NLC Ltd), Neyveli, Cuddalore District, Tamil Nadu State, India
(ii).	Consultant	:	Lahmeyer International (India) Pvt. Ltd (LII), Gurgaon, NCR, India.
(iii).	Project Title	:	2x500 MW Neyveli New Thermal Power Station (NNTPS)
(iv).	Location	:	200 kms south of Chennai and 50 kms south-west of Cuddalore
(v).	Latitude	:	11° 34′ 00″ N to 11° 35′ 00″ N
(vi).	Longitude	:	79° 26′ 00″ E to 79° 27′ 00″ E
(vii).	Elevation above MSL	:	+67 m
(viii).	Nearest Railway Station	:	Neyveli,
(ix).	Nearest Sea Port	:	Chennai, at a distance of 200 km
(x).	Nearest Airport	:	Chennai, at a distance of 200 km
(xi).	Road Access/Approach to Site	:	Connected by Chennai-Thanjavur NH 45C road and state highway connecting Cuddalore – Virudhachalam via Neyveli. Both NH and state high way roads are well connected to NLC township roads.The approach road is approximately 15 kms from Chennai–Thanjavur NH – 45C road
(xii).	**Site Meteorological Data**		
	• Max ambient temperature	:	42.8° C

	• Min Ambient Temperature	:	26.9° C
	• Wet bulb temp	:	29° C
	• Max. Relative Humidity	:	92 % in the month of September
	• Min. Relative Humidity	:	23 % in the month of May
	• Rainfall	:	About 1265.7 mm annually (average)
	• Wind direction	:	South West to North East direction
	• Wind Speed	:	97.2 km/hr (maximum recorded) 4.3 km/hr (average wind speed)
	• Seismicity	:	As per IS: 1893 (part 4) (Zone-II) Importance factor: 1.75.
(xiii).	Languages spoken in the region	:	English, Tamil

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SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

1.0.0 **SCOPE OF WORK**

1.1.0 **SUPPLIES**

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

1. Bridge girder.
2. End carriages complete with wheels
3. Electric Hoist
4. CT / L T drive arrangement
5. Electrical equipments
6. PVC Shrouded Conductor Bus Bar Type DSL with accessories for entire bay length
7. Rail (for O/H crane only)
8. Earthing arrangement.
9. Painting of crane.
10. First fill of lubricant.
11. O & M Manual, drawings and documents.
12. Main isolating switch and power cable from 1.5M above ground / operating floor to down shop lead.
13. Mandatory spares

1.1.2 Maintenance Tools and Tackles

A complete unused new set of tools & tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied .Each tool and wrench shall be stamped, so as it can be easily identified for use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and specially protected against rusting in tropical climate and minimum the following shall be provided.

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

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

1.1.3 Erection and commissioning spares. (for details refer price format)

1.1.4 Mandatory Spares -

A complete unused and new set of Mandatory Spare parts shall be supplied. The items supplied shall be of the best quality and specially protected against rusting in tropical climate. The minimum requirement of mandatory spare parts is listed in Annexure –II section-C, volume II-B of this specification.

1.2.0 Services to be provided by the bidder

1.2.1. Packing, forwarding and transportation to site.

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

1.3.0. Inspection and Testing

1.3.1. Inspection and testing at Manufacturer's works

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

i. Identification, co-relation and verification of material test certificates for the important components like girders, major load carrying components, hooks, gears, shafts, wheels, wire rope drum, wire rope, gear box etc. For other components supporting test certificates or random check tests shall be conducted / furnished.

ii. Qualification of welder and welding procedure as per ASME section IX .

iii. 100% radiography of tension zone & 25% radiography of compression zone on butt welds of load bearing members shall be carried out with acceptance norms as per ASME Sec VIII Div.1 UW 51. DP test of all butt welds shall be carried out as per ASTM E 165/ ASTM E 109 with acceptance norms as per ASME Sec VIII Div.1

iv. For fillet welds visual inspection on all welds. Die- penetration test (DPT) for fillet welds in the load bearing members as per ASME-165/ASTME 109 and acceptance norm as per ASME section VIII Div. 1.

v. Ultrasonic test on forgings and casting of critical components like hook, shafts, axles, gears, wheels, pulleys, etc. Ultrasonic test for casting as per ASME Section III NB 2572 & for forging as per ASTM A388.

Unacceptable defects in forgings are as given below: -

1. Cracks, flaws, seams and laps.
2. Defects giving indication larger than 4mm diameter equivalent flaw.
3. Groups of defects with maximum indication less than that from a 4mm dia, equivalent flaw, which cannot be separated at testing sensitivity if the back echo is reduced by 50%.
4. Defects giving indication of 2 to 4 mm diameter equivalent flaw separated by a distance less than 4 the size of the larger of the adjacent flaws.

vi. PT/MT on component with surface hardening as per ASTME -165 and ASTME 138 respectively with no surface defects.

vii. Gearbox trial run test as per AGMA standards.

viii. Acceptance and routine tests (HV and insulation) for all electrical and electromechanical components and system as per governing specification

ix. Functional and simulated operation test, sequencing, interlocks, safety, protection and alarm system. Test on CRANE / CRAB motors and other mechanical, electrical, electro-mechanical as per BHEL technical specification and or as per applicable code

x. Cranes shall be completely assembled at manufacturers' works to check the misalignment of gears, shafts and other items. Gear box shall have the idle run for minimum two (2) hours.

B. Testing At Works (Final)

i. Deflection test of bridge girder at rated load.

ii. No load / load (SWL) / Over load test (running of CT & Hoisting mechanism at 125% of rated load.)

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

iv. Measurement of speed of CT & Hoisting (lowering & raising) at rated load.

v. All Other tests as per IS-3177.

Note: Refer Annexure-III, Section-C, Volume II-B for "Shop test Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works.

1.3.2 Testing at site

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

a) All the tests as mentioned against S.N. 1.3.1 (B) above, with actual hook and wire rope.

b) Speed test at rated load for hoisting / CT and LT mechanism.

c) Brake test and working of electric hoist.

d) Any other test as per IS-3177-1999.

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

1.4.0 SURFACE PREPARATION, PAINTING & COLOUR SCHEME

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

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

Drawing/ design documents to be submitted as per list & submission schedule attached as Annexure-V. Any other design document/ drawing as required by customer/ BHEL shall be submitted by bidder during detail engineering without any implication.

2.0.0. **Works Excluded**

2.1.0 Supply of steel gantry girders/ ISMB for crane travel

2.2.0 For EOT crane:

The purchaser shall provide single point 415V, 3 phase, 4 wire and 50Hz power feeder at any point of the bay or in the middle of the bay as specified in the Data sheet A. Vendor shall provide main isolating switch at 1.5 M above the ground / operating floor level and cable required from isolating switch to DSL. Any other supply required by the bidder shall be arranged by the bidder himself by using suitable transformer as per the specification.

3.0.0. **Deviations**

If the proposal submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the appropriate “Schedule of Deviations” furnishing full particular of such deviations. Deviations are to be furnished with mention to specific clause number. Reasons / explanations for such deviations shall be furnished .Notes / comments etc. is not acceptable. If there are no deviations from the tender document, bidder shall indicate ‘NO DEVIATION’ in the deviation schedule.

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

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

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

As detailed in Annexure VI, Vol III

6.0.0 **OTHER REQUIREMENTS**

Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

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

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

ANNEXURE-I
MAKES OF SUB VENDORS ITEMS

S.N.	ITEM	MAKES
1.0	STEEL	SAIL/TISCO/ JINDAL
2.0	HOOKS	KARACHIWALA/ SMRITI FORGING / Steel Forging & Engg. Co., Kolkata
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN/ Bharat wire rope/FORT WILLIAMS
5.0	BEARINGS	SKF/ FAG/ TATA/ NBC
6.0	MOTORS	SIEMENS/NGEF/CROMPTON-Ahmednagar /KIRLOSKAR-Hubli, Bangalore / BHARAT BIJLI-Mumbai / ALSTHOM / ABB-Faridabad
7.0	BRAKES	ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE/PETHE/BCH
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ GEII/ L&T
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ TELEMECHANIQUE
14.0	TRANSFORMERS	INDCOIL / LOGICSTAT / PRAGATI / PRAYOG KAPPA / SOTHERN ELECTRIC / AUTOMATIC ELECTRIC / PRECISE ELECTRICALS / SILKAAN
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON (Except electric ballast)
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS / UML ENGINEERING
18.0	LIGHTING SWITCHES	ANCHOR / ELLORA
19.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT/POLYCAB/KEI
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT/POLYCAB/KEI
c)	FLEXIBLE TRAILING CABLES	NICCO / UNIVERSAL / POLYCAB / KEI
20.0	Cable gland	COMMET / SUNIL&CO. / ARUP ENGINEERING
21.0	PUSH BUTTONS	SIEMENS / L&T / BCH
22.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG
24	SAFETY SWITCHES	ALSTHOM / L&T / SIEMENS
25	PENDENT PUSH BUTTON STATION	OEM
26	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD
27	MCB	MDS / INDO COPP / STANDARD
28	PANELS	OEM
31	INSULATORS & COPPER CONDUCTORS	BHEL APPROVED MAKE
32	CASTINGS	KOLHAPUR STEEL / GNAT FOUNDRY / KIRTI ALLOYS
34	VVVF DRIVE	YASKAWA (L&T)/ ABB / SIEMENS / SCHNIEDER
35	SHROUDED DSL	SUSHEEL / STROMAG

NOTE :- Bidder to note that the list of sub-vendor shall be adhered to, any addition/ deletion of sub-vendor by Customer during detail engineering will not call for any Commercial implication.

ANNEXURE II

LIST OF MANDATORY SPARES TO BE SUPPLIED

1	**SG EOT/UNDER SLUNG CRANES**	
	Mechanical	
i)	First reduction pinion & shaft for hoist, cross-travel & long travel drives	1 no.each for each type
ii)	Brake drums for hoist, cross-travel & long travel drives	1 no.each for each type
iii)	Brake lining with rivets for:	
	a) Hoist	6 pairs
	b) Cross travel	2 pairs
	c) Long travel	2 pairs
iv)	Wire rope	1 complete length
	Electrical	
	Power circuit	
i)	Fixed and moving contacts for stator power contactor	1 set of each type
ii)	Contactor set for auxi. Contactors	1 set of each type
iii)	Coils for stator contactors	1 set of each type
iv)	Coils for auxi. contactors	1 set of each type
v)	Overload relay	1 set of each type
vi)	Timers	1 set of each type
vii)	Auxi. Contactors	1 set of each type
viii)	Limit switches	1 set of each type
ix)	Fixed and moving contacts	1 set of each type
x)	MCCB/ Fuses for:	
	i) Power circuit	1 no. of each rating
	ii) Power base	1 no. of each rating
	iii) Control MCBs/ fuses	1 no. of each rating
	iv) Control fuse base	1 no. of each rating
	v) Indicating lamp with indicator	6 nos. of each type
	vi) Contact element set for push button	1 set of each type
	vii) D.C. rectifier along with control panel and brake	1 no of each type
	MOTORS (To be repeated for each type & rating)	
i	Bearing (driving end)	1 No. of each type
ii	Bearing (Non-driving end)	1 No. of each type
iii	End shield (DE and NDE)	1 set of each type
iv	Cooling fan of motors	1 No. of each type
v	Fan cover	1 No. of each type
vi	Lubrication oil pump motor	1 No. of each type and rating
vii	Bearing puller	1 Nos. of each type
viii	Grease gun	2 Nos.
ix	Special spanners/tools	1 Set
2	**HOT crane**	
i)	First reduction pinion & shaft for hoist, cross-travel & long travel drives	1 no.each for each type
ii)	Grooved pulley	2 sets
iii)	Pinion	1 set
iv)	Bearing	1 set
v)	Shaft pin	1 set

Note:
1. “One (1) Set” and “One (1) set of each type & size” is defined as 100% requirement for one crane for the entire cranes of similar size & capacity.

ANNEXURE III

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

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

Basic Assumptions / Inputs for testing at Works:

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

Procedure for Load / Overload testing:

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

ANNEXURE IV

PAINTING

11.1 General

1. The term "Painting" referred herein covers rust preventive, preventive and decorative coating along with surface of the following areas.
   a) All Mechanical equipment, Technological structures, chutes, piping, ducts etc.
   b) Various types of static and rotary equipment inclusive of electric motors etc.
   c) Steel tanks and vessels
   d) Pipe work including trestles, supports, hangers, etc.
   e) Metallic duct work such as ventilation ducts, gas ducts including supports, hangers, etc.
2. Surfaces made of aluminium, brass, bronze, stainless steel, cast iron and other corrosion resistant alloys are not required to be painted unless specified except for identification bands or for aesthetic purposes.
3. All machined mating surfaces (e.g. flanges) will be properly cleaned, greased and protected before despatch.
4. The complete paint system for any item includes the following basic activities:
   a) Proper surface preparation
   b) Application of primer coats
   c) Application of intermediate coats
   d) Application of finished coats

All the above coats will be of quality paint products and the scope of work will also include supply of all paint materials as per specification.

11.2 Painting for mechanical & electrical equipment, mechanical structures, piping, ducts etc.

1. This section covers the painting requirements for the equipments, structures, piping, duct etc. and any other surface required to be painted for all the equipments in the section-1 of this specification.
2. Codes and Standards

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

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

Table 11.1
Codes and Standards for Painting

S.No	Code	Description
1.	IS:5	Colours for ready mixed paints and enamels
2.	IS 1303	Glossary of terms relating to paints

S.No	Code	Description
3.	IS 2379	Colour code for identification of pipelines
4.	IS 1477	Code of practice for painting of ferrous metals in buildings (Parts I & II)
5.	IS 2524	Code of practice for painting of non-ferrous metals in buildings (Part I & II)
6.	IS 2395	Code of practice for painting of concrete, masonry and plaster surfaces (Part I & II)
7.	IS 2338	Code of practice for finishing of wood based materials (Parts I & II)
8.	IS 6278	Code of practice for white washing and colour washing
9.	IS 3140	Code of practice for painting asbestos cement building products
10.	IS 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting
11.	IS 2074	Ready mixed paint, air drying, red oxide, Zinc Chrome, priming
12.	IS 104	Ready mixed paint, brushing, Zinc Chrome, priming
13.	IS 2932	Enamel, synthetic, exterior (a) undercoating (b) finishing specification.

3. **Preparation Of Surfaces**

a) Surface preparation being a pre requisite for any paint application, will be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint substrates and the surface preparation will be as per the painting scheme elaborated subsequently.

b) Solvent cleaning (SP 1)

The surface will be cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with an emulsion or alkaline solution to remove oil, grease, dirt, old paint, etc. Solvent cleaning will not remove rust, scales, mill scales or weld flux. Therefore, before application of paint, solvent cleaning will be followed by other cleaning procedures as stated below.

c) Hand tool cleaning(SP2)

The surface will be cleaned by vigorous wire brushing done manually to St-2 quality. This method effectively removes loosely adherent materials, but would not affect residues of rust or mill scales that are intact and firmly adherent.

d) Power tool cleaning(SP3)

The surface will be cleaned by electric or pneumatic tools to St-3 quality. The tools will be used carefully to prevent excessive roughing of surface and formation of ridges and burns. This method will remove

loosely adherent materials but would not affect residues of rust or mill scales that are firmly adherent.

e) Blast cleaning (SP4)

The surface will be cleaned by impingement of abrasive materials, at high velocity created by clean and dry compressed air blast. This method will remove loosely adherent materials as well as adherent scales and mill scales. Prior to application of blast, heavy deposit of oil and grease are removed by solvent cleaning and excessive surface scales are removed by hand tools or power tool cleaning. The surface will be cleaned to Sa-2 1/2 quality (SP 4) which means that to 95% of surface area is free from all rust, mill scales and visible residues, foreign materials, etc. The blast cleaning is not recommended for sheet metal work.

f) Blast cleaning (SP5): In this process the surface will be cleaned to 35 to 50 Microns.

4. **Primer Paints (P)**

After the surface is prepared in a manner acceptable to Owner/ consultant, two (2) coats of Primer paints will be applied only on dry and clean surfaces. Second coat of red oxide primer will be applied only after first coat has dried up completely. Coating of primer will in general conform to IS:2074-92 and will be applied by brushing to ensure a continuous film without "holidays".

a) Primer paint P1: (Epoxy based)

A two pack air drying epoxy polyamide resin based red oxide –zinc phosphate (primer):

Epoxy content (% wt)	15 to 18
Air drying time	About 30 minutes (touch dry) Over night (hard dry)
Dry film thickness (DFT/coat)	30 microns (min)
Temperature resistance	Upto 120°C dry heat

b) Primer paint P2 (Epoxy based)

A two pack air drying epoxy polyamide with zinc dust of at least 92% zinc dust on the dry film.

Epoxy content (% wt)	8 to 10
Air drying time	About 10 minutes (touch dry) 2 hours (hard dry)
Dry film thickness (DFT/coat)	40 microns (min)
Temperature resistance	Upto 300°C dry heat

c) Primer paint P3 (Ethyl zinc silicate, EZS, based)

A two pack heavy duty zinc dust rich silicate primer:

Total solids (% wt)	84 + 2

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Air drying time	16 hours
Density	3.07 + 0.005
Dry film thickness (DFT/coat)	60 microns (min)
Temperature resistance	Upto 450°C dry heat

d) Primer paint P4 : Double boiled linseed oil as per IS – 77 : specification for linseed oil, boiled for paints

e) Primer paint P5: In organic Zinc silicate with suitable air drying time. 40 microns per coat

f) Primer paint P6 : Red oxide Zinc phosphate as per IS 12744 with DFT 30 microns per coat

g) Primer paint P7 : Red oxide Zinc chrome primer(alkyd based) as per IS 2074 with DFT 40 microns per coat

5. **Intermediate paints (I)**

These paints will be applied over primer coats as an intermediate layer to provide weather proof seal of primer coats.

a) Intermediate paint (I1)

A two pack air drying high build epoxy resin based paint with MIO.

Air drying time	6 to 8 hours (touch dry) 7 days (full cure)
Dry film thickness (DFT/coat)	100 microns
Temperature resistance	Upto 180 deg.C dry heat
Compatible with	Primer P1 and P2

Intermediate Paint I2: Synthetic Enamel (long oil alkyd) to IS 2932, 1 coat = 20 Microns per coat.

6. **Finish Paint (F)**

Finish paint coats will be applied over primer coats and intermediate coats after proper cleaning and touch up of primed coats. Synthetic enamel paint comprising of IS: 2932-95 will be used for finish coats.

a) Finish paint (F1)

A two pack air drying epoxy polyamide enamel suitably pigmented.

Air drying time	2 to 3 hours (touch dry) 7 days (full cure)
Dry film thickness (DFT/coat)	40 microns
Temperature resistance	Upto 130°C dry heat
Compatible with	Primers Intermediate
Color	Generally all shades

b) Finish paint (F2)

A single pack synthetic rubber based enamel paint.

Air drying time	2 hours (touch dry)

	24 hours (hand dry)
Dry film thickness (DFT/coat)	25 microns
Temperature resistance	Upto 200°C dry heat
Compatible with	No primers
Color	Generally all shades

c) Finish Paint F3

A single pack heat resistant silicon resin based paint with leafing aluminium.

Air drying time	3 to 4 hours (touch dry) 24 hours (hard dry)
Dry film thickness (DFT/coat)	20 microns (min)
Temperature resistance	upto 400°C dry heat
Compatible with	no primer paint except P3
Colour	smooth aluminium

d) Finish Paint F4: Heat resistant Alumina Paint IS 13183 Gr II, DFT 20 microns per coat.

e) Finish Paint F5: Heat resistant Silicone Aluminium Paint with suitable air drying time as per IS 13183 Gr I, 25 microns per coat.

f) Finish Paint F6: Aliphatic acrylic polyurethane paint, DFT = 30 microns per coat.

g) After cleaning the dust on the dried up primer/ intermediate paint, first coat of synthetic enamel will be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint will be applied only after gently removing the gloss of first coat from entire surface and it is dusted off the surfaced. The requirement of workmanship will be as per IS: 1477-71.

h) Equipment No. and the name of the equipment will be painted on the surface of the equipment on visible locations. Service of the Pipe/Line designation with arrow identification for the direction of flow will be painted on all pipes at visible locations at an interval of 20 metres. Wherever pipelines are insulated, the service of the piping and arrow mark will be painted over the clad surface.

i) The color code to be followed during painting of piping will be in line with IS 9404:2002 (Identification of pipelines used in Thermal Power Plants – Color Code).

j) For painting of structure, equipment, tanks & vessels etc. suggested color code is given in Table 11.3.

k) For insulated pipeline the finish paint will be applied at that place where color band is to be painted on the aluminium sheeting. The finished paint (color band) will be of 2m length at that place.

l) Color band for piping will be applied at these following locations-

- At start and end point.
- At every 50m intervals.
- At every T joints and cross connection of piping.
- At every battery limit of pipeline.
- Near valves located at terminal points.

m) Width of band

Table 11.2

Width of band

S.No.	Size of pipe including insulated pipe line outside diameter	Width of band
1	80mm and below	25 mm
2	Above 80 mm upto 150 mm	50 mm
3	Above 200 mm upto 300 mm	75 mm
4	Above 350 mm	100 mm

n) Direction of flow will be indicated by black or white arrow in contrast to the base color on the pipeline. Length of the arrow will be minimum 125 mm and width will be minimum 65 mm. These will be put at an interval of 10 m.

7. **Suggested Colour Codes for Painting of Structures, equipments, tanks & vessels etc.**

Table 11.3

Colour of Specific Items

S.No.	Item / Service	Colour	IS-5	Colour Band	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark admiralty grey	632	-	-
2.	Boiler casing, ESP and ducting	Nut Brown	413	-	-
3.	Fans, pumps, motors, compressors, Mills.	Light grey	631	-	-
a)	Outdoor ,Stand pipes, vent pipes	Aluminium	-	-	-
b)	Indoor Tanks	Aluminium	-	-	-
4.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
5.	Switchgear	Light grey	631	-	-

S.No.	Item / Service	Colour	IS-5	Colour Band	IS-5
6.	MCC/PDB, Local control panels, Bus Ducts	Light grey	631/7078 of IS:1650	-	-
7.	Transformers	Dark admiralty grey	632	-	-
8.	Machinery guards	Signal red	537	-	-
9.	Water System				
a)	Boiler feed	Sea green	217	-	-
b)	Condensate	Sea green	217	Light brown	410
c)	D M Water	Sea Green	217	Light orange	557
d)	Soft water	Sea green	217	French blue	166
e)	Bearing cooling water	Sea green	217	French blue	166
f)	Potable & filtered water	Sea green	217	French blue	166
g)	Service & clarified water	Sea green	217	French blue	166
h)	Raw water(if applicable)	Sea green	217	White	-
i)	Cooling water	Sea green	217	French blue	166
10.	Compressed Air System				
a)	Service air	Sky Blue	101	-	-
b)	Instrument air	blue	101	White	-
11.	Oil system				
a)	Fuel oil	Light brown	410	French	166
b)	Light oil	Dark Brown	412	Brilliant green	221
c)	Lubricating oil	Light brown	410	Light grey	631
d)	Control oil	Light brown	410	Light orange	557
e)	Transformer oil	Light brown	410	Light orange	557
12.	Fire services	Fire red	536	-	-
a)	Ash slurry pipes	Black	-	-	-
b)	Vacuum pipes	Sky blue	101	Black	-
c)	Fuel pipes (Lignite)	Light brown	410	-	-
d)	Drainage	Black	-	-	-
e)	Stand pipes and all Vent pipes	Aluminum	-	-	-
f)	Bottom Ash system	Light Grey	631	-	-

8. **Paint Application**

a) Paint will be applied in accordance with manufacturer's recommendations. The work will generally follow IS 1477 (Part II) for jobs carried out in India and SSPC-PA-I or DIN 55928 or equivalent for jobs carried out outside India. Touch up paint to be applied to cover scratches after erection and assembly of equipment at site.

b) Paint will not be applied when the ambient temperature is 5°C and below. Also paint will not be applied in rain, wind, fog or at relative humidity of 80% and above.

c) Each coat of paint will be continuous, free of pores and of even film thickness without thin spots. The first coat of finish paint at site will be applied preferably within three months of the shop paint.

d) Each coat of paint will be dry sufficiently before application of next coat.

e) Surface which cannot be painted but require protection will be given a coat of rust inhibitive grease according to IS:958-75 or solvent deposited compound according to IS:1153-75 or IS:1674-60.

f) Surfaces which will be inaccessible after assembly will receive minimum coats of specified primer. Surfaces to be in contact with wood, brick or other masonry will be given one shop coat of the specified primer.

g) Parts of steel structure to be embedded in concrete will be given a protective coat of Portland cement slurry immediately after fabrication and thoroughly cleaning the surfaces from grease, rust, mill scales etc. No paint will be applied on this part.

h) The Contractor will furnish paint manufacturer's test report or technical data sheet pertaining to the paint selected. The data sheet will indicate among other things the relevant standards, if any, composition in weight percent of pigments, vehicles, additives, drying time, viscosity, spreading rate, flash points, methods of application quality of surface preparation required, corrosion resistance properties and colour.

i) Rust preventive coating should be given to HSFG bolt and nut threads.

j) Machined surfaces/weld edges are to be applied with a coating of temporary rust preventive oil.

k) All threaded and other surfaces of foundation bolts ands its materials, insulation pins, anchor channels, sleeves will be coated with temporary rust preventive fluid and during execution of civil works; the dried film of coating will be removed using organic solvents.

l) No painting is required for stainless steel components.

m) The temporary rust preventive coating that already been applied on any components, tubes, pipes etc., will be removed by suitable solvents/ heating to 350-400°C for an hour before primer paint application-but, in case, it should be ensured that the minimum surface cleanliness required for primer paint application will be Sp2 (equivalent to hand tool cleaning).

n) In components, where ver plates/sheets of thickness less than or equal to 5mm, pipes, rods are used, power tool / hand tool cleaning to SP3/SP2 will be followed and the painting will be done as per the painting scheme adopted for components that are coming in the flue gas path.

o) All weld edge preparation for site welding will be applied with one coat of weldable primer.

p) For internal protection of pipes/tubes, VCI pellets will be used at both ends after sponge testing and ends capped. VCI pellets will not be used for SS components and composite assemblies.

q) Wherever inside surfaces of ducts need protection till erection, two coats of red oxide zinc phosphate primer (P1) paint to IS 12744 to a DFT of 60 microns will be applied after power tool cleaning.

9. **Painting scheme**

a) Type of paint products like P1, P2, P3,P4,P5,P6,P7, I1, I 2,F1, F2 and F3,F4,F5,F6 has been specified elsewhere in the specification.

b) For a complete painting scheme of any item being painted, all types of paints are to be procured from the same manufacturer as approved by the Owner.

10. **Legends**

Sa - 2 .5 – The quality of surface cleaning, i.e 95 % of the surface area is free from all rust, mill scales and visible residues, foreign materials etc.

SP1-Solvent Cleaning

SP2- Hand tool cleaning

SP3 – Power tool cleaning

SP 4: Blast cleaning (Sa 2.5)

SP 5: Blast cleaning (35 to 50 microns surface cleaning)

SP 6 – Phosphating

SP - surface preparation quality

2P1 - Two (2) coats of primer paint type P1

1I1 - One (1) coat of intermediate paint type I1

2F1 - Two (2) coats of finish paint type F1

DFT - Dry film thickness

CRT - Clean and retouch.

The painting scheme to be followed for various mechanical/ electrical equipment / structures is briefly given below for guidance to the Contractor.

Table 11.4

Painting Scheme and Total DFT in Microns

S.No.	Description	Painting scheme		Total DFT in Microns
		At shop	At site	
1.	Steel structures (for Boiler Proper, Lignite bunkers, Mills, mill maintenance building, Air heaters, aux. boiler, Fans, ESPs, etc)	SP-Sa 2 ½ 2P1 + 1I1	2 F1	240
2.	Separator and separator vessel	a) Surface preparation : Power tool cleaning to St-3 grade b) 2 coats of alkyd red oxide zinc phosphate primer to IS 12744 DFT 30 micron per coat c) 3 coats of long oil alkyd synthetic enamel finish paint (International Orange) to IS 2932 – DFT 20 microns / coat (min) d) Total DFT 120 microns (min)	-	120
3.	Separator internals	SP 1 or SP 3 Rust preventive fluid of DFT = 25 µ/coat		25
4.	Following insulated parts viz., Piping,fitting/components, Pipe clamps, vessels/tanks, Equipments and ducts etc	SP 3 2P1, Total DFT – 60 microns P1 = pack of air drying alkyd red oxide zinc phosphate primer to IS 12744 – 2 coats, 30 microns per coat. Total DFT 60 microns (minimum)	-	60
5.	Following un insulated parts viz., Piping, fitting/ components, Pipe clamps, vessels/tanks, Equipments and ducts etc	a) Surface preparation : Power tool cleaning to St-3 grade b) 1 coat of alkyd red oxide zinc phosphate primer to IS 12744 DFT 30 micron per coat	1F2	70

S.No.	Description	Painting scheme		Total DFT in Microns
		At shop	At site	
		c) 2 coats of long oil alkyd synthetic enamel finish paint to IS 2932 – DFT 20 microns / coat (min) d) Total DFT 70 micron (min)		
6.	Constant load hangers (CLH) & Variable Load hanger(VLH)	SP-Sa 2 ½ 1P2 + 1 F6	-	70
7.	Hangers mentioned other than (6) above	a)Surface preparation : Power tool cleaning to St-3 grade b) 1 coat of alkyd red oxide zinc phosphate primer to IS 12744 DFT 30 micron per coat c) 2 coats of long oil alkyd synthetic enamel finish paint to IS 2932 – DFT 20 microns / coat (min) d) Total DFT 70 micron (min)	-	70
8.	Valves			
9.	Cast carbon steel valves Cast alloy steel valves, API valves, QCNRV, SV and SRV, Silencers and soot blower components	SP3 2F4	-	40
10.	Forged valves	a)Surface preparation : Solvent cleaning to SSPC-SP1 Grade. b) Phosphating to 16.15 g/sq.m.		-
11.	Top covers of Soot blower	a)Surface preparation : Power tool cleaning to St-3 grade b) 1 coat of alkyd red oxide zinc phosphate primer to IS 12744 DFT 30 micron per		70

S.No.	Description	Painting scheme		Total DFT in Microns
		At shop	At site	
		coat c) 2 coats of long oil alkyd synthetic enamel finish paint to IS 2932 – DFT 20 microns / coat (min) d) Total DFT 70 micron (min)		
12.	Floor grills, hand rails and posts, ladders / rungs	Hot dip galvanizing to 610 gms/sq.m	-	-
13.	(a)Components coming in the flue gas path like water walls	a)Power tool cleaning to St- 2 / 3 b) One coat of dip – coat paint – Red oxide zinc phosphate primer (dip / brush) DFT = 30 microns		30
	(b)Components coming in the flue gas path, Surfaces in the flue gas path of ESP, Fans and APH	a) Power tool cleaning to St- 2 / 3 b) Two coats of dip – coat paint – Red oxide zinc PO4 to IS 12744DFT = 30 microns per coat		60

Note! **For components not covered above, Contractor's standard practice will be followed with Owner's / Consultant's approval.**

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ANNEXURE - V

SI. No.	BHEL DRG.NO	DRAWING TITLE	REMARKS	SUBMISSION SCHEDULE - WEEK NUMBER FROM DATE OF P.O
1	PE-V0-400-524-A100/1	Manufacturing Quality Plan with sub vendor list for single girder EOT crane	APPROVAL	2
2	PE-V0-400-524-A100/2	Manufacturing Quality Plan with sub vendor list for single girder HOT crane	APPROVAL	2
3	PE-V0-400-524-A101	Data sheet of Single Girder Crane with painting details	APPROVAL	2
4	PE-V0-400-524-A102/1	GA.of 8T Single Girder EOT CRANE with CT DSL arrangement	APPROVAL	2
5	PE-V0-400-524-A102/2	GA.of 2T Single Girder HOT CRANE	APPROVAL	2
6	PE-V0-400-524-A103	Mechanism Sizing Calculation	APPROVAL	2
7	PE-V0-400-524-A104	G.A. drg of Hoist with trolley wheel assembly	INFORMATION	3
8	PE-V0-400-524-A105	Bottom Block assembly	INFORMATION	3
9	PE-V0-400-524-A106	General arrangement for LT cable trailing for Single Girder crane	INFORMATION	3
10	PE-V0-400-524-A107	Schematic Circuit Diagram for following a) Main Protective panel & BOM b) Main hoist panel & BOM c) Cross Traverse and Long Travel panel & BOM d) Pendent and earthing.	APPROVAL	3
11	PE-V0-400-524-A108	Long travel Machinery Assembly with LT wheel assembly	INFORMATION	4
12	PE-V0-400-524-A109	Detailed BOM/BOQ for crane	INFORMATION	6
13	PE-V0-400-524-A110	General arrangement of panel & pendent push button	INFORMATION	4
14	PE-V0-400-524-A111	Cable sizing calculation and schedule.	APPROVAL	3
15	PE-V0-400-524-A112	O & M Manual	INFORMATION	8
16	PE-V0-400-524-A113	Mandatory spares list	APPROVAL	6
17	PE-V0-400-524-A115	Erection procedure	INFORMATION	8

Notes:

1. BHEL/CUSTOMER SHALL COMMENT /APPROVE THE DRAWINGS WITHIN 15 DAYS OF RECIEPT OF DRAWINGS.
2. VENDOR SHALL RESUBMIT THE REVISED DRAWINGS WITHIN 7 DAYS OF RECIEPT OF COMMENTS.
3. INCOMPLETE DRAWINGS/DOCUMENTS SHALL NOT BE TREATED AS SUBMITTED.
4. MANUFACTURING SHALL BE STARTED ON RECIEPT OF CAT II APPROVED DRAWINGS.

DRAWING/DOCUMENT DISTRIBUTION LIST

All documents & drawings shall be in English and in metric units

SI		LII	NLC (HQ)	NLC-SITE	BHEL SITE	PMG BHEL	PEM/ UNITS/ PSSR	REMARKS
1	Master list of drawings / document (duly indicating schedule of submission)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
2	Drawings / document for Approval/Information (First Submission)	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy + 1 print		Soft copy	Soft copy (S)	
3	Return with comments/approval	Soft copy (S)	Soft copy	Soft copy		Soft copy	Soft copy	
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
5	Drawings / documents for distribution (Approved by NLC, in cat. 1 or Received for Information)	Soft copy + 2 print (HQ+ Site)	Soft copy + 3 prints	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
6	Erection Drawings / documents	-	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
7	As built Drawings / documents	Soft copy + 1 print	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
8	Operation & Maintenance Manual	-	Soft copy + 1 print	Soft copy + 10 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
9	Type Test Certificate	Soft copy	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	

NOTES:

1. The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches. QAP documents to be submitted as per distribution schedule.
2. Date of submitting soft copy is to be taken as date of submission.
3. S – Source for generation of document.

DOCUMENT MANAGEMENT SYSTEM

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

- **Internet explorer version – Minimum Internet Explorer 7.**
- **Internet speed – 2 mbps (Minimum preferred).**
- **Pop ups from our external DMS IP (124.124.36.198) should not be blocked.**
- **Vendor's Internal proxy setting should not block DMS application's link (http://124.124.36.198/wrenchwebaccess/login.aspx).**

TECHNICAL DATA SHEET FOR SINGLE GIRDER UNDERSLUNG EOT CRANE

S.N.	Description	Technical Particulars
1.0.0	GENERAL	
1.1.0	Name of Manufacturer	
	a) EOT Crane	*
	b) Runway conductors	*
1.2.0	WEIGHT OF EQUIPMENTS	
	a) Crane weight (Kgs.)*	*
	b) Weight of DSL (Kgs.)*	*
1.3.0	Design, fabrication and testing of crane conform to standard / code	IS-3177 & 807 (latest edition)
1.4.0	Number of cranes	One (1) 8T no. in compressor house
1.5.0	Crane Classification	Group M5 of IS: 3177 – 1999(latest edition) for structure and machinery.
1.6.0	Type of service	----------Indoor----------
1.7.0	Type of Crane	EOT
1.8.0	Capacity (SWC)	8T- compressor house
1.9.0	Span and lift	As per crane clearance diagram attached
1.10.0	Load test	As per IS: 3177
1.11.0	Over Load Test	(125% of rated capacity-SWC)
1.12.0	Crane structure	Fabricated from rolled section (Box section/ I- section)
1.13.0	Design ambient temperature	50^0 C
1.14.0	Runway Rail	ISMB (Shall be provided by BHEL)
1.15.0	End carriage	
1.15.1	Material	M.S. as per IS: 2062, GR B
1.16.0	Main girder	
1.16.1	Type & Size	Fabricated from rolled section (Box section/ I- section)
1.16.2	Material	M.S. as per IS: 2062, GR B
1.17.0	**Power supply**	415V $\pm$ 10%, 3 phase, 4 wire, 50 Hz,+3% -5% variation. Combined voltage and frequency variation 10% (Shall be arranged by Purchaser at 1.5 M above floor level / operating level)
1.18.0	Control Supply	110V (Shall be arranged by vendor)
2.0.0	**CRANE PERFORMANCE**	
2.1.0	**Operation**	Electrical -- From floor by means of Pendant Push Button controller suspended from panel
2.2.0	**Crane speed with full load**	
	a) Hoist (Full speed)	3.0 M/Min(with creep speed 10% of main speed through VVVF drive)
	b) Cross travel (CT)	10.0 M/min
	c) Longitudinal bridge travel(LT)	10.0 M/min
2.3.0	**Hoisting Mechanism**	Gear
2.4.0	**Type of power transmission**	Gear
2.5.0	**WIRE ROPE**	
2.5.1	Make	As per Sub-vendor list
2.5.2	Core / Construction	Steel core as per IS-2266 / 6 X 36
2.5.3	Wire rope dia. (mm)	*
2.5.4	Wire rope fall	*
2.5.5	Material	Plough steel
2.5.6	Tensile strength	160-180 Kg /mm^2
2.5.7	Min. Breaking load	*
2.5.8	Conform to (Std. / code)	IS-2266
2.6.0	**LOAD HOOK / HOOK BLOCK**	
2.6.1	Make	As per sub-vendor list
2.6.2	Type of load hook	s, Trapezoidal section-forged as per IS: 1

		safety latch.		
2.6.3	Material of load hook	Forged steel		
2.6.4	Type of Bearing of hook suspension	Thrust ball bearing		
2.6.5	Make of Bearing of hook suspension	*		
2.6.6	Type and Material of hook suspension.	M.S. Fabricated		
2.7.0	**ELECTRIC HOIST**			
2.7.1	Model No.	*		
2.7.2	Duty	Class II (M5) as per IS: 3938 (latest edition)		
2.8.0	Type of DSL			
2.8.1	Long travel	PVC shrouded bus bar conductor type		
2.8.2	Cross traverse	Flexible cable with Taut wire / Festoon cable arrangement		
2.9.0	**MOTORS**	M.H.	C.T.	L.T.
2.9.1	Make	As per sub-vendor list		
2.9.2	Rating (KW)	*		
2.9.3	RPM	*		
2.9.4	Qty.	1	1	2
2.9.5	Minimum number of poles	6	6	6
2.9.6	Type	TEFC, Sq. cage induction type,S4 duty, 40%CDF		
2.9.7	Enclosure	IP-55		
2.9.8	Number of start	150 starts/Hr.		
2.9.9	Insulation	70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.		
2.9.10	Margin	Maximum continuous motor ratings shall be 15% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.		
2.9.11	Over load protection provided	YES		
2.9.12	Ambient Design temperature	50ºC		
2.9.13	Pull out torque for motor	Pull out torque to be not less than 275% of the full load torque corresponding to 40% CDF.		
2.10.0	**LIMIT SWITCHES**			
2.10.1	Location	M.H.	C.T.	L.T
2.10.2	Qty.	1+1	1	1
2.10.3	Type	Snap action	Two way lever	Two way lever
2.10.4	Method of actuation	Snap action	Shunt type	Shunt type
2.10.5	Material of contact	Silver Cadmium		
2.10.6	Make	As per Sub-vendor list		
2.10.7	Control Voltage	110V		
2.11.0	**Control panel**	A suitable control panel will be provided comprising of main contractor, motor contactor, single phase preventor with overload relays, transformer, fuses, MCCB's, etc. Rectifier panel for brake shall also be provided		
2.12.0	**BRAKES**			
2.12.1	Location	M.H.	C.T.	L.T.
2.12.2	Qty. / Motor	1	1	1
2.12.4	Type	All brakes will be Electro magnetic type		
2.12.5	Capacity	150% FLT	125% FLT	125% FLT
2.6	Size / rating	*		
2.7	Make	As per sub-vendor list		

2.13.0	**GEAR (HOISTING)**		
2.13.1	Make	As per sub-vendor list	
2.13.2	Type	Spur / Helical	
2.13.3	Material	Gear: EN8 / 20 Mn Cr / 16 Mn Cr Pinion: EN9	
2.13.4	Lubrication	Grease / Oil splash	
2.13.5	Reduction	*	
2.13.6	Bearing Make	*	
2.13.7	Bearing Type	Antifriction deep groove ball / roller bearing	
2.13.8	Hardness (BHN)	As per IS 3177 (Latest Edition)	
2.14.0	**GEAR (L.T. & C.T.)**		
2.14.1	Location	C.T.	L.T.
2.14.2	Make	As per sub-vendor list	
2.14.3	Type	Spur / Helical	Spur / Helical
2.14.4	Material	Gear: EN8 / 20 Mn Cr / 16 Mn Cr Pinion: EN9	Gear: EN8 / 20 Mn Cr / 16 Mn Cr Pinion: EN9
2.14.5	Lubrication	Grease / Oil splash	Grease / Oil splash
2.14.6	Reduction	*	*
2.14.7	Bearing Make	As per sub-vendor list	
2.14.8	Bearing Type	Antifriction deep groove ball / roller bearing	Antifriction deep groove ball / roller bearing
2.14.9	Hardness (BHN)	As per IS 3177 (Latest Edition)	
2.15.0	**WIRE ROPE DRUM**		
2.15.1	Material	Fabricated from M.S. as per IS: 2062, Gr B and stress relieved or seamless pipe ASTM A106 / 53 Gr B	
2.15.2	Diameter	*	
2.15.3	Length	*	
2.15.4	Type	Flanged	
2.15.5	Type of grooves	*	
2.16.0	**WHEELS**		
2.16.1	Location	C.T.	L.T.
2.16.2	Diameter (mm)	*	*
2.16.3	Qty	*	*
2.16.4	Hardness	200 BHN (Max.)	200 BHN (Max.)
2.16.5	Material	EN8 / EN9	EN8 / EN9
2.16.6	Bearing make		
2.16.7	Bearing Type	Antifriction deep groove ball bearing	Antifriction deep groove ball bearing
2.16.8	Flange	Single flanged	Single flanged
2.16.8.1	Conform to IS	3177	
2.16.8.2	Wheel Base	*	
2.17.0	**SHEEVE**		
2.17.1	Material	Cast steel	
2.17.2	Groove dia/ O.D. .(mm)	*	
2.17.3	Bearing make	As per sub-vendor list	
2.17.4	Bearing Type	Antifriction deep groove ball bearing	
2.18.0	CONTROL PANEL	* Fabricated from CRCA steel sheet min 2 mm thick. * Degree of protection shall be IP 55. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.	
8.1	Qty	One	

2.18.2	Make	As per sub-vendor list	
2.18.3	Location	On the crane	
2.18.4	Size	*	
2.18.5	Thickness of sheet	2 mm	
2.19.0	ISOLATING SWITCH		
2.19.1	Qty	One (1) no at 1.5 m from operating floor.	
2.19.2	Make	As per sub-vendor list	
2.19.3	Rating	*	
2.20.0	PENDANT PUSH BUTTON	Up /down / forward / Reverse push buttons (glow type). Indicative marking for easy operation shall be provided	
2.21.0	Cables	Power	Control
2.21.1	Make	As per Sub-vendor list	
2.21.2	Material	Power cable: Stranded aluminum conductor, cross linked polyethylene (XLPE) insulated, extruded black FRLS PVC inner sheathed, armoured and overall FRLS extruded black PVC sheathed cables conforming to IS 7098 Control cable: 1100 V grade with annealed high conductivity stranded copper conductor, PVC insulated, FRLS PVC inner sheathed, armoured and FRLS extruded black PVC outer sheathed cables conforming to IS : 1554 Trailing cable: 1.1 kV grade with highly flexible stranded tinned copper conductor, insulation of EPR (Ethylene-propylene Rubber) each individual core protected and covered and overall outer cover of poly-chloroprene rubber cable conforming IS: 9968 (Part-I)-1988.	
2.21.3	Type	*	*
2.21.4	Dearing factor to be considered	YES	YES
2.21.5	Voltage grade	1100V	
2.22.0	END STOPPER (LT)		
2.22.1	Qty.	4 Nos.	
2.22.2	Material	As per IS 2062	
2.23.0	BUFFER		
2.23.1	Location	CT	LT
2.23.2	Qty	Two	Four
2.23.3	Material	Rubber/Spring	Rubber/Spring
2.24.0	PAINTING	Refer painting specification	
2.25.0	Control for Hoisting operations	Thru' VVVF drives	
a.	Speed Control	Thru' VVVF with minimum 6 pulse design	
b.	Starting torque of VVVF	Upto 400% typical	
c.	Starting current	Less than 150 % of rated torque	
d.	Temperature	Capable of withstanding upto 50°C without derating	

Note:

- **Bidder to confirm the compliance of technical details as mentioned against each item. Deviation, if any shall be brought out clearly.**
- **The bidder shall fill Technical details against each item marked (*), during detailed engineering only.**
- **In case of discrepancy between the Data sheet and requirement given elsewhere in the technical specification, the more stringent of the two as per the interpretation of purchaser shall be applicable.**

TECHNICAL DATA SHEET

A) SINGLE GIRDER UNDERSLUNG HOT CRANE

S.No.	Description	Parameters
1.0.0	GENERAL REQUIREMENTS	
1.1.0	Design, fabrication and testing of the crane conform to standard / code number	IS-3177, 807, 3832
1.2.0	Crane Classification	M5 : Mechanical, Structural
1.2.1	Over Load Test – Tonnes	125% of rated capacity of the crane
1.3.0	Type of service	----------Indoor----------
1.4.0	Type of Crane	Hand-operated Overhead Traveling
1.4.1	Crane structure	Single girder
1.4.2	Capacity (SWC) and Quantity	One no. 2T capacity in FOPH
1.4.3	Design ambient temperature	50 deg C
1.4.4	Main girder	M.S. as per IS: 2062
1.4.5	Load test	As per IS: 3177
2.0.0	CRANE PERFORMANCE	
2.1.0	Operation	MANUAL FOR HOIST AND TROLLEY BOTH
2.2.0	Hoisting Mechanism	Gear
2.3.0	Type of power transmission	Gear
2.4.0	LOAD HOOK / HOOK BLOCK	The Load block shall be swiveling type fitted with a locking device, if number of falls exceed one.
2.4.1	Type of load hook	Plain Shank, Trapezoidal section-forged as per IS: 15560, WITH SAFETY LATCH . Swiveling type standard shank hook mounted on grease lubricated anti-friction thrust bearing wiil be used.
2.4.2	Material of load hook	As per IS 1875
2.5	GEAR (HOISTING, CT, LT)	
2.5.1	Type	Spur / Helical
2.5.2	Material	Gear: EN8 / 20 Mn Cr / 16 Mn Cr Pinion: EN9
2.5.3	Lubrication	Grease / Oil splash
2.5.4	Bearing Type	Antifriction deep groove ball / roller bearing
2.6	Wheels (CT/LT)	
i)	Material	CI Gr FG –260 as per IS 210/EN 8/EN 9
ii)	Type of bearing	Antifriction deep groove ball bearing.

ii)	Hardness	170-190 BHN for underslung crane
2.7	Buffer	Rubber
2.8.0	END STOPPER	
2.8.1	Material	MS
2.9	Load chain	Gr-80, IS: 6216 (calibrated type)
2.10	Hand Chain	Gr.30, IS: 2429 (part 1) (calibrated type) min 6 mm dia
2.11	Load sprocket	As per IS 3932
2.12	Hand chain wheel for Hoisting	As per IS 3932
2.13	Coupling	As per IS 3932
2.14	Hand chain wheel for LT	As per IS 3932
2.15	Chain pulley block	• The hoist shall be duty class 2 as per IS: 3832. • Manually operated hoist shall be of spur gear chain pulley block type. It shall be suspended from the trolley by a hook. • The pulley block shall be fitted with an automatic mechanical load brake to prevent self lowering of load in all positions. • Ball and roller anti frictional bearing only will be used. • All the open gearing will have suitable cover. • Pulley used for the operating mechanism will have suitable guards to prevent the operating chain from coming out.

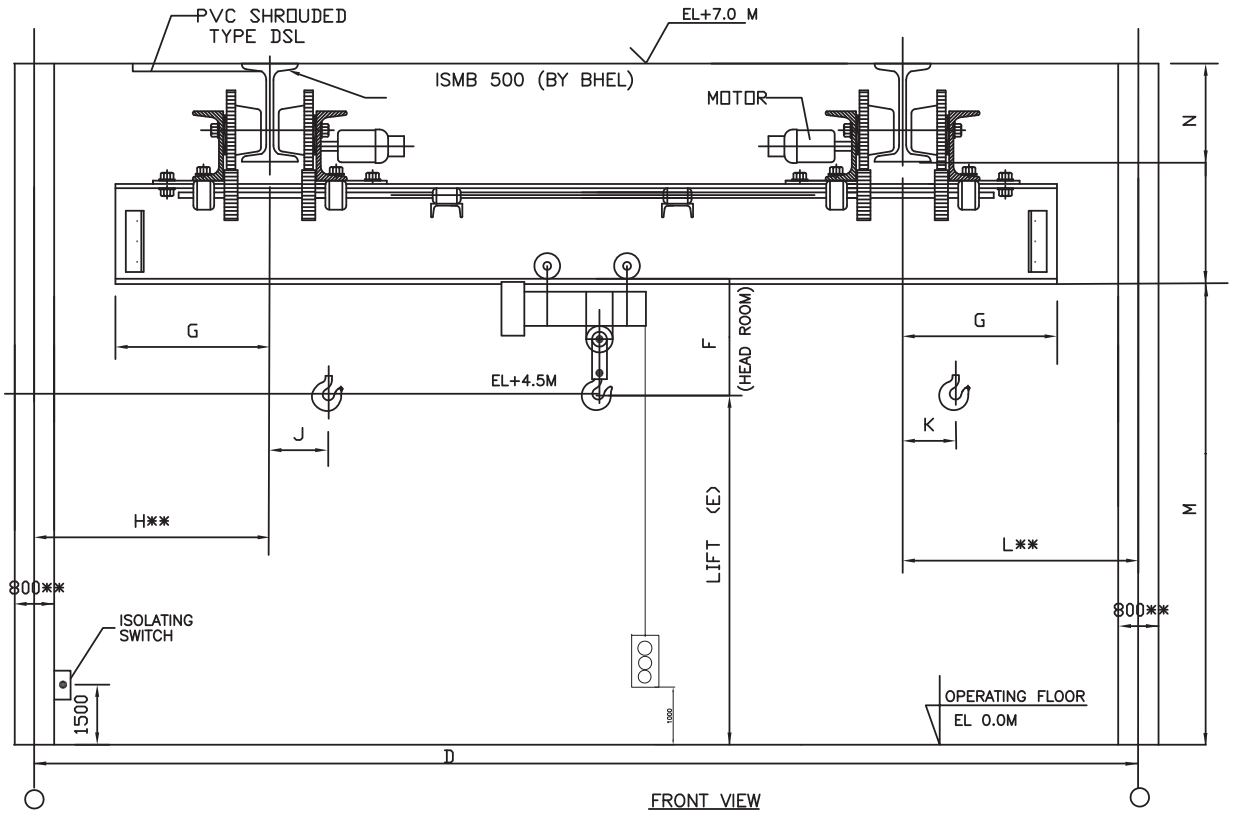
COMPUTER FILE NAME : TAL5

ALL DIMENSIONS ARE IN MM FIRST ANGLE PROJECTION

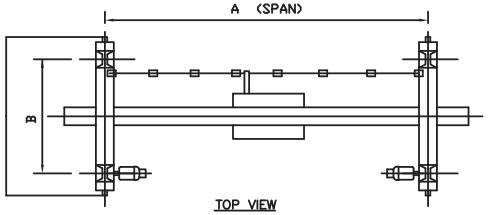
DRAWING No. PE-DG-400-524-A001

R'S DRAWING No.

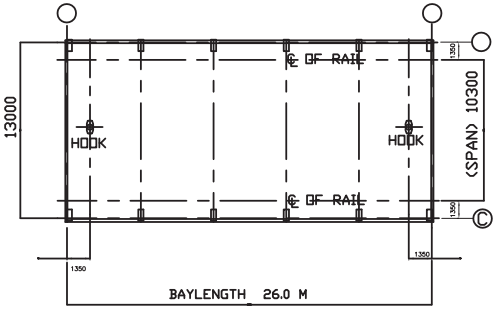
DESIGN PARAMETERS	
A	10300
B	*
C	*
D	13000
E	4500
F	*
G	750
H	1350
J	200
K	50
L	1350
M	*
N	*



FRONT VIEW



TOP VIEW



KEY PLAN

BAYLENGTH = 26 M

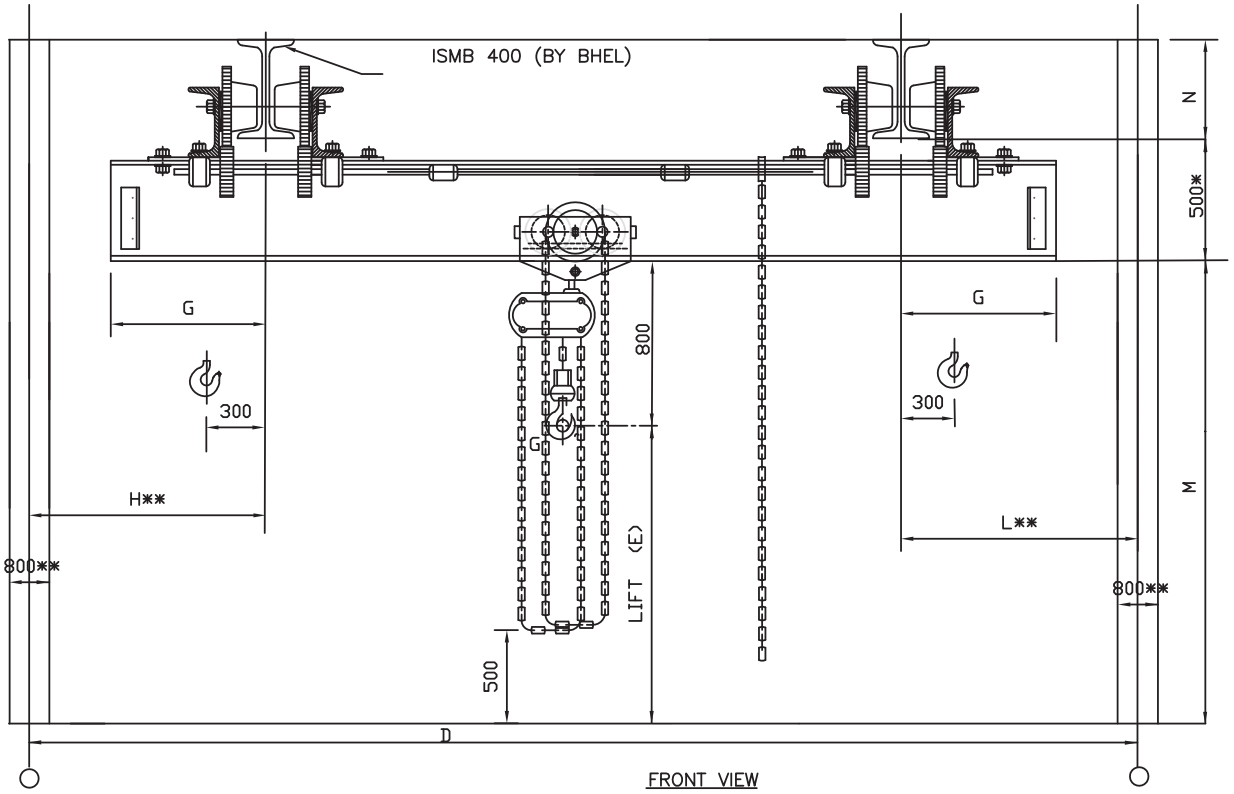
CAPACITY = 8.0 T

NOTES:

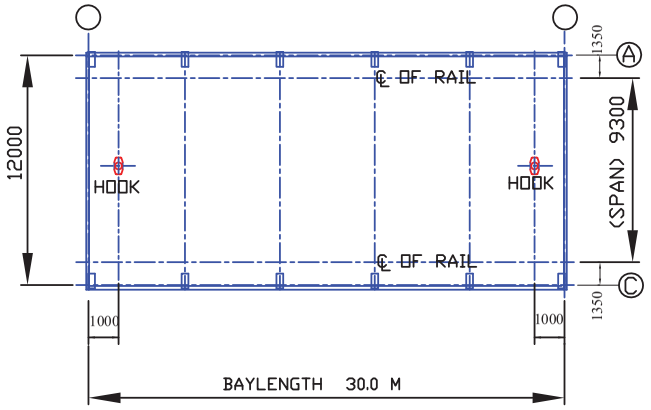
1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL EI
2. ALL DIMENSIONS ARE IN MM.
3. BIDDER TO FURNISH LT WHEEL LOAD.
4. DIMENSIONS MARKED (**) DEPENDS ON FINAL CIVIL DRAWING.
5. THERE SHALL BE NO PRICE IMPLICATION FOR CHANGE IN LIFT/ & SPAN UPTO +/- 1 M

CUSTOMER	नेवेली लग्निाइट कॉर्पोरेशन लमिटिड (एनएलसी लमिटिड) NEYVELI LIGNITE CORPORATION LIMITED (NLC LTD)
CONSULTANT	लहमेयर इंटरनेशनल इंडिया प्राइवेट लमिटिड M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD
PACKAGE : STEAM GENERATOR AND AUXILIARIES (NTA1)	
PROJECT	NEYVELI NEW THERMAL POWER PROJECT (NNTPP) 2x500 MW LIGNITE FIRED UNITS AT NEYVELI
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI	DEPT CODE M; DRN BB; DESN BB; CHD GB; APPD PK; NAME; SI
TITLE CRANE CLEARANCE DIAGRAM OF AIR COMPRESSOR 8T SINGLE GIRDER UNDERSLUNG CRANE	
DEPT. SCALE:	DRAWING NO. BHEL/SUB VENDOR DRG PE-DG-400-524-A001

COMPUTER FILE NAME : TAL5



FRONT VIEW



KEY PLAN

DESIGN PARAMETERS	
A	9300
B	*
C	*
D	12000
E	12000
F	*
G	750
H	1350
L	1350
M	*
N	*

BAYLENGTH = 30.0 M

CAPACITY = 2.0 T

NOTES:

1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL E
2. ALL DIMENSIONS ARE IN MM.
3. BIDDER TO FURNISH LT WHEEL LOAD.
4. DIMENSIONS MARKED (**) DEPENDS ON FINAL CIVIL DRAWING.
5. THERE SHALL BE NO PRICE IMPLICATION FOR CHANGE IN LIFT/ & SPAN UPTO +/- 1 M

CUSTOMER: नेवेली लग्निाइट कॉर्पोरेशन लमिटिड (एनएलसी लमिटिड) — NEYVELI LIGNITE CORPORATION LIMITED (NLC LTD)

CONSULTANT: लहमेयर इंटरनेशनल इंडिया प्राइवेट लमिटिड — M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD

PACKAGE : STEAM GENERATOR AND AUXILIARIES (NTA1)

PROJECT: NEYVELI NEW THERMAL POWER PROJECT (NNTPP) 2x500 MW LIGNITE FIRED UNITS AT NEYVELI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE	NAME	
M	DRN	BB
	DESN	BB
	CHD	BB
	APPD	PK

TITLE: CRANE CLEARANCE DIAGRAM OF FOPH
2T SINGLE GIRDER UNDERSLUNG HOT CRA

DEPT. | SCALE: | DRAWING NO. BHEL/SUB VENDOR DR
PE-DG-400-524-A00

SPECIFIC TECHNICAL REQUIREMENT OF NLC

13.7 Single Girder EOT & Under slung Crane

1. Scope of work

The scope of work of the Contractor will consist of design, manufacture, inspection, assembly, and painting at manufacturer's shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection testing & commissioning of One number Under Slung Crane of 8T Capacity for each Compressor building of the plant respectively. The capacity mentioned for above cranes is minimum. However, Contractor will

select higher capacity of crane if the weight of single heaviest component weighs more.

Necessery handling arrangement will be provided to handle the heavest mill component in the mill maintenance building and heaviest ID/FD fan & RAPH components in the boiler mainenance building.

2. Technical Specification

(1). Single girder EOT crane will be designed, manufactured, assembled and tested in accordance with the latest revision of IS:807, IS:3177, IS:3938 and other relevant codes and practices.

(2). The components of the hoist will be designed, manufactured, assembled and tested in accordance with the latest revision of IS:3938 and will be of standard make.

(3). All working parts requiring replacement or inspection or lubrication will be easily accessible without the need for dismantling of other equipment or structure.

(4). All electrical cables will be so laid that they are not liable to be damaged and can be easily inspected and tested.

(5). For out-door cranes all electrical and mechanical components which are exposed to weather will be completely covered or made weather proof. The covers will be in segments to facilitate easy dismantling and assembly.

(6). No cast iron parts will be used except for electrical equipment and no wood or other combustible material will be used unless specifically mentioned otherwise.

(7). Where down shop leads are located below runway rails, guard will be provided on the crane to prevent the hoist ropes from coming in contact with down shop leads.

(8). All bolts except those with nyloc nuts will be provided with grip lock nuts or spring washers.

(9). Power supply to the cranes will be through flexible trailing cable system/ angle bus bar type DSL system.

(10). Power isolator will be provided at operating height.

(11). All trailing cables will be clamped with PVC or non-metallic clamps.

(12). Steel frames carrying machinery will be machined to true surface.

(13). All gears and bearings will be lubricated by splash lubrication/ grease as required. All greasing points will be easily accessible.

3. Structural Design

- The crane structure will be designed in accordance with the latest revision of IS: 807.

- The bridge girder will consist of main and an auxiliary structure where necessary.
- End-carriages will be fabricated from rolled steel sections or plates, or both, welded together to form a box.
- End-carriages will be of ample strength to resist all stresses likely to be imposed on them under severe conditions, including collision with other cranes or stops. The length of the end-carriage will be such that no other part of the crane is damaged in collision.
- The end-carriage will be fitted with safety stops to prevent the crane from falling more than 25 mm in the event of breakage of a track wheel or axle. Suitable jacking pads will be provided on each end-carriage for jacking up the crane while changing track wheels.
- For single girder EOT crane/ under slung crane suitable maintenance/ repair platform with chequered plates will be provided for mounting and access to long travel drive current collection system, control panels, etc. A clear head-room of minimum 2000 mm will be made available over the top of platform from the bottom cord of the roof truss.
- Black bolts will not be used in the load bearing structures of the crane. Also high tensile friction grip bolts will not be used unless approved by the Purchaser.
- Bolts used in shear will be fitted into reamed holes.
- Transverse fillet welding on the load carrying members will be avoided.
- All butt welds on structural members, subject to tensile stress, will be x-rayed.
- Plates, bars, angles and where practicable, other rolled sections used in the load bearing members of the structure will not be less than 6 mm thick.
- Steel sections and plates, used for construction will be of the latest revision of IS: 2062 quality.

4. **Mechanical Equipment**

a). **Design of Mechanisms**

Each mechanism of the crane will be modular in construction with built in facilities for easy dismantling and maintenance of each assembly as an independent unit.

b). **Rope Drums**

Fabricated rope drum will be stress relieved before machining. For the cranes used in steel plants, the material of the rope drum will be limited to C.S. / M.S.

c). **Wire Rope**

The wire ropes will be regular right hand lay hemp cores as per IS: 2266/1989. However, ropes working under water and in corrosive

atmosphere will be galvanized and will have steel core. For rope arrangement with 2 falls, wire rope will be of non-spinning type.

d). **Rope Guides**

Suitably designed rope guides with pressure ring/ rope tightener will be provided for each lead of rope from the rope drum to prevent the rope from overriding, loosening or rope coming off the groove.

e). **Rope sheaves**

For cranes, material will be either CS/MS. Bottom block sheaves will be provided with suitable guards to retain the rope in the sheave groove. Equalizer sheave/ bar will be arranged to turn and swivel to maintain rope alignment under all circumstances.

f). **Wheels**

For single girder EOT cranes, the wheels for long travel motion will be double flanged with straight tread. The width of wheel tread will be greater than the rail head by 30 mm. For under slung cranes hoists block, the wheels will be single flanged with straight/ taper tread to suit the track beams. Minimum diameter of the LT wheels for S.G. EOT cranes will be 320 mm. Wheels will be of forged/ rolled/ cast steel with minimum hardness of 200 BHN in case of single girder under slung cranes running on rolled steel joist and 300 BHN for EOT cranes and for under slung cranes/ hoists running on wear resistant flats welded to rolled steel joists. Minimum diameter of CT & LT wheels for under slung cranes will be 150 mm.

g). **Long Travel Drive**

a) For Single girder EOT Cranes

Individual wheel drive (one wheel in each end-carriage) will be provided when the crane span exceeds 13 meters. All parts of the long travel drive will be located above the platform and easily accessible. The gear-box mounted on platform with foot mounted motor and brake will be connected with driving wheel by means of locating shaft and flexible geared coupling. The use of open gearing, chain and sprocket, pulley and belt etc. is not permitted.

b) For under Slung Cranes

Dual drive arrangement located at either end of each end carriage will be provided. Flange mounted geared motors may also be used.

h). **Hoist and Cross-Travel Drive**

The hoist and cross travel motions will be combined in one block which will be designed as per IS: 3938/1983. It will be ensured that skidding does not occur under any condition. (Refer specification for Electric Hoists below for US crane)

i). **Gearing and Gear-boxes**

Straight and helical spur gearing in metric module will be used for all motions. Worm gearing will not be used. All gears will be of hardened and tempered alloy steel with machine cut teeth. Hardness for pinion will be 220 BHN and for gears it will be 200 BHN. All gearings will be enclosed in oil tight gear-boxes. Fabricated gear-boxes will be stress relieved before machining.

j). **Bearings and Bearing Housing**

Ball and roller anti-friction bearings will be used throughout unless otherwise specified. Anti-friction spherical roller bearings will be provided for live axles of travel wheels. Housings will be split on shaft centre line to permit removal of the shaft. The underside of the base of each bearing pedestal will be machined and will bear upon a machined surface.

k). **Couplings**

Flexible coupling will be used between the LT motor and gear-box and between gear-box out put shaft and wheel shaft. In case of single motor central drive for LT motion, out put shaft of the gear-box will be connected through solid flange couplings. Half-geared couplings with floating shaft will be provided between the wheel and the line shaft.

l). **Hook Blocks**

Hook blocks will be of enclosed type leaving openings for ropes only so that ropes do not run off the sheaves. Standard swiveling shank hooks, mounted on thrust bearings will be used unless otherwise specified.

m). **Brakes**

DC Electro-magnetic brakes will be provided for each motion on the high speed pinion shaft of the gear-train.

n). **Buffers**

The crane will be provided with rubber buffers on the four corners of the end-carriages unless otherwise specified. For electrically operated hoists, steel stops at all the four ends of the track beam will be provided.

5. **Electrical Equipment:**

a) **Scope of supply**

The scope of supply covers all items of electrical equipment commencing from main current collector gear on the crane. The crane electrics include Power Isolator at floor level, power disconnecting switch on the crane bridge walkway immediately after the main current collecting gear, protective switch gear, motors, motor control panels, Variable frequency drives, resistors, brakes, limit switches, power & control cables, socket outlets, lighting distribution panel & lighting fixtures with lamps, bridge current collector system, master controllers, indicating lamps, push buttons, equipment earthing materials, etc. All sundry erection material required for installation & connecting up of electrical equipment with cable laying & fixing accessories will be included in the scope of supply of the

Contractor. DSL system (Angle iron conductor system) will be provided in shop for power supply to crane.

Signal lamps as required will be provided just below the trolley lines at both ends of the trolley lines to indicate whether the trolley lines are energized or not.

b) **Power supply**

AC 415 V +10%, 3 phase, 3-wire, 50 Hz +/- 5%, 50 KA fault level(1 second).

Voltage other than 415 V, AC, will be obtained through suitable transformer/ transformer rectifier units on the crane with miniature circuit breakers on both primary & secondary sides. Control supply voltage will be 110V AC derived from 415/110V transformer.

Each transformer will have + 5% & + 10% tappings on secondary side.

c) **Trolley power conductors**

The Power conductors or down shop lead (DSL) will have 4 conductors, 3 phase, 4 trolley line system (3 power + 1 earth).

Trolley power conductors will be of mild steel angel sections / rails.

Looping cables will be used in parallel with the conductor rails and aluminium equalising strips will be provided, wherever necessary, for limiting the voltage drops. In order to provide electrical continuity across the expansion joints the power conductors on both sides of the joints will be connected by stranded aluminum conductor jumper fitted with steel Aluminum strap and lugs suitable for the steel angle sections.

The power supply feeder and trolley line conductors/looping cables will be selected so as to limit the voltage drop to within 15% of the rated voltage at the crane motor terminals for the short time peak current corresponding to the starting of the largest capacity motor and the maximum continuous operating current of the rest on the system.

d) **Insulators and trolley line holders**

The insulators used for the manufacture of trolley line holders will be preferably steatite, tufnol or porcelain insulation material having substantial mechanical strength specifically against blows and vibrations. They will be capable of withstanding the impact and shocks resulting from operation of the machine. The creepage distance of the insulators will not be less than 80 mm.

The insulators used in the LT/AC system will have the following minimum flashover value and mechanical strength:

Dry flashover voltage	:	25 kV
Wet flashover voltage	:	12 kV
Ultimate mechanical strength	:	1000 kg.

All sharp edges will be ground smooth. The porcelain insulators will be manufactured and tested as per IS: 1445 -1997

e) Supporting brackets

The trolley line conductors will be mounted on holders. The holders will be bolted on to brackets which in turn will be welded on to crane girder at stiffeners at regular intervals. In normal run, intermediate type of brackets will be used, but when sectionalizing gaps or expansion joints are provided, sectionalizing type of brackets will be provided.

f) Steel to Aluminium straps

These are meant for connecting parallel aluminium bus, at expansion joints, power supply cables from load break switch. They will be complete with MS cadmium coated bolt nuts, spring washers, lugs etc.

g) Signal lamp assembly

Signal lamp assembly will be industrial, heavy duty dust tight and water proof in construction suitable for indoor or outdoor locations. The units will comprise three lamps for three phase with red glass lens and reflectors. The lamp will be provided with dropper resistance connected in series with the lamp and the resistance will be rated for continuous inclusion in the circuit. Alternatively, a built-in transformer may be provided to suit the lamp voltage.

h) Aluminium parallel bus

These buses will be of E.C. grade aluminium. They will be free from any deformity in profiles.

i) Current Collectors

2 nos. current collector will be provided per trolley line each rated for 100% of total rating. The collector shoe will be of heavy duty design and chamfered at both ends, each rated for 100% of total crane rating. Double collectors on each earth trolley line will be provided and these will be different from those on power trolley line. Collector will be multi hinged for self - aligning. Collector will be designed in such a way that load is transmitted not no the insulators but on the insulator stud to avoid damage to insulators.

j) Power distribution on crane

An off-load manual isolator with locking facility will be provided immediately after current collectors on incoming line on the crane. The isolator will be capable of carrying current of two largest motors.

In case of pendant operated cranes, this circuit breaker will be located in the protective panel.

The breaker will be with under voltage, over load & short circuit releases.

The breaker can be closed only when:

- All master controller handles are in neutral position.