RAGHUGANGA HYDROPOWER LIMITED

PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)

TECHNICAL SPECIFICATION
FOR
EOT CRANES

SPECIFICATION NO.: PE-TS-479-501-A401

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI BUILDING, NOIDA (U.P.)-INDIA

212851/2021/PS-PEM-MAX

PEM-66661

	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)
		SPECIFICATION NO. PE-TS-479-501-A001
		REV 00 / DATE FEB 2021

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	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)	
		SPECIFICATION No: PE-TS-479-501-A401	
		SECTION-I	SUB-SECTION-IA
		REV. 00	DATE: FEB 2021

SUB SECTION-IA

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)	
		SPECIFICATION No: PE-TS-479-501-A401	
		SECTION-I	SUB-SECTION-IA
		REV. 00	DATE: FEB 2021

SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART (SUPERVISION & MAINTENANCE SERVICES) & 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 all accessories and spares for erection, start up and commissioning as required, training of end customer at manufacturer's works, forwarding, proper packing, shipment and delivery as per SCC including warranty, supervision of erection and commissioning of crane, supervision of load & overload testing at site, supervision of erection of sole plate, anchor bolts and required accessories for rail & DSL fixing, training of operators at site and routine maintenance/ breakdown maintenance service of EOT cranes 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.

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 The standard quality plan is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan as minimum along with requirement/s mentioned elsewhere in the specification during manufacturing and testing.

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 EOT Cranes 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 insulated shrouded bus bar Cu conductor type DSL along with insert plates (fixing plates for DSL) to be mounted at civil girder. DSL insert plate with anchor bolt details drawing for encasing of insert plate in gantry girder has been indicated in input drawing. The arrangement has to be followed completely by bidder during detail engineering.
g. Earthing arrangement
h. Fill of lubricants till handing over.
i. Painting of cranes and accessories including touch up painting at site.
j. Temporary cable of suitable size as per load calculation for commissioning, testing & operation of EOT Crane till such time the DSL is charged.
k. Rail complete with sole plates, anchor bolts, clamps etc. including all accessories and end stopper. Gantry rail & sole plate layout drawing for rail and sole plate dimensions, rail to rail jointing and sole plate to sole plate jointing along with the anchor bolts details have been indicated in input drawing. When installed on their concrete foundation, the crane rails shall be shimmed by means of flat steel and fixed to the concrete with bolts. The layout has to be followed completely during detail engineering w.r.t. alignment blocks and clamps arrangement as indicated in the drawing. The dimensional details of alignment block and clamps are for reference only. Bidder may propose their size for alignment blocks and clamps during detail engineering without impacting the layout of rail and sole plate.
l. Maintenance tools & Tackle
m. Erection & Commissioning spares
n. Mandatory Spares

o. Main Isolating switch/Changeover in enclosure at operating floor for disconnecting supply to DSL.

p. Slings and cradle for load testing

1.1.4 **Mandatory Spares**

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

1.1.5 **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. Bidder shall supply minimum following spares

i) Oil seal for each gear box 1 Set

ii) Indicating Lamps 1 no. of each type 1 Set

iii) Push Button 1 no. of each type 1 Set

iv) Aux. contactor 1 no. of each size 1 Set

v) Limit switches- 1 no. of each type 1 Set

Note- One set means 100% requirement of one crane

1.1.6 **Maintenance Tools and Tackles**

As per Annexure III, section-IA of this specification

1.1.7 Any supplies to be done under warranty clause & any other clause of NIT, GCC, SCC as relevant to the package

1.1.8 Packing as per specification, forwarding and transportation to delivery address as per SCC.

1.2.0 Services to be provided by the bidder

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

1.2.2. **Scope of Supervision for Erection & commissioning:** Tentatively following visits shall be planned by site team which shall be as follows: -

a) One visit for supervision for erection of sole plate and anchor bolts for rail fixing and insert plates for DSL fixing for Power house crane & Valve house crane.

b) One visit for Supervision of Erection and commissioning of Power house crane & Valve house crane.

c) One visit for Supervision of load & overload tests for Power house crane & Valve house crane.

d) Any additional visit as per requirement of BHEL site office during erection of equipments.

Note: Bidder shall be informed at least 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two expert of bidder as deemed necessary by them

1.2.3. **Scope of Maintenance Services:** Maintenance services shall commence after commissioning and load testing of crane at site till guarantee period after handing over as per NIT. Maintenance services shall comprise of following.

Bidder may be called for maintenance services for either of the cases:

a) Routine maintenance including spare for wear and tear

i- Frequency of visits: 1 visit in every 6 months (Tentative 4 nos. visits after load/ overload testing).

ii- Any tools and tackles, consumables like oil, grease etc., spares required for replacement due to wear & tear shall be in bidder's scope and bidder has to ensure availability of the same before their arrival at site.

iii- Healthiness of crane is to be ensured.

b) Breakdown maintenance

i- Bidder to attend the crane within 72 hours of intimation by deputing expert. Any damaged item shall be replaced by bidder under warranty condition as defined under scope of supply.

ii- Any tools and tackles, consumables like oil, grease etc., spares required for replacement due to wear & tear shall be in bidder's scope.

iii- Healthiness of crane is to be ensured.

c) For checking healthiness of crane as per requirement of BHEL site office

i- Any tools and tackles, consumables like oil, grease etc., spares required for replacement due to wear & tear shall be in bidder's scope and bidder has to ensure availability of the same before their arrival at site.

ii- Healthiness of crane is to be ensured.

Note: Bidder shall be informed at least 10 days in advance for the requirement of visit at site (Except for breakdown maintenance). Visiting team shall consist of one or two expert of bidder as deemed necessary by bidder.

1.2.4. **Training to customer personal at manufacturer's works** (refer scope included in the technical specification and unpriced schedule)

1.2.5. Training of operator at site

1.2.6. Bidder has to facilitate customer / BHEL to obtain statutory clearance / licensee for radio remote control system from statutory authority.

1.2.7. 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. **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.

3.0.0. 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 / GCC / price schedule indicated in e- procurement portal 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**.**

4.0.0. Makes of Sub - Vendor items

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.

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

6.0.0. 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.

7.0.0 Testing of cranes:

Refer section IA: "**QUALITY ASSURANCE AND INSPECTION REQUIREMENT"** include in the specification.

8.0.0 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.

9.0.0 Works Excluded

a. Erection and commissioning of cranes

b. Supply feeder shall be provided by BHEL (as per electrical scope matrix of section IB) upto main isolating switch (vendor's scope) on operating floor. The main isolating switch shall be suitable for the incoming cable.

c. Gantry girder (RCC)

d. Dead load for load/ overload testing at site

e. Storage, unloading and transportation at site

f. Space for storage.

g. Erection hook

h. Exclusion, if any, mentioned in GCC, SCC.

i. Access ladder from operating floor to gantry girder walkway

10.0.0 Other requirements for the system.

i. 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. IS: 800- (latest edition) Code of practice for use of structural steel in General Building construction - shall also apply.
Any limitation on above account shall be reported during detail engineering while submitting design calculation of crane components/equipment's/sub system.

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

iii. Safety arrangements such as under voltage and single-phase protection in addition to manufacturer's standard will be provided through VVVF drive to prevent damage to motors on account of mechanical overload and electrical faults and to gearing shafts, etc. due to over stressing.
Protective relays for protection against instantaneous over-current, over-load, single phasing and under voltage for all motors shall be provided. The OC relay to be adjustable between 2 to 3 times the full load motor current.

iv. All materials / components will be new and of tested quality and will conform to the specification requirements and standards mentioned.

v. No cast iron parts will be used on the crane except for electrical motors and gearbox castings. Similarly, no wood or other combustible material will be used in any part of the crane.

vi. Qualified welders as per approved QA plan will carry out welding in accordance with established WPS.

vii. Design will be provided for easy maintenance of all the parts, particularly the wheel bearings on end carriage.

viii. The contractor shall provide an earthing system to which all equipment under his scope of supply shall be interconnected. This system will in turn be connected by the Purchaser(Customer). to the power house earth mat or the PPV earth mat to be laid by the Purchaser(Customer).

ix. The cranes shall be subject to a dynamic overload testing of 25% and a subsequent static overload testing of 40%

CONSTRUCTION FEATURES

a) The cranes will be furnished with required components comprising the following:

b) The cranes bridge shall be of solid welded steel construction designed to resist without undue deflections vertical and horizontal stresses. Perfect parallelism of the structure shall be ensured when any load up to the rated load is applied.

c) Jacking pads will be provided on the structural frames of trolley end carriage, for removal of wheels.

d) Platforms and walkways shall be of either checkered plate or grated. Suitable hand and foot-rails shall also be provided. All visible parts shall be plain with smooth, flat and appropriately finished surfaces.

e) Wheelbases for end carriage will as per IS.807 (latest edition)

f) PVC shrouded conductor bus bar type Cu DSL will be with suitable guards and service cage for maintenance of DSL will be provided with indication lamps on ends.

g) Power House Cranes shall be controlled for all three motions from the control desk located in the operator's Cabin, pendent push button station and Radio Remote Control (RRC). Valve house crane shall be controlled from pendent push button station only.

h) Crane shall be complete with trolley, tracks, wheels, axles, drive mechanism, hoisting drum brakes, horns, warning lights limit switches etc.

i) Portable hand operated lubrication equipment viz. grease gun etc. to be included in the supply.

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

Plate girders: Span/depth = 18

Lattice girders: Span/depth = 12

k) The rails or tracks of the cranes shall be resting on correspondingly provided concrete supporting structures. These shall be provided with the necessary stops. These shall be perfectly straight, free from scale and of a size to limit deflections not exceeding 1/2000 of the span between suspensions or supports if not continuously supported. Tracks or rails shall be supplied complete with fasteners, hangers, back-plates, expansion joints (where crossing concrete expansion joints) and stop blocks.

l) Bridge and Trolley frame

Bridge and trolley frames will be fabricated from steel plates / members. Mounting will be designed to facilitate easy removal of the wheels, bearings and journals. In bridge girder strength calculations, the trolleys, rails and chequered shall not be considered as load carrying members.

Bridge mechanism shall comprise of electric motors and totally enclosed speed reduction gear unit to drive the bridge wheels. The gear motors shall be keyed directly to the extended wheel shaft. The bridge motion shall be free from vibration, rocking etc. under all conditions of operations and the crane structure shall not have any tendency to get out of line.

m) Drive

All drive motors will be of crane duty conforming to IS: 325 and IS: 3177. The motor shall be suitable for 150 starts / hr. and 40% CDF. Motor nameplate rating at 40^0 C shall have Motor rating will be calculated keeping margin of at least 10% over the maximum power requirement in the duty condition specified.

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

The VVF drive control shall be used for control of each motion.

QUALITY ASSURANCE AND INSPECTION REQUIREMENT

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
2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.'
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw 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 flaw 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 flaw, 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 flaw, 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 ASTME 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:

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

b) Load test and Overload test.

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

d) All Other tests as per IS-3177:2020.

The cranes shall be subject to a dynamic overload testing of 25% and a subsequent static overload testing of 40%. The crane shall withstand these tests safely and without any failure and/or permanent deflection of any of its components or parts.

Testing at site. (shall be done in supervision of bidder)

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

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

iv. Brake test.

v. Any other test as per IS-3177

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

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

Refer Testing requirement as mentioned at ANNEXURE-VII.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-479-501-A401	DATE:
		CUSTOMER :		QP NO.: PE-V0-479-501-A101	Rev :
		PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)		PO NO.:	DATE
		ITEM: EOT CRANES	SYSTEM: EOT CRANE	SECTION:	SHEET OF

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			Remarks
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.	RAW MATERIAL													
a.	Steel Plates (Box Girder, End Carriage, Trolley & Gear Casing ,Fabricated Rope Drum)	1.Chemical & Physical	Major	Chemical & Physical	100%	-	CUSTOMER APPD GA DRG./ CRANE DS/TECH SPEC/ IS:2062-2011, GR-BR (E 250/350)	CUSTOMER APPD GA DRG./ CRANE DS/TECH SPEC/ IS:2062-2011, GR-BR (E 250/350)	T.C.	√	P	#V/W	V	# In absence of co-related TC, check testing shall be witnessed on samples selected by Main contractor
		2. NDT	Major	UT (25mm & above thickness)	100%	-	ASTM A435 / A 578 LEVEL B	ASTM A435 / A 578 LEVEL B	I.R.	√	P	#V/W	V	# Co-related Mill TC inclusive of UT will be reviewed by BHEL/CUSTOMER, In absence of UT conformance in Mill TC , then UT will be witness by BHEL.
b.	Round Bars (For Pinion ,Gear ,Axles & Shafts)	1. Chemical & Physical	Major	Chemical & Physical	100%	-	CUSTOMER appd GA DRG. /CRANE DS /EN-8(080M40), EN-9(070M55), EN-19(709M40),EN-24,BS-970		T.C.	√	P	V	V	NOTE: (1) Mech. Properties against H.T condition if applicable against respective Material standard/Grade (2) Hardness test report review after applicable Q & T condition
		2. NDT	Major	U.T	100%	-	ASTM A 388-2007	UT PROCEDURE (Attached)	I.R.	√	P	V	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

LEGENDS: *RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, ** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER, P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE, MA: MAJOR, MI: MINOR, CR: CRITICAL

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-479-501-A401	DATE:
		CUSTOMER :		QP NO.: PE-V0-479-501-A101	Rev :
		PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)		PO NO.:	DATE
		ITEM: EOT CRANES	SYSTEM: EOT CRANE	SECTION:	SHEET OF

c.	Forgings (For Gears, Wheels)	1. Chemical & Physical .	Major	Chemical & Physical	100%	-	CUSTOMER APPD GA DRG./CRANE DS / EN- 9/19(070M55)- BS:970/ C55Mn75, IS:1570-1979		T.C.	√	P	#V/W	V	# In absence of co-related TC, check testing shall be witnessed on samples selected by Main contractor NOTE: (1) Mech. Properties against H.T condition if applicable against respective Material standard/Grade (2) Hardness test report review after applicable Q & T condition
		2. NDT	Major	U.T	100%	-	ASTM A 388-2007	UT PROCEDURE (Attached)	I.R.	√	P	W	W	
d.	Casting for Gear	1. Chemical & Physical	Major	Chemical & Physical	100%	-	CUSTOMER apprd. Drg./ DS / Cast steel as per IS 2708.G-II	CUSTOMER apprd. Drg./ DS / Cast steel as per IS 2708.G-II	T.C.	√	P	V	V	
		2.NDT	Major	U.T	100%	-	ASME Sec.V,article-23,SA-609	SA - 609 , Level - II	I.R.	√	P	V	V	
e.	Pulley & Brake Drums	1. Chemical & Physical	Major	Chemical & Physical	100%	-	IS 1030-1982/IS-2707-1989/ CUSTOMER apprd. Drg./ DS	IS 1030-1982/IS-2707-1989/ CUSTOMER apprd. Drg./ DS	T.C.	√	P	V	V	
		2.NDT	Major	U.T (only boss area)	100%	-	ASME Sec.V,article-23,SA-609	SA - 609 , Level - II	I.R.	√	P	V	V	
f.	Seamless Pipe for Rope Drum	1. Chemical & Physical	Major	Chemical & Physical	100%		ASTM - A 106 GR . B	ASTM - A 106 GR . B	T.C	√	P	V	V	
		2.NDT	Major	U.T	100%		ASTM A 435 / A 578 LEVEL B	ASTM A 435 / A 578 LEVEL B	I.R	√	P	V	V	

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		CUSTOMER :		QP NO.: PE-V0-479-501-A101	Rev :
		PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)		PO NO.:	DATE
		ITEM: EOT CRANES	SYSTEM: EOT CRANE	SECTION:	SHEET OF

			Major	Mac ro Etching/Flattening for Seamless Pipe	100%		ASTM A 106-2007,GR-B	ASTM A 106-2007,GR-B	I.R.	√	P	V	V	
2.	BOUGHT OUT ITEMS													
a.	Hook	Forging Raw material	Major	Visual Check	100%		Drg. / Tech. Spec./ IS :1875-1992	No Visual defect	I.R	—	P	W	V	
			Major	UT after forging	100%		ASTM A 388-2007	UT PROCEDURE (Attached)	I.R	√	P	#W	V	# For MH Hook , UT in proof machined condition and AH Hook in grinding condition.
		Heat treatment	Major	Heat treatment after forging	100%		Mfg. Std. / Drg./Tech. Spec./ IS:1875	Mfg. Std. / Drg./Tech. Spec./ IS:1875	HT Chart	√	P	#V/W	V	# HT chart review for Main Hook at mfg. place
		Chemical test	Major	Chemical integral test piece.	Per Heat/ Batch		Appd. Drg. / IS :1875 -1992 , CLASS – II	Appd. Drg. / IS :1875 -1992 , CLASS – II	T.C.	√	P	V	V	
		Physical test	Major	Tensil test on integral test piece after heat treatment	Per Heat/ Batch		Appd. Drg. / IS :1875 -1992 , CLASS – II	Appd. Drg. / IS :1875 -1992 , CLASS – II	T.C.	√	P	W	W	Test Piece will be drawn from top of shank portion to be identified by BHEL and CUSTOMER.
		Macro etching	Major	Grain Size	100%		ASTM E 112	Grain size 6 or final	Lab T.C	√	P	V	V	
		NDT before Proof Load	Major	UT	100%		ASTM A 388-2007	UT PROCEDURE (Attached)	I.R	√	P	V	V	
			Major	DPT	100%		ASME Sec V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R	√	P	V	V	
		Proof Load Test	Major	Proof Load Test	100%		Drawing / IS: 5749/ IS: 15560 / DS	Drawing / IS: 5749/ IS: 15560 / DS	I.R	√	P	W	# V/ W	# W - FOR MAIN HOOK

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		NDT after Proof Load (UT only shank portion)	Major	U.T & MPI after Proof Load Test	100%		ASTM A 388-2007 / ASTM E 709-2007	ASTM A 388-2007 / ASTM E 709-2007	I.R	√	P	W	# V/ W	
		Identification Punch	Major	Visual	100%		—	—	—	—	P	H	H	H - Hold point (identification by CUSTOMER & BHEL)
b.	Wire Rope & slings	Visual & Breaking Strength	Major	Type, grade, breaking strength & visual , Diameter	100%		IS: 2266 – 2002 / G.A DRG / DATA SHEET	IS: 2266 – 2002 / G.A DRG / DATA SHEET	Mill T.C.	√	P	V	V	
c.	Rails	Chemical & Tensile , Cross section , Hardness , Dimension	Major	Chemical & Tensile , Hardness , Dimension	100%		G.A Drawing / IS: 3443-1980/APPD DATA SHEET	G.A Drawing / IS: 3443-1980/APPD DATA SHEET	T.C / I.R	√	P	V	V	
3.	**ELECTRICAL ITEMS**													
a.	Transformer (like Control transformer ,Light transformer)	Make , Rating	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		IR		P	V	V	
		Routine Test	Major	Doc. Review	100%		Mfg. Catalog / DS	IS :2026 & IS: 12021 for control transformer	Mfg. TC		P	V	V	
b.	SFU , MCCB , MCB , CONTRACTORS , DSL, RELAYS , FUSES , RESISTENCE BANK,HOOTER, PUSH BUTTONS, indicating instruments , junction box, Limit Switches	Make / Rating / Type / Size	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		IR		P	V	V	
		Functional / Continuity Check	Major	Doc. Review	100%		Drg./ Data Sheet / Relavant Std.	Drg./ Data Sheet / Relavant Std.	IR / COC		P	V	V	10% Verification by CUSTOMER

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c.	Motor	Type, Rating, Make, Size	Major	Visual	100%		CUSTOMER approved BOI list & ADS / DRG		Mfg. TC	√	P	V	V	**Refer Note 6** for Motor Up to 50 KW. For Motor above 50 KW separate QP Shall be applicable.
		Routine Test / Clearance of QP for Motor above 50 KW	Major	Measurement	100%		IS: 325 / App. Data sheet/CUSTOMER ADS	IS: 325 / App. Data sheet/CUSTOMER ADS	COC / Mfg T.C. (As per Note-3)	√	P	V	V	
d.	Brakes	Make,Type, Rating	Major	Measurement	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg. TC		P	V	V	
		IR,HV,Functional Test	Major	Measurement	100%		MFG. STD.	MFG. STD.	Mfg. TC		P	V	V	
e.	VVVF Drive	Type, Rating, Make,	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg. TC/ COC		P	V	V	
		Routine Test	Major	Measurement	100%		CUSTOMER APPD DA/GA DRG.	CUSTOMER APPD DA/GA DRG.	Mfg. TC	√	P	V	V	
f.	Cables (Power / Control / Trialing / Flexible)	Make, Type, Size	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC		P	V	V	Being small quantity of cables used for each size and type less than 500 mtr. Separate QAP for cable not required.
		Routine Test	Major	Measurement	100%		CUSTOMER Spec. / IS : 9963 / IS:694 /IS: 1554 / IS:7098	CUSTOMER Spec. / IS : 9963 / IS:694 /IS: 1554 / IS:7098	Mfg TC	√	P	V	V	
g.	Radio Remote, Pendent Station, Switches	Make / Rating / Type / Functional	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC / IR / COC		P	V	V	
	Cable Gland & lugs, Rectifier,Lamps,load	Make / Type	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC /IR/		P	V	V	

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	Cell								COC					
4.	**OTHER BOUGHT OUT ITEMS**													
a.	Bearings	Type & Size	Major	Verification	100%		Appd.drg./ Mfr's catalogue		Mfg TC / IR / COC	√	P	V	V	
b.	Tools and tackles	Verification of type size / rating	Major	Verification	100%		As per PO / BBU		IR / COC	√	P	V	V	
c.	Spares (Mandatory / recommended spare / commissioning spares)	Verification of type size / rating	Major	Review Of Internal Inspection Reports / Mfr's TC / COC	100%	100 %	Approved Spare List		IR / COC	√	P	V/W	V/ W	
5.	**IN PROCESS : FABRICATED COMPONENTS : GIRDER, END CARRIAGE, TROLLEY, GEAR BOX CASING , FABRICATED ROPE DRUM**													
a.	Welding	WPS & PQR	Major	Review of Document	100%		ASME SEC IX 2007	ASME SEC IX 2007	ASME PRO	√	P	V	V	Earlier CUSTOMER Approved WPS and CUSTOMER / NTPC/BHEL/BVQ/Lloyds/EIL qualified Welder acceptable.
b.	Weld Fit Up & Edge Preparation	Dimension	Major	Dimension	100%		Mfg. Drg.	Mfg. Drg.	I.R		P	V	V	
c.	Fillet Weld	NDT	Major	DPT on Fillet Weld	100%	10 %	ASME - Sec. V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R.	√	P	V/W	V	DP test of fillet weld for rope drum to be conducted after final machining. Random witness by BHEL
d.	Butt Weld (Girder ,End-carriage, Trolley & Fabricated Rope drum,if applicable)	NDT	Major	Radiography Test / Gamma Ray	$		ASME - Sec. V	ASME - Sec. VIII,Div-1, Clause- UW-51 & 52	I.R.	√	P	V	V	$ 100% in Tension Zone, 25% in Compression Zone & 100% for rope drum Seam weld, RT Film shall be reviewed by

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				DPT on Butt Weld	100%	10%	ASME - Sec. V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R.	√	P	W	V		10% random witness by BHEL
e.	Heat Treatment (SR) of Rope drum and Gear Box Casing	–	Major	Review of SR chart/Test Report	100%		Drg./ Relavant Std. / CUSTOMER Spec.	Drg./ Relevant Std. / CUSTOMER Spec.	SR Chart	√	P	V	V		
f.	Platform, Hand railing	Dimension	Major	Dimension	100%		Mfg. Drg	Mfg. Drg	—	—	P	V	V		
g.	Final Inspection of Fabricated Components (Girders, End Carriages & Trolley, end stopper)	Visual & dimensional	Major	Dimensional & Visual Check	100%		Appd. G.A Drg / CRAB	Appd. G.A Drg / CRAB	I.R.		P	V	V		At the Time of Final Insp. Of Crane
6.	**IN PROCESS INSPECTION OF MACHINED COMPONENTS**														
a.	Pinions,Gear & Wheels	1. Dimensional Check	Major	Measurement	100%		Mfg Drg / Crane Data sheet	Mfg Drg / Crane Data sheet	I.R	√	P	V	V		Hardness test report review after applicable Q & T condition
		2. Heat Treatment	Major	Heat Treatment chart	100%		Material specification/ Mfg std/ Mfg drg	Material specification/ Mfg std/ Mfg drg	I.R	√	P	V	V		Heat treatment Chart to be reviewed by BHEL & CUSTOMER
		3. Hardness	Major	Measurement	100%	100 %	Mfg Drg / Crane Data sheet/ IS: 3177	Material specification/ Mfg std/ Mfg drg	I.R	√	P	#W	V		#W - (1) 100% witness for MH/ AH Gear,pinion of entire lot (2) 100% witness for CT & LT Gear, pinion of entire lot
		4. NDT	Major	DPT on teeth	100%		IS:3658-1981 / ASME - Sec. V	NO CRACKS & LINEAR INDICATION	I.R	√	P	V	V		

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b.	Difference of Hardness of Pinion & Gear	–	Major	Documents review	100%		IS 3177 / CUSTOMER apprd. Drg. / DS	IS 3177 / CUSTOMER apprd. Drg. / DS	I.R	√	P	V	V	
c.	Rope Drum	1.NDT & Dimensional Check	Major	DP test on fillet weld & Dimension	100%		ASME SEC VIII Div -1 / Mfg. Drg.	NO RELEVANT INDICATION	I.R.	√	P	V	V	
		2.NDT	Major	DP test on Groove after machining	100%		IS: 3658-1981 / ASME - Sec. V	NO RELEVANT INDICATION	I.R.	√	P	V	V	
d.	Pulley & Brake Drums	1.Visual & dimension	Major	verification	100%		Mfg. Drg	Mfg. Drg	I.R.	√	P	V	V	
		2. NDT	Major	DPT after machining	100%		IS: 3658-1981/ ASME - Sec. V	NO RELEVANT INDICATION	I.R.	√	P	V	V	
e.	Assembled Gear Box	1. Visual & Dimensional	Major	Visual & dimensional	100%		As per Mfg Standard / DS / TS	As per Mfg Standard / DS / TS	I.R.	√	P	V	V	
		2. NDT	Major	DPT on Fillet Weld	100%		IS: 3658-1981 / ASME - Sec. V	NO RELEVANT INDICATION	I.R	√	P	V	V	
		3.Mechanical	Major	Backlash ,Contact Pattern	100%		Approved Drawing /Data Sheet/Mfg. Std.	Approved Drawing /Data Sheet/Mfg. Std.		√	P	V	V	
			Major	Reduction Ratio , No Load Run Test For Check of Oil Leakage / Temp. Rise, Vibration & Noise	100%	100 %	Approved Drawing /Data Sheet/Mfg. Std	Approved Drawing /Data Sheet/Mfg. Std	I.R.	√	P	#V/W	V	NOISE Max.85 db at 1 mtr. & 30º C temp. rise at ambient # W - for Main hoist and Aux. Hoist Gear box
f.	DSL Guard	Dimensional	Major	Dimension	100%		Mfg. Drg.	Mfg. Drg.	I.R.		P	V	V	

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7.	FINAL INSPECTION													
a.	CONTROL PANEL With VVVF Drive	Identification of all Elect. Components, Cable laying / Dressing/Ferulling /Terminations Dimensional Functional, HV, IR, interlocks, Protection DOP	Major	Visual, dimensional, Operational & Functional Check, HV,IR, Painting	100%	100 %	IS:3177 -1999 / Appd. Drg / Data sheet	IS:3177 -1999 / Appd. Drg / Data sheet	T.C	√	P	W	W	(HV at 2.5 KV Ac for power ckt at 2 KV for control ckt ,DOP by paper insertion method BOI as per CUSTOMER Approved Makes. Will be Checked at the time of Final Inspection.
		Paint Shade/ Thk/ Adhesion	Major	Visual / DFT Check	100%		APPD Painting Procedure / GA	APPD Painting Procedure / GA	T.C		P	V	V	7 Tank Pretreatment before Painting
b.	EOT crane assembly with control panel, Remote Controller Pendent Station (At Works)	Visual & dimensional	Major	Dimensional ,Span, Diagonal & Wheel Base Dimension, LT Stopper Dimension	100%	100 %	Approved G.A. Drg. / IS 3177 / DS	Approved G.A. Drg. / IS 3177 / DS	I.R.	√	P	W	W	Crane Should be Operable by RRC meant for that Crane only.

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		ITEM: EOT CRANES	SYSTEM: EOT CRANE	SECTION:	SHEET OF

		Operational	Major	(1) Speed & Current Measurement at No Load for Hoist & CT/LT motion (2) Speed & Current measurement at SWL of Hoist & CT motion (3) Over load test (125%) of SWL for Hoist motion (4) Deflection test at SWL (5) Operation Check of Brake at SWL (6) Interlock & Functional test	100%	100 %	Approved G.A. Drg. / IS 3177 / Load test procedure / DS	Approved G.A. Drg. / IS 3177 / Load test procedure / DS	I.R.	√	P	W	W	Functional & Interlock test as per approved Electrical Schematic drawing
8.	Cleaning & painting	Paint Shade / DFT	Major	Visual , DFT Check	100%		Painting Scheme / DS / TS	Painting Scheme / DS / TS	IR	√	P	V	V	
9.	Review of QA documentation						As per approved QAP				V	V	V	
10.	Packing of components	Visual inspection	Major	Visual	100%		BOM / Elec. DODL Packing specification		IR	√	P	V	V	

NOTE :

1) Original TCs / Photocopies certified in original by mill shall be furnished for review. Test In absence of correlated TCs Check test shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used.
2) X-Ray to be taken for thickness upto 19 mm and Gamma Ray for thickness above 19 mm. If Gamma Ray is used for lower thickness slow speed film like D2 or equvalent which gives enough readable and interpretable film quality to be used for clarity. All NDT shall be carried out by Qualified Level II personnel.
3) Performance of electrical & control devices along with the interlocks, protection & sequence to be checked during crane assembly and parked at works.
4) Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:/ Vendor's UT Procedure approved by BHEL may also be used.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

LEGENDS: *RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, ** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER, P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE, MA: MAJOR, MI: MINOR, CR: CRITICAL

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-479-501-A401	DATE:
		CUSTOMER :		QP NO.: PE-V0-479-501-A101	Rev :
		PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)		PO NO.:	DATE
		ITEM: EOT CRANES	SYSTEM: EOT CRANE	SECTION:	SHEET OF

(i) Cracks, flakes, seams and laps
(ii) Defects giving indications larger than 6 mm diameter equivalent flaw.
(iii) Groups of defects with maximum indication less than that from a 6 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 40%.
(iv) Defects giving indications of 3 to 6 mm diameter equivalent flaw separated by a distance less than four time the length of the larger of the adjacent flaws

5) Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:/ Vendor's UT Procedure approved by BHEL may also be used.
(i) Cracks, flakes, seams and laps
(ii) Defects giving indications larger than 4 mm diameter equivalent flaw.
(iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%.
(iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four time the size of the larger of the adjacent flaws
For hooks, for carrying out UT on the areas where there is loss of back wall echo due to geometry, the calibration shall be done on blocks of same material of similar thickness having Flat Bottom holes of required size as given above.

6) FOR MOTORS, FOLLOWING MODALITIES SHALL BE ADOPTED.
(A) LESS THAN 30KW : ACCEPTANCE OF MOTOR LESS THAN 30 KW IS BASED ON COC OF THE MANUFACTURER & THE CONTRACTOR CONFIRMING AS FOLLOWS:
• IT IS HEREBY CONFIRMED THAT THE ABOVE MENTIONED MOTOR /MOTORS WAS/ WERE MANUFACTURED TAKING CARE OF NTPC SPECIFIC REQUIREMENTS REGARDING AMBIENT TEMP., VOLTAGE & FREQUENCY VARIATION, HOT STARTS, PULL OUT TORQUE, STARTING KVA/KW, TEMP. RISE, DISTANCE BETWEEN CENTRE OF STUD & GLAND PLATE AND TESTED IN ACCORDANCE WITH APPROVED DRAWING /DATA SHEETS.
(B) 30 KW TO BELOW 50 KW
• ACCEPTANCE OF MOTOR RATING BETWEEN 30 KW & 50 KW IS BASED ON NTPC REVIEW OF ROUTINE TEST INSPECTION REPORT AS PER IS 325 ALONG WITH COC OF THE MANUFACTURER & THE CONTRACTOR CONFIRMING AS FOLLOWS:
• IT IS HEREBY CONFIRMED THAT THE ABOVE MENTIONED MOTOR /MOTORS WAS/ WERE MANUFACTURED TAKING CARE OF NTPC SPECIFIC REQUIREMENTS REGARDING AMBIENT TEMP., VOLTAGE & FREQUENCY VARIATION, HOT STARTS, PULL OUT TORQUE, STARTING KVA/KW, TEMP. RISE, DISTANCE BETWEEN CENTRE OF STUD & GLAND PLATE, SPACE HEATER AND TESTED IN ACCORDANCE WITH APPROVED DRAWING /DATA SHEETS.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
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LEGENDS: *RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, ** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER, P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE, MA: MAJOR, MI: MINOR, CR: CRITICAL

7. OVERHEAD E.O.T. CRANES

7.1 GENERAL

The Contractor shall supply install and commission the overhead E.O.T. Cranes required for the powerhouse and valve chamber. The cranes shall be supplied and installed ready for operation, including the runways and power in-feeds.

7.1.1 Scope and Limits of Supply

The scope of supply and services shall include:

- Design, calculations, manufacture, workshop assembly and workshop testing of the equipment.
- Priming and application of the finishing coating on all equipment to be painted.
- Seaworthy packing of the equipment, including the protective varnishing or greasing of all surfaces that will be left bright/un-painted during services.
- ~~Transportation (sea and land), including en-route storage, the necessary loading and unloading up to site~~, including the insurance from despatch/transport and upto defect liability period of 2 years after commissioning. as per BHEL NIT
- ~~Unloading at site, necessary storage, erection (including the necessary erection equipment), site tests and commissioning of the cranes.~~
- Supply of mandatory spare parts, tools and maintenance devices.

The limits of supply are as follows:

~~All concrete works are included in the scope of Lot-1 Civil & HM works, but~~ alignment, anchoring, welding and anti-corrosive protection of the equipment is responsibility of Lot 2 Mechanical and Electrical works Contractor as well as Supervision of the placing of concrete in and around Lot 2 Mechanical and Electrical works embedded parts including rails.

~~The Lot-1 Civil and HM Works Contractor is responsible for all excavation and concreting works and related safety measures~~. All equipment necessary for transport and erection of the cranes shall be provided and operated by the Mechanical and Electrical works Contractor. ~~Necessary co-ordination with Lot-1: Civil & HM Contractor shall be made for use of crane by Civil Contractor as well as amongst various sub-suppliers of mechanical & electrical equipment~~.

7.1.2 General Arrangement

~~Reference is made to powerhouse and valve chamber drawings showing required working space and general arrangement lay-out drawings~~.

7.1.3 Design Criteria

Maximum deflection of the crane bridges or gantries under the rated load shall not exceed 1/1000 of the crane's span (rail axis to rail axis).

The cranes shall be subject to a dynamic overload testing of 25% and a subsequent static overload testing of 40%. The crane shall withstand these tests safely and without any failure and/or permanent deflection of any of its components or parts.

7.2 BRIDGES

The cranes bridge shall be of solid welded steel construction designed to resist without undue deflections vertical and horizontal stresses. Perfect parallelism of the structure shall be ensured when any load up to the rated load is applied. Standard size crab rails and appropriate crab stops shall be provided.

Platforms and walkways shall be of either checkered plate or grated. Suitable hand and footrails shall also be provided.
All visible parts shall be plain with smooth, flat and appropriately finished surfaces.

Suitably locked and fixed access ladders to the crane bridges/gantries/cabin shall be provided.

7.3 TRACKS

The rails or tracks of the cranes shall be resting on correspondingly provided concrete supporting structures. These shall be provided with the necessary stops. These shall be perfectly straight, free from scale and of a size to limit deflections not exceeding 1/2000 of the span between suspensions or supports if not continuously supported.
Tracks or rails shall be supplied complete with fasteners, hangers, back-plates, expansion joints (where crossing concrete expansion joints) and stop blocks.

Spring-type or rubber-type buffers shall be mounted at the ends of the crane tracks.

7.4 CRABS

Crabs of sturdy steel construction shall be provided for the main and auxiliary hoists of the crane. They shall be mounted on the bridge and designed for equal load distribution on all wheels when being applied under any load condition. Spring-type or rubber-type buffers shall be

placed at the ends of the frames. Sturdy wheel braking supports shall be provided where necessary.

Main crabs shall travel on rails mounted securely and absolutely parallel on the bridge. The rail ends shall be provided with stop blocks. The crab of auxiliary hoists shall travel on an I-beam arranged on one of the outer sides of the bridge and be, therefore, completely independent from the main crab.

7.5 HOISTING MECHANISMS

All hoisting gears shall be mounted properly on the crab frame and be driven by suitable electric motors and gears to obtain the stipulated hoisting and lowering speeds.

All reduction gears shall be fitted with ball or roller bearings, running in an oil bath within an oil - and dust - tight gearbox, equipped with sight gauge glasses.

All rotating and moving parts shall be suitably protected by sheet metal guards or other convenient protective devices.
The hoists shall be equipped with an electrically released, spring-set, friction type holding brake (cone or disk) with a capacity not less than 200% of the full load torque of the motor, and with an electro-hydraulic braking system.

Additionally, an emergency brake acting on the drum and operating with some retardation shall be provided for each electric hoisting mechanism.

Load blocks shall be constructed to protect the hoisting ropes from damage and to prevent them from leaving the sheaves under all operating conditions.

7.6 TRAVELLING AND TRANSLATION MECHANISMS

Bridge and main crab mechanisms shall be equipped with geared double motor drives. Provisions shall be made to ensure individual protection of each motor and interlocking to warrant full simultaneous operation of both drives. Flexible connections shall be provided between motors and gears.

The mechanisms shall be designed and executed so that travel and translation respectively will be steady and free from racking, objectionable vibrations and undue noise at rated speed and under any load.

Electrically released, spring-set, friction-type disk brakes, with a capacity of twice the full load torque exerted by the travel and translation mechanism motor(s) respectively shall be provided.

The brakes shall operate when the power to the drive motor(s) is cut and shall be equally effective in both directions of travel and translation.

Travelling and translation mechanisms shall be so designed that in the event of an axle break the crane bridge or crab cannot drop more than 25 mm before striking the top of the rail.

7.7 DRUMS

As the crane will have main and auxiliary hoisting hooks, rope drums are to be designed accordingly. Rope drums shall be perfectly circular, in accordance with the diameter of the rope used and provided with a finely ground grooving. The bottom of the grooving shall be circular and its diameter larger than the rope diameter. Opposite pitch grooving shall be provided to ensure perfect vertical lifting and lowering.

Each drum shall be of sufficient length to carry all the rope without overlapping when the hook is in fully raised position. With the hook in its lowest position not less than 2.5 rope turns shall remain on each drum.

All drums shall be designed to carry safely and without deformation any load up to the test loads, and ensure ready access to the rope anchorage.

7.8 HOOKS

Hooks for main hosit shall be of the Ram's horn type and be either drop-forged or hammer-forged. The hook of auxiliary hoist shall be of the single hook type and also forged.

All hooks shall swivel freely in both directions and rest on dust-protected ball or roller bearings.

For all hooks the relevant DIN-Standards or equivalent shall apply. Hooks shall have locking system to protect from falling of materials to be lifted.

7.9 ROPES

All hoisting ropes shall be of special non-spinning type made of high-grade galvanized steel wire.

Each rope shall be capable of supporting the maximum (rated) load during worst manoeuvring positions. The minimum breaking strength of the ropes shall be not less than six (6) times the hoist's rated load.

The ropes shall be impregnated with grease to resist wear and possible corrosion. Where more than one part of rope is used for the support of the load, the tension in the various parts shall be equalized by means of appropriate pulleys in the load block.

7.10 RAILS

Rails shall be made of profiles suitably dimensioned for the purpose and consist of wear resistant steel such as manganese steel.

All rails shall be perfectly straight and even, and free from scale.

7.11 MOTORS

Motors shall be of the induction type and with sufficient capacity to properly handle the loads. They shall be rated for 40% relative duty factor (ED) of tropical-proof make and have class F or better insulation.

7.12 CURRENT CONDUCTORS

The current conductors shall form part of the crane supply.

Feed rail systems shall be of the metal enclosed, collector bus way type with internally supported collector having no live part outside of the enclosure. It shall consist of an assembly of standardized, fully interchangeable units and shall include expansion sections at each concrete expansion joint, two end feed boxes, coupling sets, dead-end caps, track hangers and all other equipment required for completing the system.

The feed rail system, when assembled in place, shall permit independent longitudinal movement of the steel housing and conductors in order to allow for unequal expansion and contraction due to temperature changes. The conductors shall be housed in a common enclosure made of not less than 2.5 mm thick sheet steel. Conductors shall be of hard-drawn copper, capable of carrying the rated current per pole continuously without overheating.

Down shop leads shall be supplied and suitably fixed on concrete column/wall at one end of the powerhouse for connection from 3-phase, 4 wire, 400 V AC supply for the feed rail system.

The current collector (trolley) shall be of the slide-shoe or tandem-wheel spring type. Crab current conductors shall preferably be of the suspended looping type, with a corresponding suspending wire arranged neatly between the crane's end pieces. Bare copper wire will not be accepted.

7.13 LIGHTING

Two (2) mercury vapour lamp units (complete with reflector) shall be furnished for the crane. They shall be arranged conveniently on the bridge girders or gantries for general illumination of the area under the crane.

Each lamp shall have a capacity of not less than 400 watts, whose maintenance and replacement shall be possible from the bridge or gantry walkway. Lighgting in operator cabin shall also be provided.

7.14 POWERHOUSE CRANE

The Powerhouse Crane of the travelling overhead bridge type shall be designed for installing, removing and dismantling all equipment /accessories installed in the powerhouse.

The crane capacity will be determined by the weight of the generator rotor and/or stator, whichever is the heaviest part. Apart of these stipulations the following main parameters apply:

- Length of crane runway	As per drawing
- Crane beam elevation	884.60 masl
- Span of runway rails	As per drawing
- Main Hook rated capacity	About 60 tons or Adequate to handle heaviest package +10% margin
- Main Hook Hoisting speed	1.0 m/min
- Main Hook Inching speed	Step-less, frequency converter Speed control system
- Auxiliary Hook capacity	10 ton
- Trolley travelling speed	0-5 m/min
- Crane travelling speed	0-15 m/min

All dimensions shall be confirmed by the Engineer prior to definite design and manufacturing. Proper coordination among the manufacturers of generating unit and crane shall be made during design of crane components.

7.15 VALVE CHAMBER CRANE

The Valve Chamber Crane of the travelling overhead bridge type shall be designed for installing, removing and dismantling all equipment /accessories installed in the valve chamber.

The crane capacity will be determined by the weight of the butterfly valve. Apart of these stipulations the following main parameters apply:

- Length of crane runway
- Crane beam elevation
- Span of runway rails
- Hook rated capacity

- Hook Hoisting speed
- Hook Inching speed
- Trolley travelling speed
- Crane travelling speed

All dimensions shall be confirmed by the Engineer prior to definite design and manufacturing. Proper coordination among the manufacturers of valve and crane shall be made during design of crane components.

7.16 CONTROL AND PROTECTION DEVICES

7.16.1 Control

Control of the crane shall be locally from a bridge-mounted operator's cabin as well as remotely from the radio operated portable control joy stick device. Switching over from local to remote control and vice versa shall be accomplished by interlocked key switches. The control equipment for crane shall be manufactured in accordance with the standard control equipment of the Bidder/manufacturer.

The cabin shall be accessible from ladders from service bay and far-end of machine hall and ensure an easy and free view of the load and area served. A desk comprising the controls for all operation modes of the crane shall be mounted in a suitable and functional manner in the cabin. Cabin and desk shall be of sturdy construction so as to withstand safely possible accidents or sudden crane motions. Electric grounding of the cabin and control desk shall be provided.

All equipment installed on the control desk shall be arranged in an operational and symmetrical manner, and marked clearly and permanently. A pilot lamp at the desk shall indicate when the power supply to the crane is switched on. Switches for cabin lighting and the outside vapour lamps shall also be provided.

The cabin installation shall include an operator's seat also.

7.16.2 Wiring

All wiring within the control desk and between control desk and the various equipment on the crane shall be supplied.

The cables and wires shall be installed in rigid or flexible conduits, whereby separate conductor systems shall be used for power and control circuits. All conductor systems shall be grounded.

All wiring shall be stranded conductor and be brought out to terminal blocks to facilitate external connection. All wires shall be tagged or marked for permanent identification to facilitate erection and maintenance.

7.16.3 Protection

All security and protection devices and measures shall be provided and shall comply with relevant IEC standards / other international standards / international practices / existing rules for lifting equipment.

The following shall apply:

- All movements shall be provided with progressive action braking systems to avoid any accidents. The braking systems shall be designed to come into operation in the event of a power failure.
- A dead man switch shall also be provided to automatically stop all crane movement in the unfortunate instance of death of operator during operation of the crane.
- All movements shall be provided with adjustable travel limit switches.
- The hoisting brakes shall be able to hold any load up to the rated load in stationary position without slip.
- Cable slacks, over-speed limiters and overload limiters shall be provided.
- Each rail of the crane shall be of standard type and be connected to the Powerhouse/Emergency closing valve grounding system, at each end and there shall be perfect contact between rails and wheels.
- Rated loads shall be indicated on the bridge so that they are clearly readable from the erection floor. Lifted load carried by the crane should be displaced by LED and be readable from service bay/machine hall floor.

A separately mounted push-button switch with a lock-out lever shall be located in the cabin to disconnect the main line contactor to the protective panel. A manually operated disconnect switch with fuse or circuit breaker of requisite rating shall be connected in circuit in the line side of the main line. The contactor of the protective panel end, shall have provisions for locking with a padlock in the open position.

7.17 TOOLS AND MAINTENANCE DEVICES

All tools, devices and equipment for the proper maintenance, servicing, assembly and disassembly of the cranes shall be supplied. All such tools, devices and equipment shall be stamped or marked for identification.

An itemised list of these special tools & tackles, maintenance devices and equipment furnished shall be submitted with the tender under the respective price schedule in Volume 1.

7.18 SPARE PARTS

7.18.1 Mandatory Spare Parts

The following spare parts shall be supplied with each crane:

- 1 (one) motor of each type used for the crane
- 1 (one) set of bearings, bearing bushings, wear pins, etc., of each type used
- 1 (one) set of brake shoes and sleeves for each type of brake used
- 3 (three) sets of carbon brushes for each type of motor used
- 3 (three) sets of carbon brush holders for each type of motor used
- 1 (one) set of gaskets and packings for each type used
- 1 (one) set of limit switches of each type used
- 5 (five) sets of lamps, fuses, indicators, coils, thermal relays, resistors, capacitors and other important small parts of each type used
- Insulators for travelling trolley wires for one line
- 5 (five) grease nipples and/or cups for each size and type and grease gun with appropriate nozzle
- 1 (one) complete assembly set of Switches, Contactors, Relays, etc
- 100% of finger tips and segments for controller
- 1 (one) hoisting rope of proper length of each type used,
- 1 (one) solenoid for each type of brake used,
- 1 (one) complete set of slings and lubricants used throughout the crane,

~~The itemized cost of these spares shall be entered in the Price Schedule in Volume 2.~~

7.18.2 Recommended Spare Parts

~~The Contractors shall provide list of such additional recommended spare parts (in addition to mandatory spares mentioned above) necessary for five years of operation. The itemised price shall be quoted under the respective price schedule for the recommended spare parts.~~

7.19 SHOP ASSEMBLY AND TESTS

The following tests and checks shall be carried out in the manufacturer's shops:

- Check of the straightness of the bridge girders and gantry girders,

- Check of the assembled gantries and bridges with regard to proper fit, parallelism of the girders and main dimensions,
- Load tests at rated load/dynamic overload (125%) and static overload (140%).
- Functional tests on the motors and limit switches,
- Check of the approach distances of main and auxiliary hooks,
- Check of the wiring and cabling work as far as readily mounted.
- Any other tests as per the relevant standards and as per normal practice of the manufacturer.

All these checks and tests shall be witnessed by the Employer and/or the Engineer.

7.20 SITE TESTS

Tests shall be carried out as per relevant standards and shall include the following tests and checks after installation of the equipment at site:

- Functional checks, including limit switches,
- Check of the operating speeds,
- Check of the approach distances,
- Check of the braking distances,
- Check of the bridge and beam deflections.
- Load test (rated load/dynamic over load (125%)
- Check of the protection equipment
- Any other tests as per the relevant standards and as per normal practice of the manufacturer

7.21 PARTICULAR TENDER DOCUMENTS

The following particulars shall be supplied with the Tender for crane:

- Sets of scaled and comprehensive drawings, comprising plan view, longitudinal and transverse sections of the cranes. These drawings shall also show the approach distances/hook limits.
- A condensed description of the crane, with all important data and information.
- Various control schematic drawings with inter-locking scheme etc.

Description of erection procedure, including indication of number, capacity and position of erection hooks being supplied.

20. TRAINING AND MAINTENANCE & GUIDANCE SERVICE

20.1 Training

20.1.1 Training for Employer's Staff and Personnel

The Contractor shall invite the Employer's staff for the training in the Contractor's country, or any other country where any plant is ready for Training.

The Contractor shall provide the following for each of the employer's personnel participating in the training programme:

- Return air ticket from Kathmandu to the place of training
- Hotel accommodation
- Travelling expenses
- Per diem allowance of US$ 150
- Health insurance to cover all medical costs that may be required during the stay abroad for factory /training.

Payment for training shall be made to the satisfaction of Employer and Engineer, after completion of all training activities.

The training of the Employer's Personnel during the manufacture and testing of the equipment shall include several sessions of classroom and workshop training in the various premises of the Contractor and or sub-contractor where plant has been manufactured.

The training during the manufacture and testing shall comprise the following equipment:

- E.O.T.Cranes

- Communication systems
- RTU

The overall break-up of trainees and trainee man-months for the abroad training program shall be as follows:

20.1.2 Training for Employer's Management Personnel

The Contractor shall arrange observation tour for the Employer's management personnel in manufacturer's country in order to familiarise them with quality assurance method to be adopted during design and manufacturing process, and available after-sales services. The number of personnel for observation tours in manufacturer's country shall be 4 (four) and the number of days allocated for this purpose for each person shall be 7 (seven) days including travelling.

The Contractor shall provide the following for each of the employer's personnel participating in the training programme:

- Return air ticket from Kathmandu to the place of training
- Hotel accommodation
- Travelling expenses
- Per diem allowance of US$ 250
- Health insurance to cover all medical costs that may be required during the stay abroad for factory /training.

20.2 Maintenance and Guidance Service at Site

From commencement of erection work at the Site until a date one month after the date of issuance of the Taking-Over Certificate, the Contractor shall instruct and train those employees designated by the Employer who will subsequently be responsible for the operation and maintenance of the equipment.

At least thirty (30) days prior to the date of commencement of the erection work, the Contractor shall submit the program of the said instructions and training in the English language, with time schedule for approval of the Engineer and /or the Employer.

The training at site shall consist of an adequate number of classroom sessions and the regular observation of the assembly and installation works as well as the participation in the work, if

appropriate. The instructions and training shall take place during installation, testing, commissioning and trial operation of various equipment/systems.

During the trial operation the Contractor shall include the Employer's Personnel into the operation and regular maintenance of the equipment. Complementary instructions may be given by presenting the Operation & Maintenance Instructions in adequate training sessions. Further, during the defect liability period, Contractor shall assist Employer in solving operational problem, trouble shooting and maintenance of plant properly by advising and suggesting to Employer's staff as and when required without any undue delay.

The cost of such instruction shall be deemed to be included in the Tender Price. The Contractor's costs for this training shall be included in the overall costs for the Works provided in accordance with the Technical Specifications. All necessary expenses for such services shall be deemed to be included at the appropriate place in the contract price.

	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)	
		SPECIFICATION No: PE-TS-479-501-A401	
		SECTION-I	SUB-SECTION-IA
		REV. 00	DATE: NOV 2020

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		

	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)	
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		SECTION-I	SUB-SECTION-IA
		REV. 00	DATE: NOV 2020

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		SCHNEIDER (Earlier TELE MACHANIQUE)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	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		

	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)	
		SPECIFICATION No: PE-TS-479-501-A401	
		SECTION-I	SUB-SECTION-IA
		REV. 00	DATE: NOV 2020

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		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	

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		SECTION-I	SUB-SECTION-IA
		REV. 00	DATE: NOV 2020

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
21.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
22.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	

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		SPECIFICATION No: PE-TS-479-501-A401	
		SECTION-I	SUB-SECTION-IA
		REV. 00	DATE: NOV 2020

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
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		

	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)	
		SPECIFICATION No: PE-TS-479-501-A401	
		SECTION-I	SUB-SECTION-IA
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		JAINSON		
		DOWELL		
25.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		
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.		

	TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)	
		SPECIFICATION No: PE-TS-479-501-A401	
		SECTION-I	SUB-SECTION-IA
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		
		MITSUBISHI ELECTRIC		
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*		
		BONGFILIOLI*		
41.	RAIL	JSPL		
		SAIL		

NOTE:

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

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.

ANNEXURE-II
MANDATORY SPARES (FOR EACH CRANE)

Sr. No	Description of spares	Qnty		Remarks
		PH Crane	Valve house Crane	
1)	Motor of each type used for the crane	1 no.	1 no.	
2)	Bearings, bearing bushings, wear pins, etc., of each type used	1 set	1 set	
3)	Brake shoes and sleeves for each type of brake used	1 set	1 set	
4)	Gaskets and packings for each type used	1 set	1 set	
5)	Limit switches of each type used	1 set	1 set	
6)	Lamps, fuses, indicators, coils, thermal relays, resistors, capacitors and other important small parts of each type used	5 set	5 set	
7)	Insulators for travelling trolley wires	for one line	for one line	
8)	Grease nipples and/or cups for each size and type and grease gun with appropriate nozzle	5 no.	5 no.	
9)	Switches, Contactors, Relays, etc	1 (one) complete assembly set	1 (one) complete assembly set	
10)	Finger tips and segments for controller	100%	100%	
11)	Hoisting rope of proper length of each type used,	1 set	1 set	
12)	Solenoid for each type of brake used,	1 no.	1 no.	
13)	Slings and lubricants used throughout the crane,	1 (one) complete set	1 (one) complete set	

NOTES

1 Set for the particular equipment, would include all components required to replace the item, for example a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly. One (1) set means 100% requirement for one crane.

2 Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.

3 In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

4 Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

5 Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.

6 *Interchangeability and Packings:*
All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre-set and/or preprogrammed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc. should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre-setting/pre-programming before putting them in to service. The spare shall be treated and properly packed for long term storage.

7 *Identification:*
Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

8 Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification, same shall be deemed to have been covered in bidder’s scope of supply.

ANNEXURE-III
TOOLS & TACKLES

Maintenance Tools and Tackles:

All tools, devices, equipment and testing instruments etc. for proper handling, maintenance, assembly, erection and dis-assembly of any part of the inlet valves shall be supplied with the first equipment. All such tools, devices and equipment shall be stamped or marked for identification. The supply shall comprise the following tools and equipment, and the following list is to be considered as a minimum and, as necessary, to be complemented by additional tools and equipment required.

one (1) set of lifting slings, lifting eyebolts, shackles, jacks and other lifting devices required for the proper and safe lifting of parts or the fully assembled spherical valve by the powerhouse crane.

all special tools, devices and equipment that may be required and/or useful for the most expeditious assembly or dismantling of any part of the equipment.

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 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.
10.	Hydraulic jack	2 No.s

Note: - One set of tool and tackles for Power house area Cranes, One set of tool and tackles for PPV area Crane along with O&M manual in the toolbox shall be supplied.

ANNEXURE-IV
PAINTING SPECIFICATION

A. **Structural**

Surface preparation: All surfaces to be painted shall be thoroughly cleaned of all dirt, dust, grease, cement scale or oil before the application of paint. Oil and grease shall be removed with solvents not harmful to the surface. If required by the paint system, the surface shall be finally cleaned with water. Surfaces shall be dry unless dampening is required for a particular finish material. Any surface contaminated during paint application shall be re-cleaned thoroughly before painting is being continued.

The surface cleaning quality will conform to SA 2.5 of Swedish standards institution SIS 055900.

Primer: First layer of priming paint (minimum dry film thickness: 40 microns) followed by two (2) priming layers having a minimum dry film thickness of 30 microns each. All these layers shall be of red lead on chlorinated rubber/synthetic resin basis (minimum total dry film thickness: 40+30+30=100 microns).

Finish Coat: Final coating shall be with 2 finishing coats (minimum dry film thickness: 30 microns each) on chlorinated rubber/synthetic resin basis. (2 x 30 μ = 60 μ)

Total DFT: (100+ 60 = 160μ)

B. Electrical /Control Panel

Control panels shall be powder coated. (min DFT 80-110μ)

C. COLOR SHADE

S. No	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow- shade 356 as per IS-5	
2	Bottom block assembly	Golden Yellow- shade 356 as per IS-5	
3	Hooks	Black	
4	Motors	Light Gray- shade 631 as per IS 5	
5	Control Panels	Light grey- shade 631/7078 as per IS 5	

D. Handrail- After careful blast-cleaning same shall receive two (2) layers each of a primer and oil-resisting varnish or enamel.

ANNEXURE-V
MAIN DRAWING LIST WITH SCHEDULE OF SUBMISSION

A. DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

The successful bidder shall submit the following drawings / documents during detail engineering for approval:

BASIC ENGINEERING DRAWINGS/DOCUMENTS

S.N.	BHEL drawing No.	Title	Schedule date of submission from date of LOI. (in week)
1	PE-V0-435-501-A101	Manufacturing Quality Plan with sub vendor list For EOT CRANE	3
2	PE-V0-435-501-A104/1	Mechanism Sizing Calculation for POWER HOUSE EOT CRANE	3
3	PE-V0-435-501-A104/2	Mechanism Sizing Calculation for VALVE HOUSE EOT CRANE	3
4	PE-V0-435-501-A105/1	General arrangement for POWER HOUSE EOT CRANE with CT DSL details	3
5	PE-V0-435-501-A105/2	General arrangement for VALVE HOUSE EOT CRANE with CT DSL details	3
6	PE-V0-435-501-A106/1	Crab sub assembly for POWER HOUSE EOT CRANE with CT wheel assembly	4
7	PE-V0-435-501-A106/2	GA of Electric hoist for VALVE HOUSE EOT CRANE with CT wheel assembly	4
8	PE-V0-435-501-A109	Hook block assembly with details of hook, nut and check plate For EOT CRANE	4

OTHER DRAWING/DOCUMENTS

S.N.	BHEL drawing No.	Title	Schedule date of submission
FOR POWER HOUSE CRANE			
1	PE-V0-435-501-A103	Data sheet of motors for POWER HOUSE CRANE	14 days after CAT II approval /clearance from BHEL on Mechanical sizing calculation (PE-V0-435-501-A104)
2	PE-V0-435-501-A110	Long travel Machinery Assembly with LT wheel assembly For POWER HOUSE CRANE	14 days after CAT II approval /clearance from BHEL on GA drawing (PE-V0-435-501-A105)
3	PE-V0-435-501-A117	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Cross Traverse & BOM d) Long Traverse & BOM Including earthing diagram For POWER HOUSE CRANE including control write up	7 days after CAT II approval /clearance from BHEL on Mechanical sizing calculation (PE-V0-435-501-A104)
4	PE-V0-435-501-A118	General Arrangement of a) Protective panel b) Main hoist panel c) Cross Travel panel d) Long Traverse travel	7 days after CAT II approval /clearance from BHEL on electrical scheme (PE-V0-435-

		panel. e) Pendent f) Remote Radio Control For POWER HOUSE CRANE	501-A117)
5	PE-V0-435-501-A119	Cable Sizing and cable schedule For POWER HOUSE CRANE	7 days after CAT II approval /clearance from BHEL on electrical scheme (PE-V0-435-501-A117)
6	PE-V0-435-501-A127	Data sheet of POWER HOUSE CRANE with painting details	7 days after CAT II approval /clearance from BHEL on GA drawing (PE-V0-435-501-A105)
7	PE-V0-435-501-A112	Structural calculations For POWER HOUSE CRANE	14 days after CAT II approval /clearance from BHEL on GA drawing (PE-V0-435-501-A105)
8	PE-V0-435-501-A201	Manufacturing Quality Plan with sub vendor list for 10T electric hoist	7 days after CAT II approval /clearance from BHEL on GA drawing (PE-V0-435-501-A105)
9	PE-V0-435-501-A202	10T electric hoist GA, sizing calculation and electrical scheme	7 days after CAT II approval /clearance from BHEL on GA drawing (PE-V0-435-501-A105)
VALVE HOUSE CRANE			
1	PE-V0-435-501-A103	Data sheet of motors for VALVE HOUSE CRANE	14 days after CAT II approval /clearance from BHEL on Mechanical sizing calculation
2	PE-V0-435-501-A117	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM b) Cross Traverse & BOM c) Long Traverse & BOM Including earthing diagram For VALVE HOUSE CRANE including control write up	7 days after CAT II approval /clearance from BHEL on Mechanical sizing calculation
3	PE-V0-435-501-A118	General Arrangement of a) Protective panel b) Main hoist panel c) Cross Travel panel d) Long Traverse travel panel. e) Pendent	7 days after CAT II approval /clearance from BHEL on electrical scheme
4	PE-V0-435-501-A119	Cable Sizing and cable schedule For VALVE HOUSE CRANE	7 days after CAT II approval /clearance from BHEL on electrical scheme
5	PE-V0-435-501-A127	Data sheet of VALVE HOUSE CRANE with painting details	7 days after CAT II approval /clearance from BHEL on GA drawing
6	PE-V0-435-501-A112	Structural calculations For VALVE HOUSE CRANE	14 days after CAT II approval /clearance from BHEL on GA drawing
Common drawings			
1	PE-V0-435-501-A151	Field quality plan For EOT CRANE	7 days after CAT I approval /clearance from BHEL on GA drawing
2	PE-V0-435-501-A114	O & M Manual For EOT CRANE	14 days after CAT I approval of all drawings
3	PE-V0-435-501-A123	Mandatory spare parts list For EOT CRANE	14 days after CAT II approval /clearance from BHEL on G.A. of Crane , Mechanical sizing calculation, technical data sheet & Schematic Circuit diagram
4	PE-V0-435-501-	Erection procedure For EOT CRANE	28 days after CAT II approval

	A125		/clearance from BHEL on G.A. of Crane , Mechanical sizing calculation & Schematic Circuit diagram
5	PE-V0-435-501-A108	General arrangement for PVC shrouded DSL for EOT CRANE	7 days after CAT II approval /clearance from BHEL on GA drawing
6	PE-V0-435-501-A150	Crane lubrication drawing For EOT CRANE	14 days after CAT II approval /clearance from BHEL on GA drawing
7	PE-V0-435-501-A132	Gantry Rail installation for EOT CRANE	7 days after CAT II approval /clearance from BHEL on GA drawing

Notes:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

l) " DOCUMENTATION " at clause no. 4.0.0 of customer specification also to be referred for finalizing drawing list during detail engineering.

B. DOCUMENT MANAGEMENT SYSTEM:

Bidder to note that the successful bidder, during detail engineering, will submit the drg/d oc through web based Document Management System in addition to hard copies to be s ubmitted as per dwg/ document distribution schedule. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodol ogy would be finalized after award of contract.

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://124.124.3 6.198/wrenchwebaccess/login.aspx)"
DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, c ommenting and tracking documents on PEM's DMS have been uploaded on PEM intern et website (www.bhelpem.com) under the Vendor session.
For quick access bidder may refer the link
http://bhelpem.com/DMSManuals/DMSManuals.html

The contractor shall submit to the Employer/Engineer for approval the instruction manuals concerning the correct manner of erection for the work as early as possible but well before despatch of the Plant and those for the operation and maintenance not later than six months before Taking over of the Works, with special references to any recently developed features. Instruction manuals shall describe in detail erection procedure and use of all erection equipment and measurement devices. Procedure for assembling, adjusting, operating and dismantling of each component system and machine shall be described and illustrated.

Maintenance of each component shall be described in detail including the recommended frequency of inspections and lubrication. The instruction manuals shall include easily readable diagrammatic drawings of the equipment to facilitate understanding the descriptive information. The Contractor shall, in preparing the instruction manuals, take into account the lack of experience and familiarity of the operating personnel with this type of equipment. The instruction manuals shall include a complete list of all drawings prepared for this Contract, spare parts list, and a parts list for each component of item of equipment. The parts list shall include manufacturer's code and serial numbers and ordering instructions and shall be detailed as far as possible for only the equipment supplied.

Details in regard to classification, deadline and numbers of manuals, documents to be submitted to the Employer and the Engineer shall be as stated in Clause 29.

29. SUBMISSION OF TECHNICAL DOCUMENTS

29.1 Numbers to be submitted

All technical documents to be submitted by the Contractor under the Contract, including but not limited to the documents listed herein pursuant to Clause 29, shall be submitted in the following number of copies:

Document		Distribution	
		Engineer	Employer
1	***General Technical Documents:***		
1.1	- Draft version for Approval	3 H + 1 E	3 H + 1 E
1.2	- Final version after Approval including correction	3 H + 1 E	3 H + 1 E
2	***As-built Drawings:***		
2.1	- Draft version for Approval	3 H + 1 E	3 H + 1 E
2.2	- Final version after Approval including corrections	2 H + 2 E	4 H + 2 E
3	***Operation and Maintenance Manuals:***		

Document		Distribution	
		Engineer	Employer
3.1	- Preliminary version 112 days prior to commencement of Commissioning	3 H + 2 E	3 H + 1 E
3.2	- Final Draft version for Approval	3 H + 1 E	3 H + 1 E
3.3	- Final version after Approval including corrections	2 H + 2 E	4 H + 2 E
4	***Commissioning Manuals:***		
4.1	-Tentative version for Approval	3 H + 2 E	3 H + 1 E
4.2	- Final version after Approval including corrections	2 H + 2 E	4 H + 2 E

Key: H = hardcopy (paper or other as appropriate);
E= electronic copy, with fully open accessibility, editing and user capability, stored on CD or DVD or other approved electronic medium.

29.2 Deadlines for Submission

The technical documents to be submitted by the Contractor under the Contract shall be submitted for approval. The contractor shall submit Lot 2: M&E construction schedule with this bid by matching design/ manufacture/ supply/ erection/ commissioning activities of all his equipment/ systems with the construction activities of Lot1: Civil & HM. M&E submission schedule should also include, inter-alia, the completion in days after commencement date for various milestones included in Annexure-1, Section 2.4, Conditions of Contract in Volume2.

30. RIGHT TO CHANGE DESIGN AND DRAWINGS

When additional information regarding equipment/systems/permanent constructions or other conditions become available as a result of change in design/requirement of the works and it is found desirable to make requisite changes, the Employer reserves the right to make the necessary or desirable changes after taking into account the opinion of the Engineer.

31. AS-BUILT DRAWINGS

The Contractor shall submit as-built drawings of the completed works to the Engineer/Employer immediately after commissioning but well before the expiration of Defect Liability Period. The numbers of copies shall be as described in Sub-Clause 29.1.

The as-built drawings shall clearly show the details and dimensions of the permanent equipment/systems for which construction has been actually made, based on the changes of design from time to time as ordered by the Engineer or proposed by the Contractor and approved by the Employer/Engineer.

ANNEXURE-VI
PACKING PROCEDURE

Packing and Marking:

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

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

Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

SEAWORTHY PACKING
(PACKING INSTRUCTIONS FOR GENERAL COMPONENTS / ASSEMBLIES / EQUIPMENT)

1 GENERAL

This standard lays down packing instructions for seaworthy packing of Components /Assemblies/ Equipment to be dispatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit for storage. For specific applications the concerned engineering department shall issue a product standard. Reference of this standard, must appear in the Shipping list/Packing List.

2 SCOPE

This procedure gives minimum guidelines for seaworthy packing to be complied with for packing of Components /Assemblies / Equipment. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage for periods more than one year.

3 CROSS REFERRED SPECIFICATION

- Multi-layered cross laminated plastic film : AA51420
- Packing Wood : AA51401
- Silica gel : AA55619
- Thermocole : AA51416
- Packing slip holders : AA7240901
- Corrugated Fibre Board : AA51414
- Rubber sheet : AA59001
- VCI paper : AA51406
- High quality full glossy out door finishing paint : AA56126
- Polyethylene air bubble film : IS 12787
- Structural steel - standard quality (plates, sections, strips flats & bars) : AA10108
- International Standards For Phytosanitary Measures No. 15 : ISPM-15:2009

4 WOOD SPECIFICATION FOR PACKING

The wood shall conform to specification AA51401.

For export packing wood in addition to the above the following has to be met:

The standard requires the use of debarked wood in the construction of compliant wood packaging material. Debarked wood is defined in the ISPM 5.

5 TYPE OF PACKING

The following 5 types of packings have been standardized for packing of General Components /Assemblies.

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It must not be used directly or indirectly in any way detrimental to the Interest of the company.

– 'OP' - Open Type
– 'PP' - Partially Packed
– 'CP' - Crate Packing - Components/Equipment requiring physical protection
– 'CQ' - Case Packing - Small medium Components/ Assemblies/ Equipment which require corrosion & physical protection
– 'CR' - Case Packing - Electrical Components/Assemblies which require special packing viz. Water Proof, Shock Proof, etc.

6 DESCRIPTION OF TYPES OF PACKING

The various types of packing, as standardized above, are described below.

6.1 'OP' - Open Type

In case, of components which are not affected by water & dust & do not require special protection &, are generally not machined, shall be sent as open packages. However these components may be sent in crates, wherever necessary.

6.2 'PP' - Partially Packed

Components which need special protection, at selected portions only, shall be dispatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces after application of TRP should be protected with Multi-layered cross laminated plastic film to AA51420.

6.3 'CP' - Crate Packing – General

Assemblies/Components which need only physical protection from the point of view of handling shall be dispatched duly packed in crates.

6.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipment

a) Small & Medium sized components/assemblies/equipment due to size/weight & to avoid handling, and pilferage, problems shall be packed in Case/Containers.

b) Wherever required adequate quantity of silica gel to AA55619 or VCI Powder/ Tablets, packed in thin muslin cloth cotton bags shall be suitably placed.

c) Small machines/components of less weight shall be provided with suitable cushioning. Wood Wool/Expanded Polyethylene Foam Sheet, if used, shall be sandwiched between polyethylene sheets and sealed.

d) The components inside the case shall be entirely covered with Multi-layered cross laminated plastic film to AA51420, where-ever required.

6.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons.

a) Adequate quantity of Silica gel to AA55619 packed in cotton bags, of 100 grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with Multi-layered cross laminated plastic film to AA51420, before being packed in the cases.

b) VCI Powder/Tablets can be used as an alternative to Silica Gel to AA55619.

c) Empty space in the cartons shall be filled with small chips of Expanded Polystyrene (Thermocole), Wood Wool etc. Polyethylene air bubble film shall conform to IS 12787/AA51420 Expanded polystyrene (Thermocole) shall conform to AA51416.

d) The cartons shall be manufactured from corrugated Fibre Board, meeting requirements of AA51414.

6.6 Special Packing

Components requiring special packing (as per customer/contractual/ engineering requirements) not included in this specification shall be covered by product standards.

7 PREPARATION OF PACKING CASE

1) Cases and crates with gross weight up to 1,000 kgs. shall be provided with bottom cleats of min. 40 mm thicknesses to ensure clearance for handling by forklift. Cases and crates exceeding gross weight of 1,000 kgs. shall be provided with skid runners, number and size according to weight of package.
2) The base of the case shall be made of wooden batons for planks giving necessary reinforcement, such that the bottom of the equipment is at a height of 100 to 200 mm from the ground level depending upon size & weight of equipment. However for packing cases of smaller size equipment can be at a height of 40 mm from the ground level.
3) In case of 'CR1 - Packing Viz. Electrical & Electronic components for instruments/assemblies, a rubber sheet, Self-expanded polyethene foam sheet, preferably 10 mm thick, shall be fixed on to the base to act as cushioning to the equipment.
4) The four sides, shall be lined, from inside with multi-layered cross-laminated polyethylene sheet of 90GSM as per AA51420 and tacked at suitable places.

   Whenever specified the top cover will have a layer of multi-layered cross laminated polyethylene sheet of 90 GSM over the cover. This should project about 100 - 250mm on all sides.

   It is preferable to have a single piece of the above Multi-layered cross laminated polyethylene sheet fixed on the four sides. In case jointing is unavoidable, it should be done by overlapping of approximately 100mm.
5) Place the Components/cartons with corrosion inhibitors duly applied wherever necessary for place suitably, thin muslin cloths bags containing 100 grams (approx.) of activated Blue Silica Gel to AA55619, wherever necessary. Alternatively VCI Powder or Tablet may be used.
6) In case, depression is formed, at the top, after the equipment is lowered, provide ply board/wooden batons.
7) Cover the whole equipment with polyethylene sheet of at least 100 micron thickness, on all sides preferably by a single piece.
8) For indoor panels/equipment, provide suitable packing batons with covering of Thermocole/expanded soft polyethylene foam/polyethylene air bubble film wrapped with suitable cords, to avoid cutting of the polyethylene sheet so that finished surface is not damaged.
9) Empty space in the box shall be filled with adequate cushioning material e.g. Thermocole Chips, Wood Wool etc. to avoid movement for shocks. Alternatively put wooden blocks/batons wherever necessary.
10) The inner side of the top cover shall be lined with polyethylene sheet, of at least
11) 100 micron thickness, which shall project approximately 25 to 150 mm depending upon the size of the case on all sides of the top cover shall be provided below the top cover. This projection, after nailing the top cover, shall be folded over, on the sides of the crates & tacked, to, prevent ingress of water from the top.
12) For specific requirement of packing the cases are to be provided with Tongue and Groove joints.

8 STEEL CONTAINERS

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies.

The containers are to be made of structural steel as per AA10108 with proper reinforcement with I, C and T Sections.

Following precautions are to be taken during packing:

– Put the Components/Assemblies/Equipment in the steel container properly. Cover the Components/Assemblies/Equipment with polythene.

– To arrest the movement in the steel container necessary wooden Blocks/Batons may be put.

– Put cover on steel, container and Bolt Properly.

9 SEALED PACKING

Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture.

The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.

10 SLING PLATE

Sling plate shall be provided to prevent damage to the packing box during lifting. Size of the sling plate shall be selected depending upon the net weight of the consignment.

11 PACKING SLIP HOLDERS

Two nos. steel packing slip holders, specification no. AA7240901 containing the packing list, sealed in thick polyethylene film, shall be fixed one inside and the other outside the packing box.

12 Volatile Corrosion Inhibitor (VCI) Paper

a) Un-protected surfaces of steel and cast iron components, tools bearing, shaft seals etc. are covered with VCI paper. VCI paper has been impregnated with corrosion inhibitors which by evaporation and chemical conversion protect metals in an enclosed area against corrosion.

b) 7 m^3 VCI paper is necessary for 1 m^3 of packed item approximately as per AA51406.

Application Limitation:

VCI paper shall not be used for components made of aluminium, aluminium alloys as well as Zinc, copper, brass, cadmium and silver.

VCI powder is sprinkled inside the piping components ends shall be protected with end cover as specified in plant standards, drawings.

13 Moisture Absorber

Silica gel is used for this purpose to protect the contents over sufficiently long time from corrosion. At the time of use, silica gel should be so dried that its colour becomes dark blue. These shall be filled in small cotton bags. Before sealing the equipment, the silica gel bags should be kept inside the polyethylene film cover at different locations. The quantity of silica gel should not be less than 1.0 kg per cubic metre volume of the packing box

14 GENERAL PRECAUTIONS

a) While fixing nails during packing, necessary care shall be taken to ensure that materials used for protection inside the case e.g. paper, polyethylene sheet, coir etc. do not get damaged.

b) Sling protection brackets to be provided on cases wherever required.

c) It shall be ensured that all stencil marks external, front & rear sides of the casing shall be of water proof Material to prevent obliteration in transit.

d) The various caution signs shall be marked with stencil on both sides of the packing box.

e) Do not pack any other Mechanical items with this case (do not use any other non-permitted packing materials).

THE FOLLOWING DETAILS ARE TO BE MARKED ON THE PACKING CASES.

a) Address of consignee.

b) Purchase Order No./ SO No/WO No.

c) Description of item or title of packing list.

d) Case identification Number/ Packing List No.

e) Net Weight.

f) Gross Weight.

g) Dimensions of box

h) Marking showing upright position.

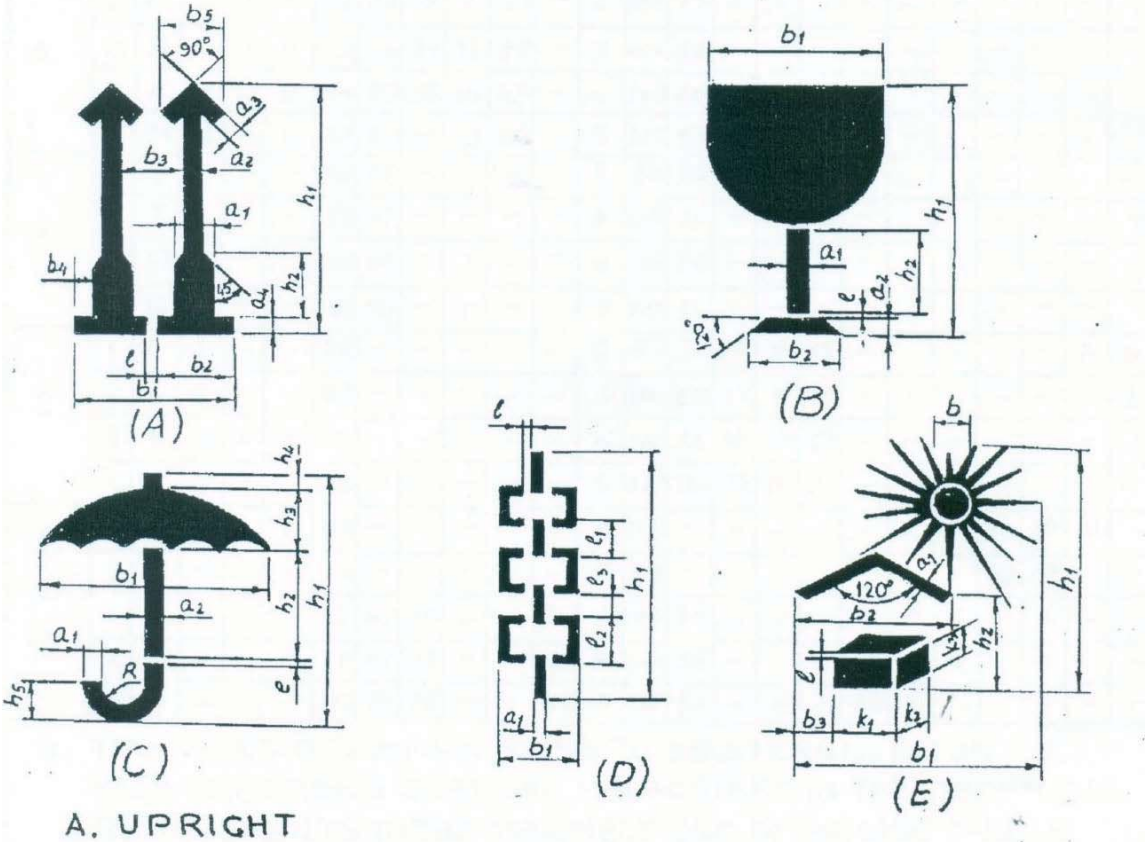
i) Marking showing sling position.

j) Marking showing umbrella (i.e. for machines/components to be stored under covered storage.

k) Loading and unloading precautions

MARKINGS ON PACKING CASES

1. THIS PLANT STANDARD PRESCRIBES THE VARIOUS CAUTION SIGNS AND OTHER MARKINGS ON PACKING CASES.
2. DIMENSIONS IN THE TABLE 1 SHALL BE USED FOR MAKING STENCILS ONLY.



A. UPRIGHT
B. FRAGILE
C. PROTECTION FROM FALLING OR CONDENSING MOISTURE.
D. SLINGING POSITION
E. PROTECTION FROM DIRECT RADIATIONS.

Figure 1

CENTER OF GRAVITY

Figure 2

Table 1

DESIGNATION		DIMENSIONS IN mm.																						
		a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4	b_5	b	l	h_1	h_2	h_3	h_4	h_5	K_1	K_2	K_3	l_1	l_2	l_3	R
A	1	12	5	5	4	52	25	19	8	21	–	2	84	23	–	–	–	–	–	–	–	–	–	–
	2	17	7	7	6	75	36	29	11	30	–	3	119	33	–	–	–	–	–	–	–	–	–	–
	3	24	10	10	8	104	50	38	16	42	–	4	168	46	–	–	–	–	–	–	–	–	–	–
	4	34	14	14	11	147	71	59	23	60	–	5	239	65	–	–	–	–	–	–	–	–	–	–
B	1	5	5	–	–	50	33	–	–	–	–	2	84	25	–	–	–	–	–	–	–	–	–	–
	2	7	7	–	–	71	47	–	–	–	–	3	119	36	–	–	–	–	–	–	–	–	–	–
	3	10	10	–	–	100	66	–	–	–	–	4	168	50	–	–	–	–	–	–	–	–	–	–
	4	14	14	–	–	142	94	–	–	–	–	5	239	71	–	–	–	–	–	–	–	–	–	–
C	1	4	3	–	–	66	–	–	–	–	–	2	80	39	19	5	11	–	–	–	–	–	–	6
	2	6	4	–	–	85	–	–	–	–	–	3	114	55	27	7	16	–	–	–	–	–	–	9
	3	8	6	–	–	120	–	–	–	–	–	4	160	78	38	10	22	–	–	–	–	–	–	12
	4	11	9	–	–	170	–	–	–	–	–	5	227	110	54	14	31	–	–	–	–	–	–	17
D	1	6	–	–	–	30	–	–	–	–	–	4	148	–	–	–	–	–	–	–	30	30	10	–
	2	9	–	–	–	42	–	–	–	–	–	5	209	–	–	–	–	–	–	–	42	42	14	–
E	1	3	–	–	–	69	47	10	–	–	16	2	91	26	–	–	–	17	8	11	–	–	–	–
	2	4	–	–	–	98	67	15	–	–	23	3	128	33	–	–	–	24	11	16	–	–	–	–
	3	6	–	–	–	138	94	20	–	–	32	4	182	62	–	–	–	34	16	22	–	–	–	–

Black and Red Marking Ink to IS: 1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink.

"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".

Besides the caution signs the product information shall be stencilled of letters with 13mm to 50mm height.

In case of consignment consists of more than one package, each package shall carry its Package No. as given in shipping list. All caution signs shall be stencilled in higher quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel (AA56126).

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks. Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: In case the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

15 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

15.1 Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.

15.2 Appropriate material handling equipment like fork lifters, cranes etc. Shall be used where needed.

15.3 Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. Shall be done carefully.

15.4 For critical items, where specified, special handling fixtures shall be used for lifting.

15.5 Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.

15.6 Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.

15.7 Precision machined components like blades, catches, rollers etc. Shall be lifted using suitable wooden pallets.

15.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH:

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

– The markings showing the upright position.

– The markings showing the sling position

– Markings showing the fragile contents.

– Other required markings as per Clause No. 12

15.8.1 Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15º.

15.8.2 Handling and lifting should be done without jerks or impacts.

15.8.3 Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.

15.8.4 On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.

15.8.5 Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.

15.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

16 GI SHEET

The packing cases are covered with GI sheet on outside for sides and top; inside for bottom as per the Figure-3 (GI sheet covering is applicable for all closed type of wooden packing).

17 Treatment of Wood & Application and use of the mark

For seaworthy export packing, treatment of wood has to be carried out as below subject to BHEL Engg & QC approval.

As per customer requirement for export packing, wood to be treated as applicable should be done as per International Standards for Phytosanitary Measures ISPM: 15 to control the growth stages viz. egg to adult of structural insects (beetles, borers, bugs, fleas, flies, lice, moths, roaches, termites) and other pests (mice, rats, spiders) etc. in stored products.

The specified marks applied to wood packaging material treated in accordance with ISPM 15 must conform to the requirements described in Annex 2 of ISPM 15.

17.1 Heat treatment using a conventional steam or dry kiln heat chamber (treatment code for the mark: HT)

When using conventional heat chamber technology, the fundamental requirement is to achieve a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including its core).

This temperature can be measured by inserting temperature sensors in the core of the wood. Alternatively, when using kiln-drying heat chambers or other heat treatment chambers, treatment schedules may be developed based on a series of test treatments during which the core temperature of the wood at various locations inside the heat chamber has been measured and correlated with chamber air temperature, taking into account the moisture content of the wood and other substantial parameters (such as species and thickness of the wood, air flow rate and humidity). The test series must demonstrate that a minimum temperature of 56 °C is maintained for a minimum duration of 30 continuous minutes throughout the entire profile of the wood.

Treatment schedules should be specified or approved by the National Plant Protection Organisation (NPPO). Treatment providers should be approved by the NPPO.

17.2 Heat treatment using dielectric heating (treatment code for the mark: DH)

Where dielectric heating is used (e.g. microwave), wood packaging material composed of wood not exceeding 20 cm when measured across the smallest dimension of the piece or the stack must be heated to achieve a minimum temperature of 60 °C for 1 continuous minute throughout the entire profile of the wood (including its surface). The prescribed temperature must be reached within 30 minutes from the start of the treatment.

Treatment schedules should be specified or approved by the NPPO.

17.3 Methyl bromide treatment (treatment code for the mark: MB)

Wood packaging material containing a piece of wood exceeding 20 cm in cross-section at its smallest dimension must not be treated with methyl bromide.

The fumigation of wood packaging material with methyl bromide must be in accordance with a schedule specified or approved by the NPPO (National Plant Protection Organisation) that achieves the minimum concentration-time product (CT) over 24 hours at the temperature and final residual concentration specified in Table 1. This CT must be achieved throughout the profile of the wood, including its core, although the concentrations would be measured in the ambient atmosphere. The minimum temperature of the wood and its surrounding atmosphere must not be less than 10 °C and the minimum exposure time must not be less than 24 hours. Monitoring of gas concentrations must be carried out at a minimum at 2, 4 and 24 hours from the beginning of the treatment. In the case of longer exposure times and weaker concentrations, additional measurement of the gas concentrations should be recorded at the end of fumigation.

If the CT is not achieved over 24 hours, corrective action needs to be taken to ensure the CT is reached; for example, the treatment is restarted or the treatment time extended for a maximum of 2 hours without adding more methyl bromide to achieve the required CT (see the footnote to Table 2).

Table 2 – Minimum CT over 24 hours for wood packaging material fumigated with methyl bromide

Temperature (°C)	CT (g·h/m^3) over 24 h	Minimum final concentration (g/m^3) after 24 h#
21.0 or above	650	24
16.0 – 20.9	800	28
10.0 – 15.9	900	32

In circumstances when the minimum final concentration is not achieved after 24 hours, a deviation in the concentration of ~5% is permitted provided additional treatment time is added to the end of the treatment to achieve the prescribed CT.

One example of a schedule that may be used for achieving the specified requirements is shown in Table 3.

Table 3 – Example of a treatment schedule that achieves the minimum required CT for wood packaging material treated with methyl bromide (initial doses may need to be higher in conditions of high sorption or leakage)

Temperature (°C)	Dosage (g/m^3)	Minimum concentration (g/m^3) at:		
		2 h	4 h	24 h
21.0 or above	48	36	31	24
16.0 – 20.9	56	42	36	28
10.0 – 15.9	64	48	42	32

Treatment providers should be approved by the NPPO.

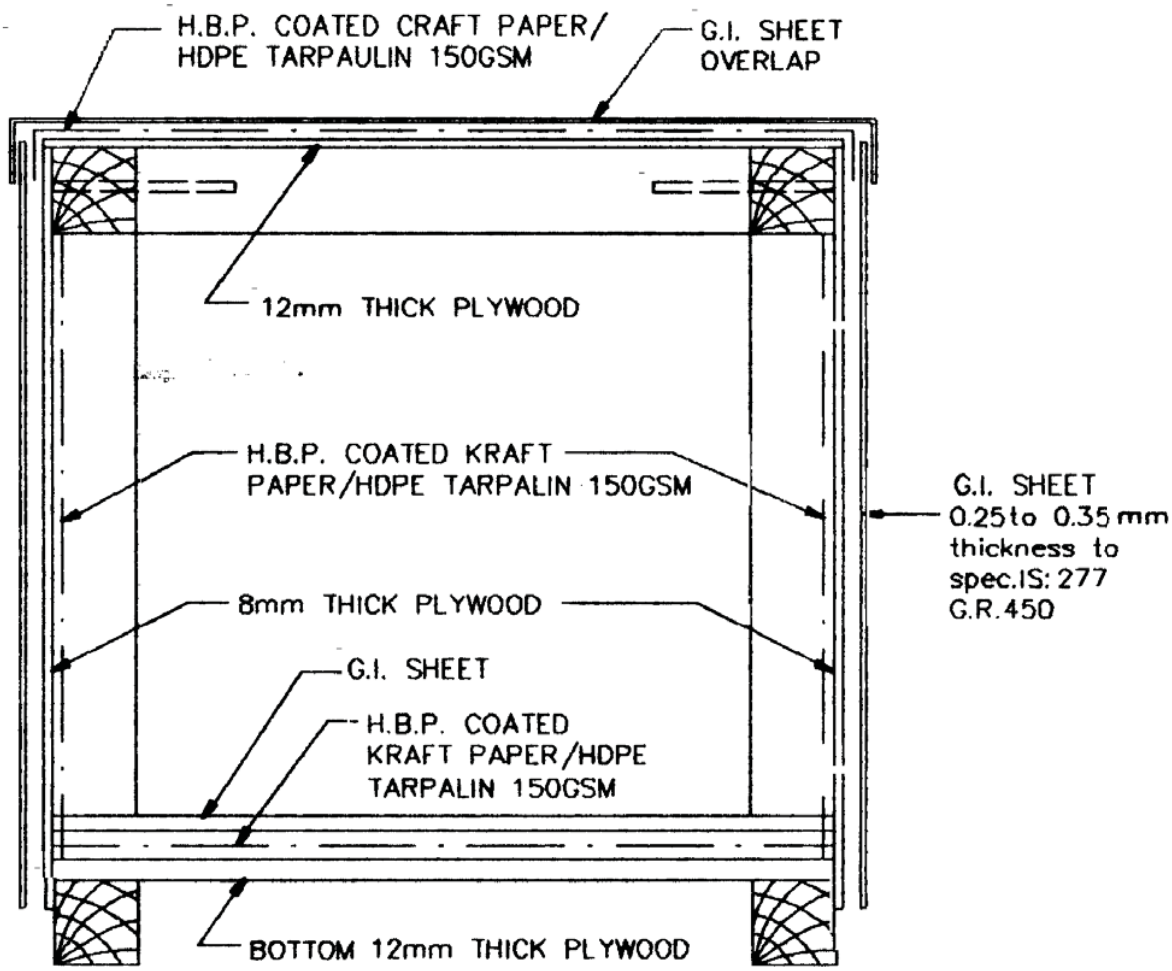
17.4 Marking

The specified marks applied to wood packaging material treated in accordance with ISPM 15 must conform to the requirements described in ISPM 15.

18 PROVISION FOR INSPECTION

This clause is applicable only where contractual requirement of customer is there. For other packings this is not applicable.

Each transportable packing's shall have provision for inspection by customer authority etc. during transport from origin of dispatched till destination. This inspection may require opening of the package and subsequently closing it again. For this purpose suitable designed opening with bolted cover shall be provided. Such an opening shall be clearly marked as "OPENING" with clear instruction for opening & closing written on this cover. For large consignment the size of the opening shall be suitable to facilitate entry of personnel.



CLOSED PACKING CASE WITH
G.I.SHEET SHOWING LAYERS
OF PACKING MATERIALS

Figure 3

ANNEXURE-VII

SHOP TEST PROCEDURE FOR GEAR BOXES & LOAD/ OVERLOAD TESTING OF EOT CRANE AT MANUFACTURER'S WORKS

A. SHOP TEST PROCEDURE FOR GEAR BOX (Procedure No. PEM (Q)/001)

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
5.1.0	1.1.1 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	1.1.2 General
6.1.0	1.1.3 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 ar 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. 1.1.4 Name plate should provide information eg. Ratio, KW rating, Bearing details and

	manufacturers name.

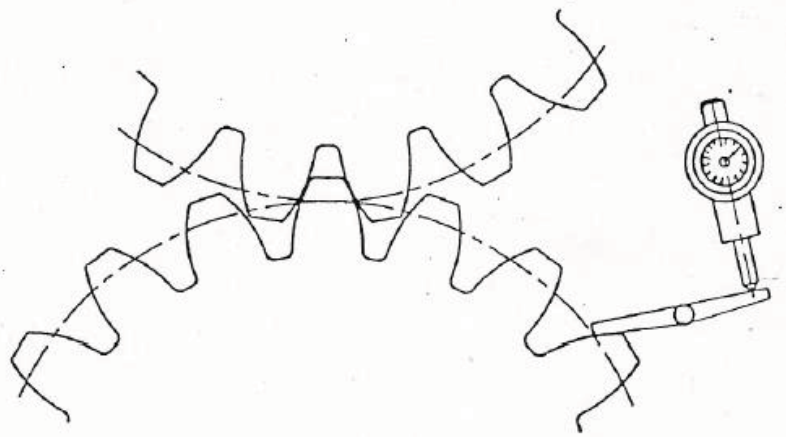


FIG.1 MEASUREMENT OF BACKLASH

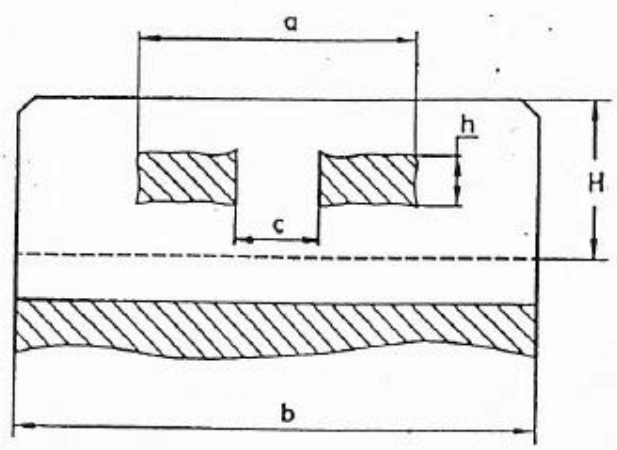


FIG.2 AREA OF CONTACT OF GEAR TEETH

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

B. Procedure for Load & Overload testing of Double Girder EOT Cranes at Manufacturer's Works

Objective: To demonstrate final NO load, Load, Overload, Deflection & Functional tests of assembled crane/s for the purpose of acceptance.

Basic Assumptions / Inputs for testing at Works:

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

Procedure for Load / Overload testing:

The cranes shall be tested for no load, load test & overload test at works generally in conformance with the IS – 3177 (latest edition). 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.
- Overload relays will be checked for proper functioning.

Hoisting & Cross Travel motions:

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.

Note: Complete No load, load & over load tests in line with IS-3177 (latest edition) shall also be done after erection of EOT crane at site.

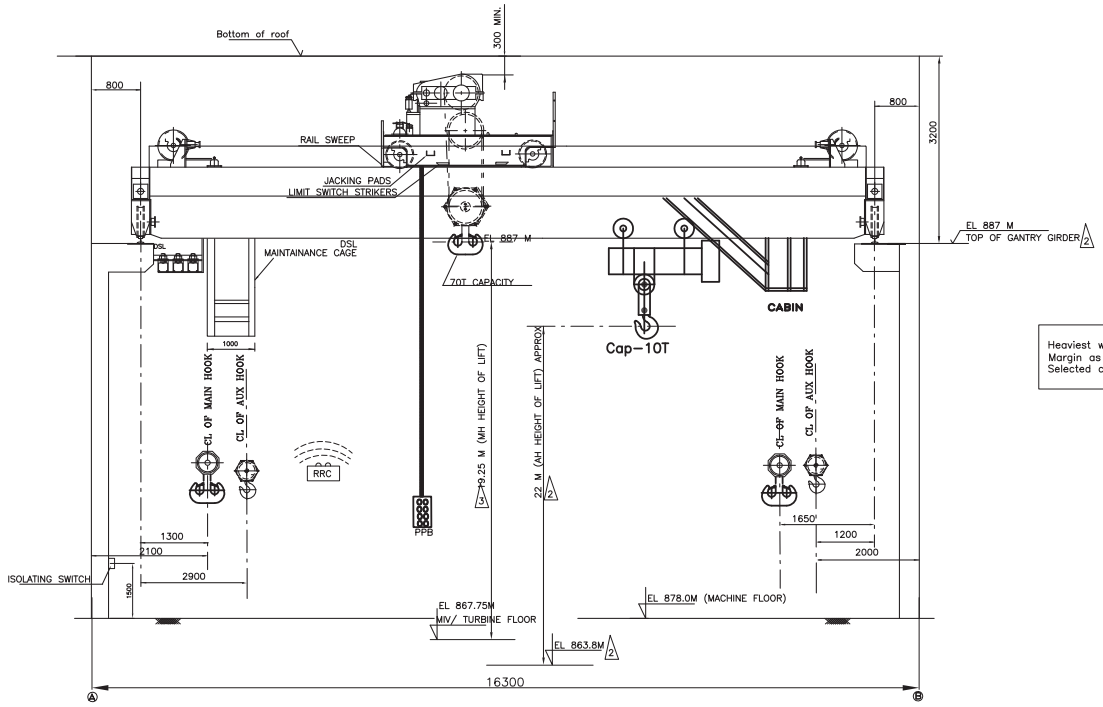
ANNEXURE-VIII
INPUT DRAWING

ALL DIMENSIONS ARE IN MM

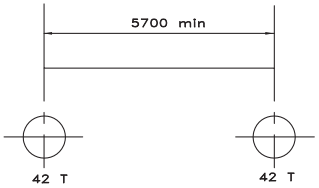
FIRST ANGLE PROJECTION

DRAWING NO. PE-DG-479-501-A001

CUSTOMER'S DRAWING NO.

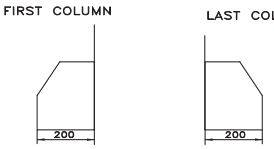


VIEW–XX



LT WHEEL LOAD DIAGRAM (WITHOUT IMPACT).

Heaviest weight to be handled= 62T
Margin as per contract specification= 10%
Selected crane capacity= 70/10T



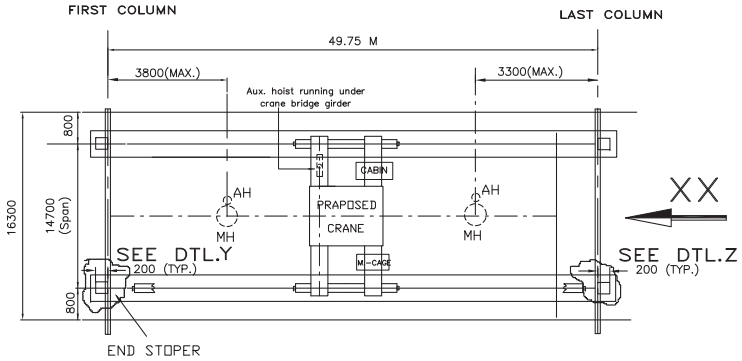
DETAIL 'Y' DETAIL 'Z'

NOTES

1) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
2) SPAN , LIFT , HOOK APPROACHES & BAYLENGTH ARE SUBJECT TO CHANGE AS PER CHANGE IN FINAL CIVIL STRUCTURE.

REFERENCE DRAWINGS

1) BHEL DRG. NO. 12000020851 Rev 2 (CROSS SECTION OF POWER HOUSE)
2) BHEL DRG. NO. 12000020854 Rev 2 (STATION LAYOUT PLAN AT EL 878.00M)



KEY PLAN

RAGHUGANGA HYDROPOWER LIMITED

CONSULTANT: WAPCOS LIMITED (A GOVT. OF INDIA UNDERTAKING)

PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)

BIDDER: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA

CODE		NAME	DESIGN	DATE
M	DRN		Sd/-	
	DESN		Sd/-	
	CHD		Sd/-	
	APPD		Sd/-	

TITLE: CRANE CLEARANCE DIAGRAM OF 70/10T EOT CRANE FOR POWER HOUSE

DEPT. | SCALE | DRAWING NO. PE-DG-479-501-A001
SIGN | SHEET 1 OF 1 | REV. 3
DATE

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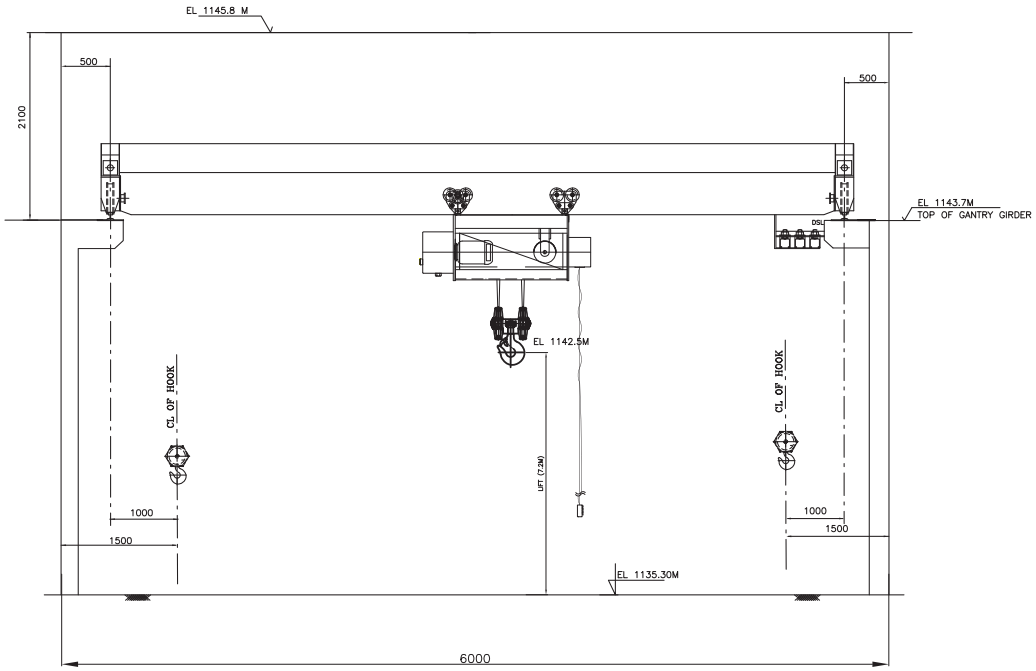
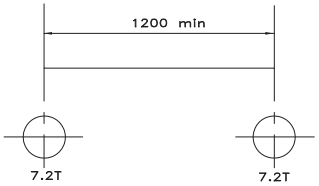
COMPUTER FILE NAME : TAL5

ALL DIMENSIONS ARE IN MM

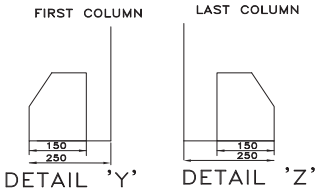
FIRST ANGLE PROJECTION

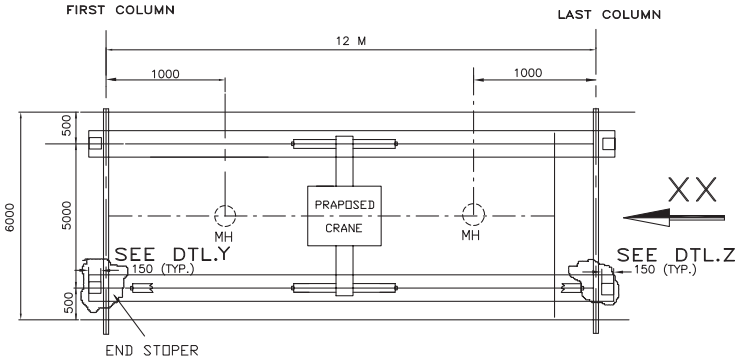


VIEW–XX



LT WHEEL LOAD DIAGRAM (WITHOUT IMPACT).





NOTE: End stoppers to be placed 100mm offset towards outside from centre line of first and last column.

KEY PLAN

NOTES

1) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.

2) SPAN , LIFT , HOOK APPROACHES & BAYLENGTH ARE SUBJECT TO CHANGE AS PER CHANGE IN FINAL CIVIL STRUCTURE.

REFERENCE DRAWINGS:

1) DRG. NO. RGHEP/T/EM/2016/005

	RAGHUGANGA HYDROPOWER LIMITED
CONSULTANT	WAPCOS LIMITED (A GOVT. OF INDIA UNDERTAKING)
PROJECT	RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)
BIDDER	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
TITLE	CRANE CLEARANCE DIAGRAM OF 15T EOT CRANE FOR VALVE HOUSE
DRAWING NO.	PE-DG-479-501-A002
REV.	1

CODE: M

	NAME	SIGN	DATE
DRN		Sd/-	
DESN		Sd/-	
CHD		Sd/-	
APPD		Sd/-	

DEPT. SCALE SIGN DATE

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COMPUTER FILE NAME : TAL5

DRAWING No.

CUSTOMER'S DRAWING No.

SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

SUB-SECTION IB **SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)**

BHEL	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR EOT CRANE RAHUGHAT HYDRO ELECTRIC PROJECT (2X20 MW), MYAGDI, NEPAL	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION : C
		REV NO. : 00 DATE : 15.12.2020
		SHEET : 1 OF 1

1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
d) Electrical load requirement for EOT Crane.
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
h) Motor shall meet minimum requirement of motor specification.
i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) Cable BOQ worked out based on routing of cable listing provided by the vendor for " both end equipment in vendor's scope"shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc. is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures:

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Datasheets & quality plan for motors.
c) Electrical Load data format (Annexure –II)
d) Sub vendor list for motors (Annexure-III)
e) Technical specification for motors
f) Technical specification for cable and cable trays

REV: 0 DATE: 15.12.2020

ANNEXURE – I

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: EOT CRANES
SCOPE OF VENDOR: SUPPLY
PROJECT : 2 X 20 MW RAHUGHAT HYDRO ELECTRIC PROJECT, NEPAL

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

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

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

NOTES:

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

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

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

Legends for Inspection agency

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

P. PERFORM
W. WITNESS
V. VERIFY

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

TITLE	SPECIFICATION NO.
LV MOTORS	VOLUME II B
DATA SHEET-A	SECTION D
	REV NO. 00 DATE 5.9.2017
	SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	≤200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP54 / IP55
5.0	Cooling	:	TEFC / TETV / CACA
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: -5% to +3%) and
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	During Detail Engineering
	e) Short time rating for terminal box	:	During Detail Engineering
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B
8.0	Minimum voltage for starting	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply **(20KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
12.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
13.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
14.0	Additional tests	:	As per QP
15.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
	c) Degree of protection	:	IP65
16.0	Makes	:	AS PER SUB VENDOR LIST
17.0	Terminal box	:	Suitable to rotate at 90 degrees
18.0	Paint shade	:	Shall be given during Detailed engg.
19.0	Efficiency class	:	As per IS 12615 : 2011

Also detailed Customer spec. for Motors is to be referred as enclosed with technical spec.

TITLE	SPECIFICATION NO.
LV MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE SHEET 1 OF 2

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

NAME OF VENDOR					
			SEAL	REV.	
NAME	SIGNATURE	DATE			

TITLE	SPECIFICATION NO.
LV MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE SHEET 2 OF 2

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

NAME OF VENDOR					
			SEAL	REV.	
NAME	SIGNATURE	DATE			

22. ELECTRIC MOTORS

For all electric power drives, three-phase, squirrel-cage type induction motors complying fully with IEC recommendations shall be used. All motors shall be of the totally enclosed, externally cooled (fan cooled) type IP44. Winding insulation shall be Class F throughout.

Starting shall be direct-on-line with starting currents not exceeding 6 times the rated current. However, for motors being large in relation to the feeding transformer, suitable automatic change-over starters shall be provided

All motors shall be so designed that start-up can be effected successfully at 85% of the rated voltage of the motor. The motors shall be designed to operate continuously without over-heating at 400 V ±10%.

Special attention shall be paid when designing the electric motors on account of the temporary frequency rises, which may arise in the motor feeding voltage during full load shedding of the turbines. The motors shall, therefore, be tested for over speeds of not less than 40% of their rated speed.

LOT 2
ELECTRO - MECHANICAL WORKS

VOLUME 3
EMPLOYER'S REQUIREMENT

SECTION 3.5
PARTICULAR TECHNICAL SPECIFICATIONS

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9.0 CABLES, CABLE RACKS, CABLE TRAYS & ACCESSORIES

9.1 INTRODUCTION

9.1.1 General

This chapter covers the design, manufacture, factory test, supply, delivery, installation, field-testing and commissioning of all Power, Communication, Control, Instrumentation Cables, cable termination/sealing ends, necessary racks, cable trays and accessories required for the entire project. Specific cables as asked for in other chapters of the specifications also need to be designed/ supplied/ suitably included except where specifically asked for cables in various other Chapters of these Specifications. In general cables asked for in this and other chapters shall meet the total requirement of all works related to cables for the entire project.

The Tenderer shall submit with his Tender the type-test reports, necessary technical brochures, design calculations and drawings for the cables and trays, to verify compliance with the Specification.

Manufacturer of cables shall hold valid ISO 9001quality certificate.

9.1.2 Reference with Other Chapter

The supply of cable sealing ends or terminations shall be coordinated with the supply of generator, transformers, medium voltage and low voltage switchgears to ensure proper connections at all terminals.

Cables for illumination are covered in Illumination Chapter. However, the cables required for small power installations shall be covered under this chapter.

9.1.3 Scope of Work

The scope of work shall include detailed engineering, manufacture, factory test, supply, delivery, installation, field-testing and commissioning of all Power, Control, Instrumentation and Communication cables, cable termination/sealing ends, necessary cable trays and accessories with insurance up to DLP of 2 years after commissioning, required for the project.

Power cables for the 11kV and low-tension circuits shall be of single or multi-core copper, cross-linked polyethylene (XLPE) insulated PVC sheathed type with suitable cable ends. 11kV cables shall have metal shield or have semi-conducting tape and tinned copper wire shielded as specified and as per specific requirements at various locations.

The following cables/ terminations & sealing end/ accessories/ cable racks/ cable trays etc.

shall be furnished in accordance with Specifications:

a) The following power cables shall be used for each circuit at power station.

Cable	Circuit
11kV, single-core,1000sq.mm	11kV main circuit from the 11kV generator circuit cubicle to the 26 MVA Generator Step up transformer and shall be used in duplicate for each phase for the two generators. (Refer drg. no. RGHEP/EM/017)
11kV, three-core, 95sq.mm	11kV cable from the 11kV generator circuit cubicle to each of the two 500 kVA,11kV/400 V station service transformers (refer drg. No. RGHEP/EM/017 & RGHEP/EM/018)
11kV, three-core, 240sq.mm	11kV cable from the 11kV generator circuit cubicle to bushing on primary side of 1000 kVA,11kV/11kV Isolation transformer. Further, the same size of cable provided from bushing on secondary side of the transformer to 11 kV Local supply cubicle (LSC)- refer drg. No. RGHEP/EM/017 & RGHEP/EM/018
11kV, three-core, 95sq.mm	11kV cables from LSC in Auxiliary bay to the terminal poles in switchyard for connection to 11kV distribution line to headworks and for termination on another 11 kV line (that shall pass through switchyard to camp - under construction by Employer).
1100V, single-core, 500sq.mm	LT cable from each of the two 500kVA 11/0.4 kV station service transformers (to be used in duplicate for each phase) to the low-tension switchgear board in the powerhouse. (Refer drg. No. RGHEP/EM/017 & RGHEP/EM/018).
1100V, three-core, 70sq.mm	LT cable from 100 kVA, 11/0.4 kV pole-mounted transformer to the main distribution board in headworks control room.

1100V, three-core, 70sq.mm	LT cable from 100 kVA, 11/0.4 kV pole-mounted transformer to the main distribution board in valve chamber.
1100V, single-core, 300sq.mm	LT cable from 400 kVA DG control panel to low tension switchgear board in auxiliary bay of powerhouse (to be used in duplicate for each phase Refer drg. No. RGHEP/EM/018)
1100V, single-core, 70sq.mm	LT cable from 100 kVA DG to low tension switchgear board in headworks control building.

All AC power cables of requisite rating for 400 V circuit from LT switchgear in the power house to No. 1 Unit MCC, No.2 Unit MCC, Common MCC & Power Distribution Boards.

All AC Power cables of requisite rating to different loads fed by No.1 Unit MCC, No.2 Unit MCC & Common MCC.

All AC power cables to different loads of requisite rating fed by AC panels 1 & 2.

All requisite size AC power cable and rating from main distribution board to sub distribution boards at headworks and valve chamber shall be supplied and installed.

All DC power & control cables of requisite rating to different loads fed by 110V DC panel including cables connection to 110 V sub DCDBs & Loads fed.

All DC power cables between Battery chargers No. 1 & 2 to 110 V DC panel and from 110 V DC Batteries.

110V DC cables from 110V DC panel to each of the two 110V/48V DC to DC converter

DC power cables connections between 110V/48 V DC to DC converter to DC panels.

All DC power cables to different loads fed by 48 DC Panel.

a) Control and instrumentation cables
b) Communication cables
c) Cable terminations etc. for 110V as well as 48 V DC cables
d) All cable racks/cable trays and other supports for cable and bus-bars distribution

Other cable including (accessories, material etc.) not specifically included above, but essential and generally provided for this size & type of plant shall deem to be included in scope of supply.

The sizes of various cables indicated above are tentative. The Contractor shall review the same and shall be responsible for estimating the requirement (in regard to size and/or provision for multi-run cables in parallel) and accordingly supply the requisite quantity of various types and sizes of the cables including sealing ends/terminations, cable racks, cable trays etc., as per relevant IECs. During detailed design stage if it is found that types or quantities of cables of increased cross-section or multi run parallel cables than those indicated above are required the same shall require to be supplied without any additional cost to the employer. The prices of such items shall deem to be included in the prices of the respective materials (in the Price Schedule).

9.2 DESIGN REQUIREMENTS

9.2.1 11 kV Power Cables

a) General

The rated voltage of the power cables shall be 12 kV for 11 kV circuits.

The power cable shall be cross-linked polyethylene insulated (XLPE), screened and steel tape armoured.

The scope shall include the supply, laying, termination and testing of 11 kV power cables between various cubicle/equipment as detailed under clause 9.1.3 of this chapter. The cables shall be supplied with necessary terminations/sealing ends/accessories for the both connecting ends of each and every cable.

b) Conductor

Conductor for power cable shall consist of stranded annealed copper wires. They shall comply with IEC Publication.

c) Cable Rating

The current rating for the cable and conditions of installation shall be adequate for size of the equipment (GSU transformers, station service transformers, Isolation transformer, transformers at headworks/valve chamber, and feeders).

The rating of cables shall not be less than fault current for 1 sec. Single core / three core cables depend upon the cable size and condition of installation also.

The 11 kV power cables shall be rated as follows :

		11kV
(a)	Rated voltage, phase to phase (Uo)	11 kV
(b)	Highest voltage of three-phase system (Um)	12 kV

(c)	Rated lightning impulse withstand voltage	28 kV
(d)	Rated power-frequency short duration withstand voltage for one minute	75 kV

The maximum temperature for the power cables shall be less than the following values:

		Continuous Rating	Short-Time Rating	Short-Circuit Rating
(a)	Conductor	65°C	90°C	250°C
(b)	Sheath	-	-	250°C

d) Anti-Termite Covering

Anti-termite protection applied to the cables and shall be black PVC suitable for the operating temperature of cables and shall meet the requirements of IEC standard.

e) Outer Covering

The outer covering of the cable shall be extruded, continuous black PVC suitable for the operating temperature of cable and shall meet the requirements of IEC standard.

f) Cable Drum

Cable drum shall be non- returnable and made of steel suitably protected against corrosion.

g) Jointing Accessories

Cables shall be installed in single lengths and straight-through jointing shall not be permitted.

h) Voltage Identification

The plastic covering shall be embossed with the name of the manufacturer, voltage class, number, material and size of conductors, the cross sections, type of insulation followed by:

Electric cable - (Corresponding) volts

i) Phase Identification

Phase identification for either triplex or multi-core conductor cable shall be in accordance with the following:

Phase A (R) : Red
Phase B (Y) : Yellow

Phase C (B) : Blue

j) Installation requirements

12 kV cable shall be laid in the cable duct/cable trench/cable tray/ladder.

At the opening in the civil structures from where the power cables are passing through in the open, suitable sealing means like lean concreting shall be provided by the Contractor to keep out ingress of water in the powerhouse etc. from outside.

The method of cable laying shall be designed by the Contractor to ensure highest security and reliability during and after the installation. The cable installation shall be carried out by the Contractor in accordance with the procedures approved.

k) Cable termination/Sealing ends

11 kV cable terminations shall be of the heat-shrinkable type / pre-moulded push-on type. Requisite terminations for 11 kV cables detailed in clause 9.1.3 shall be provided for facilitating connections with generator circuit cubicle, transformers, switchgears, feeders etc. in the powerhouse/switchyard etc.

The cost of all necessary termination/sealing ends shall be included in the price of the cables.

9.2.2 1100 Volt Power Cable

a) General

The low voltage cables shall be 1100 V grade polyethylene (PE) insulated and PVC sheathed. Low voltage AC power systems shall have solidly grounded neutral with phase-to-phase voltage level of 400 V and phase to neutral voltage of 230V for AC system and 110V & 48V for the DC systems. The size of the single core conductor cable shall not be less than 2.5 sq. mm for lighting circuits and 4 sq. mm for power circuits.

b) Conductor

Conductor shall consist of stranded annealed copper wires. They shall comply with relevant IEC Standards. The cable is intended for use at normal conductor operating temperatures not exceeding 70 degree C.

c) Insulation

The electrically and thermally stable polyethylene insulation shall be extruded onto the conductor so as to prevent contamination and voids, if any, shall be between insulation and conductor.

d) Current Rating

The Contractor shall state the maximum continuous current rating and conditions of installation for low voltage power cables.

e) Jacket

The cable core assembly shall be covered with a flame-retardant and moisture resistant PVC jacket, which is free stripping from the insulation. The overall jacket shall be clean, dry, and free grease and shall be suitable for paint application.

f) Anti-termite protection shall be applied to the cable and shall consist of either a non-magnetic metallic barrier or layer of nylon sheathing.

g) Identification

1) Each cable shall have a printed legend on the overall jacket with the manufacturer's name, voltage class, the number, material and size of conductors, type of insulation and a unique number or code indicating the production run or batch.

2) The colors for core identification and colour sequence shall be in accordance with follows :

- Single-core : Black
- Twin : Red and black
- Three-core : Red, yellow and blue
- Four-core : Red, yellow, blue and black

9.2.3 Control and Instrumentation Cables

a) General

All control and instrumentation cable shall be 650/1100 V grade multi-conductor, colour-coded, PVC insulated armoured cable as per IEC/IS standard. Each multicore cable shall have not less than 20 percent 2 spare cores, whichever is the greater.

b) Conductor

Copper conductor shall be of stranded circular non-compacted cross-section. The sectional area of the core conductor shall not be less than 2.5 sq.mm and shall conform to the following requirements:

Current transformer secondary circuits :

The total burden of instruments and relays connected plus that of cable shall be less than the rated burden of respective current transformer. The Contractor shall calculate the load of CT core considering all connected loads and submit to the employer for approval. In case of CT burden constrain, CT circuit cable cross sectional area shall be increased. In this case the Contractor shall supply and install the cable of required cross-section area without any additional cost to the Employer.

Potential transformer secondary circuits :

Allowable voltage drop in the cables under the total burden of instruments and relays connected shall be less than two (2) percent.

AC and DC circuits :

Allowable voltage drop in the cable shall be less than 10 volts.

1100V, PVC insulated wires shall be used for power and heater circuits for auxiliary equipment.

The minimum size shall be 4.0 sq.mm PE insulated wires connecting the low-tension cubicle to the motor control centres, AC panels, DC panels, crane trolley, etc. shall have sectional area of at least 35sq.mm.

c) Insulation

The electrically and thermally stable PE insulation shall be extruded onto the conductor so as to prevent contamination and voids, if any, shall be between insulation and conductor.

Assembly

1) Single core and multicore conductor cables shall be assembled in accordance with applicable IEC standards.

2) A flame-retardant binder tape may be used underneath the overall jacket of multi-conductor cables, if required, to achieve the desired flame retardative characteristics. Tapes, if used, shall be non-hygroscopic.

e) Jacket

1) The cable core assembly shall be covered with a flame retardant and resistant jacket.

2) The overall jacket shall be clean, dry, and free from grease and shall be suitable for paint application.

3) Cable jacketing shall be free from water. Evidence of water shall be the ground for rejection of the cable.

f) Anti- Termite Covering

Anti-termite protection shall be applied to the cable and shall consist of either a non-magnetic metallic barrier or layer of nylon sheathing.

g) Identification

Each cable shall have a printed legend on the overall jacket, with the manufacturer's name, voltage class, the number, material and size of conductors, type of insulation and a unique number or code indicating the production run or batch. The identification shall remain legible for the life of the cable.

9.2.4 Communication Cables

a) All cables and wiring shall have copper conductors and FRLS PVC insulation and shall comply with IEC standards.

b) Each communication cable shall have not less than 20 percent or 4 spare twisted pairs whichever is the greater. Cabling and wiring installations shall be arranged to minimize the risk of fire and damages, which might be caused in the event of fire.

c) For telephone type cables, 2 conductor wires of not less than 0.6 mm dia shall be used. Where twin or quad make up is required in any cable, the cores shall be uniformly twisted and the lays arranged such that cross talk is reduced to a minimum.

d) No conductor smaller than 32/0.2mm (1 mm^2), or having less than three strands, shall be used for interconnecting the cables except in the case of telephone extensions. All cables shall have insulation, which will withstand the highest temperature to be experienced in service.

e) Each conductor of a multicore cable shall be readily identified by a numbered tape or, in the case of telephone type cables, color-coded insulation.

9.2.5 Cable trays

a) The Contractor shall design, supply and install cable trays as required within the powerhouse, including associated fittings, accessories, supporting racks and brackets and all hardware. The cable tray system layout shall be submitted by the contractor in accordance with the Nepal Regulations, the IEE Regulations and / or North-American National codes (CSA Standard C22.1 or NEC ANSI/NFPA-71981). Cable trays in the cable trenches between the powerhouse and switchyard (11 kV cables to GSU transformers, 11 kV LSC to 11 kV terminal poles in switchyard and between various bays of switchyard are to be covered by metallic cover. Cable trays at other locations of powerhouse are also included in scope of supply.

Cable trenches in switchyard, other areas of the project (and powerhouse, if any) shall be constructed by Lot 1 Contractor as per requirements of Lot 2 Contractor. However, all supports (angles, embedded plates, bolts etc. for supporting cable trays) shall be supplied by Lot 2 Contractor.

b) The cable tray shall be designed and manufactured in accordance with the NEMA Standard publication No. VE1-1979. The tray shall be still hot-dip galvanized after fabrication in accordance with the ASTM A386.

c) The trays shall be:

- Ladder type, NEMA class 8A, 600 mm wide, 76 mm deep (inside measurement), rung spacing 300mm.

- Ventilated type, NEMA class 8A, 600mm wide, 76 mm deep (inside measurement).

d) All ladder tray fitting shall be ladder type tray fitting. All ventilated tray fittings shall be ventilated or solid tray type.

e) All ladder and ventilated tray bends, tees and crosses shall have a 600mm inner radius.

f) Cable tray supports shall be of heavy duty reinforced type, hot-dip galvanized steel, suitably sized in accordance the tray system, cables and live loads normally experienced during cable installation. The maximum deflection between two consecutive supports shall not exceed 7.5 mm for ladder type trays and 4.0 mm for ventilated type trays. The Contractor shall design to supports to walls and ceilings, and shall submit them for approval of the Engineer.

g) The contractor shall supply and install galvanized steel cable tray covers, where cables are liable to mechanical damage in various sections including vertical cable tray runs. Design of such cable tray covers with details of locations for its use shall be submitted to the Engineer for approval.

h) Prefabricated galvanized steel barriers shall be supplied and installed if deemed necessary and only with prior written approval of the Engineer.

i) Power cables shall be fastened to the trays to ensure equal spacing and a neat workman like appearance with nylon self locking ties in accordance with Table B-2M of the IEE regulations. Where single conductor cables are installed to form a three –phase feeder, they shall be made for power cables, LV cables, control and instrumentation cables by providing cable tray in tiers.

j) Special care shall be taken to adequately support cables on all vertical cable runs using cable clamps of approved design.

k) In outdoor areas the supply of complete cable trays with cover, of approved design and materials, shall be included and erected as necessary to protect the cables against the effect of sun/ weather/ rain and mechanical damage etc.

9.3 SPECIAL REQUIREMENTS

Small cut piece lengths of cables will not be accepted. Cables up to 500 meters in length or as approved by Employer shall be of one length shipped in a drum of adequate size. For higher quantities, multiple lengths/drums may be shipped subject to the approval of Engineer.

The routing of cables should be such as to limit interference to a minimum. Any auxiliary supplies necessary to power solid-state circuits shall be derived from the main station battery and not from batteries internal to the protection.

All construction materials such as conduit pipes, PVC pipe, steel angle, steel channel, steel plates, cable supporting brackets and racks, wooden cleats, bolts, nuts and other items required for completeness sake shall be provided without extra charge and shall comply with the highest grade specified in the relevant standards.

Steel conduit pipe or PVC pipe shall be provided in the places where control cables or insulated wires will be exposed in the powerhouse/switchyard/other locations.

Steel plates shall also be supplied to cover the block-out or extra space left where conduit pipes or cables shall run through.

The cables in cable trench between outdoor switchyard and powerhouse and as well as other areas of powerhouse/switchyard/other locations are supported by hot dip galvanized steel cable tray.

[illegible]e cable tray support shall not exceed 2 meter interval and the vertical spacing shall be [illegible]mm measured from the bottom of the upper tray to the top of the lower tray. A

minimum of 230mm clearance shall be maintained between the top of a tray and beams, piping, etc. to facilitate installation of cables in the tray.

The cable trays for cables of different voltage levels shall be stacked in descending order which the higher voltage at the top.

11kV power cables should be installed in cable trays separate from low voltage power and control cables and signal /communication cables.

Analog signal cables should be run separate from all power and control cables, and from unshielded cables carrying digital or pulse type signals.

9.4 DRAWINGS, DATA & MANUALS

The following information shall be furnished along with the bid.

a) Manufacturer's leaflets giving constructional details, dimensions and characteristics of different cables.

b) Current rating of various cables including de-rating factor due to grouping, ambient temperature and type of various installation.

9.5 SPARE PARTS

9.5.1 Mandatory Spare Parts

The Tenderer shall supply but not limited to each type of following cables with terminations etc.:

- 10% of power cables
- 10% of control & instrumentation cables
- 10% of communication cables

9.5.2 Recommended Spare Parts

The Tenders are required to provide the itemised price list under the respective price schedule for the recommended spare parts recommended by him for five (5) years operation of the plant after commissioning.

9.5.3 TOOLS AND MAINTENANCE DEVICES

All tools, devices, equipment and testing instruments etc. for proper handling, maintenance, assembly, and dis-assembly of any part of the cables shall be supplied. List of tools/ devices etc. shall be included in the technical bid.

Itemised price of such tools/devices shall deem to be included in the relevant price schedule.

9.6 TESTS

9.6.1 Routine and Type/Design Tests

Routine Tests

The cables shall have passed the following routine tests and any other relevant routine tests for power, control and communication cables at the manufacturer's works. Routine test certificates shall be provided for the cables for approval of the Employer/Engineer before shipment.

- Construction inspection
- Measurement of electrical resistance as per clause 14.2 (IEC 502)
- Partial discharge tests
- High voltage tests
- Insulation resistance tests
- Physical and aging tests for insulation and jackets.

Type Tests

The cables, related equipment and materials shall be type tested standard products of competent manufacturers. Type test certificates shall be submitted to Employer/Engineer.

Workshop tests shall be carried out in compliance with the certified QC plan and the relevant IEC Standards.

Type tests (both electrical and non-electrical) after installation as per IEC 502, Section 3 article 16, 17 and 18; including the below noted tests; shall be carried out to prove the general qualities and design of a given type of cable and for the purpose of acceptance of the lot:

a) Partial discharge test
b) Bending test, followed by a partial discharge test
c) Tan delta measurement
d) Heating cycle test, followed by a partial discharge test
e) Impulse test, followed by voltage test for 4 hours.

Special Tests

The cable shall be subjected to the following special tests as per clause 15 of IEC and test certificates shall be provided.

- Conductor examination
- Check of dimension

- Electrical tests
- Hot set tests

The Bidder shall submit copy of type test reports from recognized testing laboratory for the offered power cables along with the bid.

9.6.2 Field Tests

Field/site tests shall be carried out in compliance with the approved QC plan and the IEC Standards. The following tests are the minimum requirement as applicable.

a) Measurement of insulation resistance
b) DC di-electric test
c) Inspection of the completed cable systems;
d) Continuity tests;
e) Voltage test on outer sheath;
f) High voltage withstand test.

9.7 PERFORMANCE GUARANTEE

The performance figures quoted on schedule of Technical Data shall be guaranteed within the tolerance permitted by relevant standards and shall become part of the Contract. In case of failure of the cables to meet the guarantees, the Employer reserves the right to reject the item. The Contractor shall have to rectify/replace the defect/defective part after approval from Employer at no extra cost to the Employer during defect liability period.

SUB-VENDOR LIST FOR LT MOTORS

SL NO.	VENDOR NAME	
1	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003
2	BHARAT BIJLEE LTD.	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.
3	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA
4	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032
5	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055
6	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA
7	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006
8	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW DELHI-110 045
9	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053
10	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA

SUB-VENDOR LIST FOR GLANDS

1	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA
2	ARUP ENGG & FOUNDARY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068
3	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018
4	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063
5	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
6	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059
7	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001

SUB-VENDOR LIST FOR LUGS

212851/2021/PS-PEM-MAX

1	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
2	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001

ANNEXURE-A

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

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

LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	2x20 MW RAHUGHAT	NAME		DATA FILLED UP ON	
	SYSTEM	EOT CRANE	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

SUB SECTION-IC

DATA SHEET-A

TABLE -1

S.N.	AREA / EQUIPMENT DESCRIPTION	Type	QTY (nos.)	CAPACITY (T)	LIFT (M)	SPAN (M)	TRAVEL (M)	Remark
1	Power house	DOUBLE GIRDER EOT	1	70T	22	14.7	49.75	One (1) no. EH of capacity 10T envisaged below one of the crane girder shall be in the scope of bidder's supply
2	Valve house	SINGLE GIRDER EOT	1	15T	7.2	5	12	

Description	POWER HOUSE CRANE	VALVE CHAMBER CRANE
Capacity	70T	15T
Type	Double girder EOT crane	Single girder EOT crane
Number of crane/s	1 no.	1 no.
Main hoist capacity (SWL/ OVERLOAD at 125%)	70 T / 87.5 T	15 T / 18.75 T
Aux. hoist capacity (SWL/ OVERLOAD at 125%) (Electric hoist under crane girder)	10T / 12.5 T	NA
Crane span	Refer crane clearance diagram attached	
Crane travel	Refer crane clearance diagram attached	
Hook approaches	Refer crane clearance diagram attached	
Lift	Refer crane clearance diagram attached	
Main hoist speed	1.0 m/min	1.0 m/min
Aux. hoist speed (Electric hoist under crane girder)	1.0 m/min	NA
Trolley travelling speed	5.0 m/min	5.0 m/min
Crane/EH travelling speed	15.0 m/min	15.0 m/min
Creep speed	10% of main speed (through VFD) for all motions	

*** Information's are to be furnished by bidder during detail engineering stage only.**

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A) TECHNICAL DATA SHEET FOR POWER HOUSE CRANE AND VALVE HOUSE CRANE

S.N.	Description	Technical Particulars			
1.0	Design, fabrication and testing of the crane confirm to standard / code number	IS: 3177 & IS 807 (latest edition)			
2.0	Crane classification	M3 (Mechanical, Electrical and Structural) (Suitable for light operation cranes)			
3.0	Suitable for outdoor or indoor duty	Indoor			
4.0	**Painting & Color Coding**	As per specification			
5.0	**Packing**	Seaworthy packing of the equipment, including the protective varnishing or greasing of all surfaces that will be left bright/un-painted during services. (if shipment sent via sea only) Else, normal packing shall be followed.			
6.0	Power conductors (DSL)				
6.1	Type	LT: PVC shrouded Cu conductor bus bar. CT : Flexible trailing cable mounting on retracting support (Festoon type) EPR insulated and CSP Sheathed type			
6.2	Length	Suitable for entire bay length			
7.0	**COMPONENT DETAILS**				
7.1	**Trolley**				
	Type	Fabricated			
	Method of fabrication	Fusion welded			
	Material conforming to IS:	IS: 2062 Gr. A or B			
7.2	**Rope drums**	**Main hoist**		**Aux. Hoist**	
	Material (Indicate IS)	Seamless pipe ASTM -106 or fabricated Fe410w IS: 2062 Gr A/B & stress relieved			
	Numbers provided	One for each hoist			
	Type of grooves	Identical Right hand and Left hand			
	Flange /Flangeless	Flanged			
	Other requirements	Drum will have minimum one spare groove when this hook is at its highest position. Rope will be of sufficient length so that drum has 2.5 turns when hook is at the lowest position.			
7.3	**Rope details**	All hoisting ropes shall be of special non-spinning type made of high-grade galvanized steel wire.			
	Standard conforms to	IS:2266			
	Construction	6 x 36 construction or equivalent			
	Factor of safety	6			
	Type of core	Steel			
	Grade	1770/ 1960			
7.4	**Sheaves details**	**Main hoist**		**Aux. Hoist**	
	Material	Fe 410 WA IS: 2062 Gr. A or B / CS Gr. 280-520 IS: 1030 Design as per IS: 3177- latest edition			
	Diameter of Equivalent sheaves in mm on Root	Should not be less than 62% of calculated main sheave diameter.		Should not be less than 62% of calculated main sheave diameter.	
	Type of guards provided	Fabricated from rolled steel plate			
7.5	**Coupling & Shafting**				
7.5.1	**Coupling details (between motor and gear box)**	**Main Hoist**	**Aux. Hoist**	**Cross Travel**	**Long Travel**
	Type	Flexible shock absorbing coupling excepting pin bush type			
	Guards and Enclosures	Provided			

7.5.2	**Coupling details (gear box and wheels)**	**Cross Travel**		**Long Travel**	
	Type	Flexible geared			
	Guards and Enclosures	Provided			
7.5.3	**Coupling details (gear box and rope drum)**	**Main Hoist**		**Aux. Hoist**	
	Type	Flexible coupling			
	Guards and Enclosures	Provided			
7.5.4	**Shafting (Output)**				
	Factor of Safety	As per IS : 3177 (latest edition)			
	Arrangement of Lubrication	Grease cups/ Nipples			
	Type of Lubricant	Grease			
7.6	**Gear box details**				
A.0	**Hoist Motions**	**MH**	**MH Micro**	**AH**	**AH micro**
	Type of mounting of gear box	Horizontal / Vertical			
	Classification	Suitable for M3 duty			
	Type of gears	Helical / Spur	NA	Helical / Spur	NA
	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	Difference in Gear and pinion hardness	Min 20 BHN			
	Material (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/EN 24. Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460 OR Hardened and ground gears & pinions. The hardness of gears & pinions shall be in the range of 560 - 580BHN.			
	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved			
B.0	**Travel Motions**	CT	CT micro	LT	LT micro
	Type of mounting gear box	Vertical/ Horizontal	NA	Vertical/ Horizontal	NA
	Classification	M5 duty			
	Type of gears	Helical/ Spur	NA	Helical/ Spur	NA
	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	Difference in Gear and pinion hardness	Min 20 BHN			
	Materials (gear / pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/EN 24. Hardness conforming to IS: 3177 (latest edition) OR Hardened and ground gears & pinions. The hardness of gears & pinions shall be in the range of 560 - 580BHN.			
	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved			
7.7	**Wheels details**	**Cross travel**		**Long travel**	
	Specification conforming to	IS: 3177 (latest edition)			
	Material	Forged rolled/ cast steel / C55Mn 75			
	Arrangement of lubrication	Grease			
	Other requirement	Bridge and trolley wheels shall be identical for interchangeability.			
7.8	**Lifting hooks**	POWER HOUSE CRANE		VALVE CHAMBER CRANE	
	Type	Main hook- Ram shorn with safety latch swiveling		Shank type with safety latch swiveling type as per latest	

		type as per latest edition of IS 5749 Aux. hook- Shank type with safety latch swiveling type as per latest edition of IS 15560 and TS		edition of IS 15560 and TS	
	Material	Class 2 as per IS 1875:1992 (re affirmed 2004) for hooks conforming to IS: 5749 Class 1A and class 3 steels of IS 1875 for hook of grades L & M respectively as per IS 1875:1992 for hooks conforming to IS : 15560			
7.7	**Brakes**				
A.0	**Hoist Motions**	POWER HOUSE CRANE		VALVE CHAMBER CRANE	
	Type of brake	EHT+DCEM for main hoist and aux. hoist		DCEM	
	Number provided each crane	(1+1) per motor		1 per motor	
	Braking capacity	200%		200%	
B.0	**Travel Motions**	POWER HOUSE CRANE		VALVE CHAMBER CRANE	
	Type of brake	EHT+EHT (for CT & LT motion)		DCEM	
	Number provided per motor	(1+1) per motor		1 per motor	
	Braking capacity	200%		200%	
7.10	**Bearings**				
	Type	Antifriction ball / roller bearings			
	Method of lubrication	Grease lubrication			
	Bearing life	10,000 working hours.			
7.11	**Bridge girder**				
	Type & Quantity	Box type – 2 nos, Material: IS 2062 Gr. A / B for Power house crane. For valve chamber crane, I beam / fabricated beam may use as per manufacture standard for single girder crane.			
	Maximum Vertical Deflection	Maximum deflection of the crane bridges or gantries under the rated load shall not exceed 1/1000 of the crane's span			
	Type of connection to end carriage	By fitted bolts			
7.12	**Rails-Bridge girder**				
	Type / section	Rails sections as per IS: 3443.			
	Standard conforming to	IS: 3443			
	Material	55C11			
8.0 R1	**Motors**	Suitable for design ambient temperature of 40^0 C			
8.1	**Type/ Enclosure**	SC, suitable for Inverter duty / TEFC			
8.2	**Hoist Motions**	**MH**	**MH micro**	**AH**	**AH micro**
	Numbers furnished	1	NA	1	NA
8.3	**Travel Motions**	**CT**	**CT micro**	**LT**	**LT micro**
	Numbers furnished	1	NA	2	NA
8.4	Voltage, phase and frequency	3 Ph., 4 wire, 415V ± 10%, 50 Hz ± 5% Any Combined voltage & frequency variation upto above limits.			
8.5 **R1**	Motor with Enclosure	IP – 54			
8.6	Rated capacity (KW)	The motor shall be suitable for 150 starts / hr and 40% CDF. Motor nameplate rating at 40^0 C shall have Motor			

		rating will be calculated keeping margin of at least 10% over the maximum power requirement in the duty condition specified.			
8.7	Class of insulation	Class 'F' for sq. cage motors with temperature rise limited to that of class B			
8.8	Space heater requirement	For motors above 30 KW rating			
8.9	Pull out torque	The pull out torque of the motor will not be less than 225 % of the full load torque at rated voltage and frequency.			
9.0	**Limit switches**	**Main hoist**	**Aux. Hoist**	**Cross Travel**	**Long Travel**
	Type	Rotary gear + Gravity limit switch	Rotary gear + Gravity limit switch	Lever type (one way/ two way)	Lever type (one way/ two way)
	Number provided per crane	1+1	1+1	2/1	2/1
	Control voltage/ Enclosure	110 V/ IP 54			
10.0	Load Cell along with the display	Shall be provided			
11.0	**Control panel**				
	Material	Rolled sheet steel 2mm size, fabricated from CRCA sheet steel			
	Degree of Protection	IP 54			
12.0	**Master Controllers (for Power house Crane only)**	**Main Hoist**	**Aux Hoist**	**Cross Travel**	**Long Travel**
	Number of steps	5	5	4	4
	Voltage & current rating	415 V/10 A			
	Location	In Cabin			
13.0	**Cable**	**Power**		**Control**	
	Material	Copper		Copper	
	Size	Suitable size		Suitable size	
	Type	FRLS-PVC, XLPE insulated type			
	Voltage grade	1100 V			
	Voltage drop	Cable from MCC board to motor terminal shall be so sized that the voltage drop does not exceed 5% of rated voltage.			
14.0	**Contactors**	AC 4 duty for reversing application. AC 3 duty for non-reversing application			
15.0	**Switches**	AC 23 for motor application, AC 22 for other application.			
16.0	**Fire Extinguisher**	POWER HOUSE CRANE	PPV HOUSE CRANE		
	Type and size	4.5 kg , CO_2 type			
	Numbers per crane & Location	One no. in Cabin and two nos. on bridge	Two nos.		
17.0	**Power Supply**	415 V, 3 phase, 4 wire supply at operating floor at centre of bay length.			
18.0	**Transformer**	Qty. / Rating			
	Control	1 X 100 % - 415/110V			
	Lighting	1 X 100 % - 415/240V			
19.0	**Illumination**	POWER HOUSE CRANE		VALVE CHAMBER CRANE	
	In Cabin (for Power House crane only)	Two 10W LED fixture, 2nos. 240V – 5A – 3 pin industrial socket. 15A/20A socket outlet shall be provided for A/C		N.A.	
	Over Bridge	4 nos 40 W fluorescent with incandescent lamps and 4nos. 240V – 5A – 3 pin industrial socket			
	Under bridge	Two (2) mercury vapour		Two (2) mercury vapour lamp	

		lamp units (complete with reflector) (min 400W)	units (complete with reflector) (min 400W)
	For inspection of crane components	One (1) portable 40W hand lamp with 25m length flexible cable for inspection of crane components	
20.0	**Buffer**	Cross Travel	Long Travel
	Number	4	4
	Type	Spring or rubber buffer. To be designed to bring the loaded crane to rest from speed of 50 % of the rated speed. The Deceleration rate shall not exceed 5m/s2 in line with clause 8.11.2 of IS 3177.	
21.0	**Type of platform required on the bridge.**	Chequered plate platform 6 mm thick as per IS :3502	
	Length	Full span length	
	Type of access from gantry girder level to crane bridge	Rung ladder at ends from gantry girder level walkway to crane bridges walkway	
	Type of access to maintenance cage from crane bridges walkway	Rung ladder	
	Type of access to Cabin from crane bridges walkway(Applicable for Power house crane only)	By Staircase	
	Provided at both ends	Yes	
22.0	**Operators Cabin**	(Applicable Only For Power House Crane)	
	Type of construction	Open type	
	Area and minimum clear height	2500x1800 mm with clear height of 2000 mm	
	Operator's seat	Revolving type	
	Warning gong	A foot operated type-warning gong suspended outside the cabin with control inside the cabin will be provided and an additional 300 mm dia. hand operated metal gong	
	Position of controllers	In front/ side of operator's chair	
	Ventilation	One (1) no. fan	
	Additional features in operator's cabin(For Power house crane only) and on pendant push button	-Emergency Push Button -Switches for lights and bells -Lamps for Power 'ON' indication and emergency corner switch operation	
	Type of control for Hoists/ CT/LT operation	Through VVVF drive	
23.0	**Sweep**	Sweep shall be attached to the end carriages and to the trolley to remove foreign materials from the rails.	
24.0	**Isolating switch**	One no. isolating switch shall be provided at centre of the bay at operating floor.	
25.0	**Earthing details**	The crane structure, motor frames, and metal cases of all electrical equipment including metal conduit or cable guards shall be effectively connected to earth complying with Indian Electricity Rules (IS 3043) as per IS 3177 clause no. 23.	

	Material of earthing	GI
26.0	**Fault current level**	22 kA
27.0	**Foldable ladder**	A collapsible ladder of suitable height shall be provided in Crane to perform any maintenance works at the roof.

The cranes shall be subject to a dynamic overload testing of 25% and a subsequent static overload testing of 40%. The crane shall withstand these tests safely and without any failure and/or permanent deflection of any of its components or parts.

SUB SECTION-IIA

STANDARD TECHNICAL REQUIREMENT (MECHANICAL)

DOUBLE GIRDER EOT CRANE

1.0.0 **SCOPE**

This specification covers the design, material, manufacture, assembly, inspection and testing at manufacturer works for EOT cranes and shall be applicable unless the requirements are addressed otherwise in BHEL / BHEL's Customer approved documents.

2.0.0 **CODES AND STANDARDS**

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

i)	IS 807	Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists
ii)	IS: 3177	Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes.
iii)	IS: 2266	Specification for steel wire ropes for general Engineering purposes.
iv)	IS: 4029	Guide for testing induction motor (for temperature rise).
v)	IS: 15560	Steel hooks for standard shank design.
vi)	IS: 3443	Specification for crane rail section.
vii)	IS: 325	Three phase induction motors
viii)	IS: 900	Code of practice for installation and maintenance of induction motors.
ix)	IS: 4237	General requirement of switchgear and Control gear for voltage not exceeding 1000V.
x)	IS:434 (Part I)	Copper conductors rubber insulated cables for voltage up to 1000V.
xi)	IS 1596	Polyethylene insulated PVC sheathed cables
xii)	IS 3043	Code of practice Earthing
xiii)	IS: 3938	Electric Wire Rope Hoists.
xiv)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
xv)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
xvi)	IS: 691	Flexible trailing cables rubber insulated.
xvii)	IS: 1653	Steel conduits for general engineering purposes.
xviii)	IS: 2509	Rigid non-metallic conduit for electric-Installations
xix)	IS: 2062	Steel for General Engineering purposes.
xx)	IS: 1030	Carbon Steel castings for general engineering purposes.
xxi)	IS: 1570	Schedules for Wrought steels.
xxii)	IS: 1875	Carbon steel billets, blooms, slabs and bars for forgings.
xxiii)	IS: 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
xxiv)	IS: 1852	Rolling and cutting tolerances for Hot rolled steel products.
xxv)	IS: 2291	Tangential Keys and Keyways.
xxvi)	IS: 2292	Taper Keys and Keyways.
xxvii)	IS: 3961	Recommended current rating for cables.
xxviii)	IS: 694	PVC insulated cables for working voltages up to and including 1100V)
xxix)	IS: 1554 (part-I)	PVC insulated (heavy duty) electric cables: Part 1: for working voltages up to and including 1100 volts.
xxx)	IS: 4289	Flexible cables for lifts and other flexible connections:

		Part 1: Elastomer insulated cables.
xxxi)	BS: 970	Wrought steels in the form of blooms, billets, bars and forgings
xxxii)	IS: 5749/ BS 3017	Specification for Forged Rams horn Hooks

Indian electricity rules - 1956.

In the event of any conflict between the specification (between section-I and section II), the more stringent of the two as per interpretation of purchaser shall govern.

3.0.0 **DOUBLE GIRDER EOT CRANE**

3.1.0 **DESIGN REQUIREMENTS**

3.1.1 The crane shall be designed in accordance with the latest edition of IS-3177, IS-807 and any other standard as referred there in and subject to any modification and requirement as specified herein after. Class of crane mechanism shall correspond to that of the crane requirement and as specified elsewhere.

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

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

3.1.4 For welded construction such as bridge girders, end carriages, rope drum, gearboxes etc. steel shall be conforming to IS-2062 quality. Welding shall be carried out only by qualified welders and subjected to NDT as specified in Quality Plan.

a. Welding shall be performed by shielded electric arc, gas or other approved methods. The electrodes used for welding shall conform to AWS A5.1.

b. Wherever lateral welding of the main plates of box girders are required, it shall be butt-welded.

c. Qualification of welding procedure and welder: These shall be carried out as per ASME Boiler and Pressure vessel code Sec. IX - Welding and brazing qualifications.

d. Electrode designations and qualifications shall be as per AWS A 5.1.

e. Electrodes should be of radiography quality with heavy covering as per IS: 814 and relevant requirement of ASME Sec IX and IIC.

f. Bare electrodes as per IS: 7280 and flux wire combination as per IS: 3613.

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

3.1.6 Guard shall be provided on crane to prevent the hoist ropes coming in contact with down shop leads.

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

Suitable guards shall be provided to revolving shafts, coupling etc.

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

3.1.8 Walkways of CT shall be of chequered plate minimum 6 mm thick O/P at least 800 mm clear inside with non-skid toe plates 8mm thick, projecting 100 mm above the floor. Walkways shall be of rigid construction and designed to sustain a distributed load of not less than 300 kg/ sq. mm.

Intermediate posts for supporting handrails shall not be spaced more than 1.5 meters apart.

Ladders provided shall have at least 450mm clear width with 20 mm rungs (rods) spaced 300 mm apart.

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

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

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

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

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

The permissible camber shall be shown in drawing or data sheet submitted for approval.

3.2.0 **STRUCTURAL DETAILS**

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

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

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

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

3.2.1.4 Nuts and Bolts will be as per IS:1363, IS: 1364 and IS: 1367. High-tension friction grip bolts as per IS: 3757 and High- tension friction grip nuts as per IS: 6623.

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

3.2.1.6 All butt welds on structural members subjected to tensile stress shall be of radiographic quality as ASME Sec VIII Div.1 acceptance norms.

3.2.1.7 Fillet welding on load carrying members shall be avoided.

3.2.1.8 For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8mm thick. For tubes having both ends sealed the minimum thickness shall be 6 mm. For unsealed tubes the minimum thickness shall be 8mm.

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

3.2.1.10 Minimum thickness of chequered plates for platform shall be over 6 mm over plain. Chequered plates shall not be considered for strength calculations of load carrying members.

3.2.1.11 Splice shall be designed to resist all the forces and moments to which it is subjected to plus 50% thereof.

3.2.1.12 However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splice in line with the gravity axis of the member joined so as to avoid the eccentricity of the loading.

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

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

3.2.2 **Bridge Girder**

3.2.2.1 The bridge girder shall consist of a box construction with double Web plate girders or lattice girders and shall be of adequate strength to withstand the rolling loads and other stresses it is subjected to. The design of the girder shall be in accordance with latest edition of IS- 807.

3.2.2.2 Maximum deflection of the bridge girder, with safe working load, shall not exceed 1/900 of the span or as per latest IS. The girder shall be supported on the centerline of LT wheels during the deflection check. The girder shall be cambered by an amount by an amount equal to the maximum deflection.

3.2.2.3 Box section shall be adequately reinforced by internal diaphragms and ribs to withstand the most severe combination of load that may develop under different working conditions. Additional Internal diaphragms shall be provided at points where external members are welded for providing support to drives etc.

3.2.2.4 Box girders shall be provided with end plates sealing. Diaphragms inside the girder shall extend to the full - width & depth of the girder and the web plates shall be reinforced by angles all along the full length of the plates spaced midway between the diaphragms. Full depth diaphragms or stiffeners shall be furnished at bridge drive supports and below the line shaft bearings.

3.2.2.5 Short diaphragms shall be furnished and are required to transmit the trolley wheel loads to the web plates. Trolley rail section shall not be considered into design of bridge girders.

3.2.2.6 Full length chequered platforms on both side shall be provided on the side of bridge girders as specified in data sheet - A.

3.2.2.7 There should not be accumulation of water/oil inside the box girders. If required breathing holes can be provided for expansion / contraction, due to change in temperature. Tapped (threaded) holes shall be provided with ½" NPT plug in the bottom of the girders, at both ends, to drain off any accumulation of water / Oil inside the girder. Instruction shall be painted on the girders to remove the plug and check for water/oil before lifting. Plug shall be replaced after installation.

3.2.2.8 All connection splices shall be designed for full strength of member of loads indicated unless otherwise approved. Beams and connections shall be designed for 60% of shear capacity of beam section plus additional axial load if any. Not more than one splice shall be provided to make up full length of number.

3.2.2.9 Maximum Span/ Depth ratio for Girder

- Plate Girder : 18
- Lattice Girder : 12

3.2.3 **End carriage**

3.2.3.1 End carriages shall be fabricated from rolled steel section or plates. End carriage shall be of ample strength to resist all stresses likely to be imposed on them under service conditions including collision with other cranes or stops. The length of the end carriages shall be such that no other part of the crane is damaged in collision. End carriage shall be so designed as to distribute the load evenly between the wheels from each bridge girders.

3.2.3.2 The wheel base shall not be less than 1/5th of the span. End carriage shall be fitted with safety stop to prevent the end carriage falling more than 25 mm in the event of breakage of a track wheel, bogies or axle.

3.2.3.3 Suitable jacking pads at a suitable height from rail level shall be provided on each crane for crane jacking. Jacking pad dimensions shall be suitable for full seating of the jacking pad seat without any instability. When changing the track wheel, jacking pads shall not interfere with replacement of track wheel.

3.2.4 **Crab (Trolley)**

3.2.4.1 The crab frame shall be built from heavy steel section, welded properly to form single piece frame & to resist vertical, lateral and torsional strain and to support all loads without undue deflection. It should be properly machined to receive hoisting mechanism, cross traverse arrangement/mechanism, wheels etc. etc.

3.2.4.2 Sheaves, part of hoisting mechanism, shall be so arranged on trolley that rope reeling arrangement shall ensure lifting of load in vertical line with minimum of swing or side movement. Trolley shall be provided with chequered plates all over except for opening required for ropes and equipment foundation. Equipment foundation shall not be welded/ supported on chequered plates. Toe plates 100 mm high and 6mm thick shall be provided around opening provided for movement of ropes. Suitable railing shall also be provided around the opening for rope in case the opening is large.

3.2.4.3 Platforms and Ladders

a) 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..

b) Every platform shall be provided with steel chequered plate top and be securely fenced with 1050 mm high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely

c) Safety hand railing of tubular construction 32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1100 mm and 600 mm and vertical post spacing not exceeding 1750 mm with provision of kick plate (100 mm high and 6mm thick) shall be provided on bridge walkways and on end carriages, staircases, trolley and at any other place where access is provided. Bends shall be neat and made by machine. The top rail should be so laid that there is no intermediate obstruction and hand need not be lifted from rail while walking

d) 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.

3.2.5.0 Brief description of crane operation, Maintenance and periodical lubrication etc. typed in English and in local language neatly framed in a permanent frame for easy reference.

3.2.6.0 Suitable inspection cages to accommodate two persons to facilitate inspection of DSL.

3.3.0 **MECHANICAL**

3.3.1 **Rope drums**

Rope drums shall be of mild steel plate fabricated/ cast steel/ as per IS 3177. All fabricated rope drums shall be stress relieved. The drum shall be so designed to take full length of hoisting rope in single layers. The end of the rope shall be anchored to the drum in such a way that the charger in readily accessible. Each rope shall have not less than two (2) full turns on the drum when the hook is at lowest position not taking into consideration the turns covered by the rope in charge. One spare groove shall be provided for each rope drum when the hook is at the highest position. Each rope end shall be clamped with minimum two clamping wedges with at least two bolts on each clamping arrangement.

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

For evaluation of Radiography the designed thickness of the drum (top of crest to ID) shall be taken into consideration and not the thickness of plate selected.

3.3.2 **Hoist ropes**

Ropes of steel core as specified in Data sheet" A" shall be of 6x36 or 6x37 construction of extra flexible plough steel as per IS 2266 having minimum UTS of 1770 kN.

3.3.3 **Rope sheaves**

Sheaves shall be of cast (Castings to IS: 1030 Gr. II with Y.P. greater than 50% of UTS) or forged steel. All sheaves shall be identical, however, exception may be made for equalizer sheave. Sheave groove shall be ground finished for getting increase rope life. Equalizer sheave shall be arranged to turn and swivel in order to maintain rope alignment under all circumstances.

3.3.4 **Wheels**

LT & CT wheels shall be double flanged with straight tread. The wheels shall be capable of taking up misalignment in span as specified. Solid wheel shall either be of forged steel or as specified in Data sheet. The wheel rim shall be with minimum hardness of BHN 300-350. Wheels may be either hardened on tread portion as per IS –3177 or Volume hardened. Contact stresses between wheels and rails should be within permissible limits.

3.3.5 **Buffer**

Each End carriage shall be provided with buffer as per data sheet 'A'. Buffers should be so located that removal is not required while changing wheels or bogies. Buffers shall have sufficient tension on energy absorption capacity to bring the unloaded crane to rest from the speed of 100% of the rated speed to zero speed. Buffer is to be fitted to each end of carriage assembly and crab so that buffer contact takes place before the bridge or trolley reaches the end of rail.

3.3.6 **LT drive**

The bridge motion shall be achieved by suitable drive arrangement as specified elsewhere. When twin drives are used, these shall be operating in unison to avoid skewing effect. The drives shall be interlocked for simultaneous starting, stopping & speed control.

3.3.7 **CT drive**

Trolley drive shall be achieved by suitable drives & power shall be transmitted to the geared wheel by means of pinions mounted on both ends of the output shaft.

3.3.8. **Gearing**

3.3.8.1 Gears in speed reducer unit for bridge drive, hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The housing shall be of sufficient design not to permit temperature in excess of 90°C for the oil bath. Spur and helical gearing shall normally be used for all motions. Worms and bevel gears shall not be used. First high-speed reduction shall be through helical gears. All gears shall be hardened and tempered and of alloy steel with machine cut teeth 1.6 Micron finish or better and lapped with some minimum applied load to remove high spots and to improve tooth contact. Cast alloy steel is acceptable only for gears in the last stage of speed reduction. Surface hardening of teeth is not acceptable. Gear teeth shall preferably be cut in metric module system. Gears shall be designed to meet requirement of crane duty as per IS: 3177. The ratings of gears shall be established as per IS: 4660.

3.3.9 **Gear Box**

3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket. In case of totally enclosed gearboxes, splash or automatic lubrication system shall be used. Covers shall be split horizontally at each shaft centre line, so that top half can be removed for inspection and repair with out disturbing the bottom half. Gear shafts shall be supported on ball/roller bearings mounted in gearbox unless specially agreed otherwise. The gear boxes shall be provided with breather, air vent, oil level indicator, dip stick, drain plug and lugs for lifting.

Radial clearance between the gear boxes inner surface and outside diameter of the gears shall be at least 1.25 times the depth of larger gear tooth inside the gear box or 20mm which ever in

higher. Facial clearance between inner surface of gearbox and face of gear or pinion shall be at least 20 mm. Gearbox shall be inspected in line with QP and as per PEM (Q)/001 enclosed.

3.3.9.2 The gearboxes shall be of mild steel or cast steel. All fabricated gearboxes shall be stress relieved at a temperature between 590 to 680 deg. C. The temperature shall be maintained within ± 20 deg. C and at no time during the soaking cycle the temperature shall fall below 590 deg. C or exceed 680 deg. C. Soaking shall be done for a period proportionate to 1 (one) hour/ 2.5 cm. of wall thickness.

3.3.10 **Bearing**

3.3.10.1 Ball and roller antifriction bearing of attached sub-vendor list, make shall be used throughout, except where specified otherwise. Drive side bearing on Hoisting equipment shall be ball / roller bearing type. Rated life of ball and roller bearing shall be not less than total working life as per data sheet-A. Life of bearing shall be calculated in accordance with manufacturer's recommendations.

3.3.10.2 Provision shall be made for service lubrication of all bearings. Lubrication arrangement and clamping shall be done neatly. Bends in pipe shall be done with the help of machine. Bearing enclosures shall be designed as far as practicable to exclude dirt and shall prevent oil leakage. Accessibility should be such that parts may be safely lubricated from the walkway or ladder when the crane is not in motion.

3.3.11. **Shafts, Couplings and axles**

3.3.11.1 Shafts and axles shall be made from solid rolled or forged steel bars and shall have ample strength and rigidity and adequate bearing surface. If shouldered, they shall be provided with fillets of ample radius and /or be tapered to avoid stress concentration.

Motor shafts shall be connected to gearbox input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts. For driving hoist drum full-geared couplings shall be used between hoists drum & hoist gearbox output shaft. Couplings shall be of cast steel/wrought steel conforming to IS: 1030 grade 280-520 and shall be designed to suit service conditions.

3.3.11.2 Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement whenever necessary. Whenever components of considerable amount of inertia are directly mounted on the high-speed shaft (e.g. brake drum, coupling etc.) they shall be balanced statically to minimise vibration.

3.3.12 **Repair Cage**

A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. The repair cage shall be adequately sized to accommodate two persons. And guarded for safety and correctly located for the intended service. Suitable access to the cage shall be provided. Repair cage shall be provided at the corner of the crane.

3.3.13 **Lifting hook**

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition. All hooks used shall be in normalized condition only.

3.3.14 **LIFTING HOOK BLOCK ASSY**

3.3.14.1 Lifting hook block assembly shall be Ram shorn type or approved for capacity greater than 50 Tonnes and point hook with Shank for capacity below 50 Tonnes and shall be of forged steel construction. 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. All hooks used shall be in normalized condition only. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely.

3.3.14.2 The sheaves of the hook block shall be enclosed in a casing permitting generous lubrication of wire ropes, sheaves and also preventing accidental tapping of hands.

3.3.15 **Brakes**

3.3.15.1 Selection and design of brakes shall be such as to meet the requirement. Brakes shall be designed to suit 150% of torque transmitted to the brake drum with full load for hoist motions and 125% of motor rated torque before de-rating for LT/CT motion. Brakes shall be provided as specified in Data Sheet 'A'. Brake drum shall be separately mounted and coupling halves shall not be used as brake drum.

i) **SERVICE BRAKE**

Double shoe types & disc type service brakes shall be provided for each motion of the crane as/or as specified in Data Sheet. The service brakes shall apply automatically when power supply to the drive motor is cut off or fails.

ii) **HOIST CONTROL**

Hoist motion shall be provided with a self-contained sturdy braking system to control the speed of hoisting as well as lowering motion. The braking system shall be reasonably uniform and effective in all loads at any position.

3.4.0 **ELECTRICAL**

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

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

3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipment on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 2% or specified in data sheet "A". It shall be supplied with brackets. Maintenance cage for DSL shall be provided on crane.

3.4.1.3 The current collectors shall be with adequate current carrying capacity and shall maintain adequate contact pressure. Spacing between current collectors shall be such as to provide sufficient quenching area for sparks coming out of collectors surface. The collector system per conductor shall spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.

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

3.4.2 **DRIVE MOTORS**

3.4.2.1 Crane Motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The starting torque of motor shall not be less than 2.25 times the rated torque and pull out torque shall not be less than 275% of the rated full load torque of motor.. In case of VVVF drive system, the creep speed will be achieved through VVVF drives and the motors for Main hoists, Auxiliary hoist, CT and LT will be Squirrel cage. Hoisting drive motors shall be provided with antifriction roller / ball bearings on the drive side.

3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending up on the ambient temperature and voltage /frequency variation shall be applied to de-rate the motors. The minimum margin of 10% shall be considered over the calculated rating of the motor. The protection class of the motors shall be as IP-55. Motors shall be tested at manufacturer's works in accordance with IS-325/as per agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325 or as per the motor spec.

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

3.4.2.4 Motors shall be painted in line with painting instructions specified in Painting Scheme Annexure IV attached along with the technical specification.

3.4.3 **Limit switches**

The hoist mechanism of the crane shall be provided with rotary type limit switch to open the control circuit & in order to prevent the crane hook from over hoisting and over lowering, one gravity type back up limit switch of hand reset type shall also be provided. This switch will operate in the event of failure of main limit switch. Lever operated limit switches shall be provided at both ends of longitudinal travel and cross traverse. These limit switches shall be self-reset type. The limit switches shall be as per "Data Sheet A"

3.4.4 **Switch**

All switches shall be hand operated; air break, heavy duty, quick make and quick break type. Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Safety Interlocks-Disconnect Switch-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. Main/ safety disconnect switch shall have provision of pad locking in OFF position

3.4.5. **Contactors.**

Contactors shall be suitable for heavy duty, with current rating not less than connected motor full load current. All reversing contactors shall be mechanically and electrically interlocked.

Each contactor shall be provided with three positive acting ambient temp. Compensated thermal overload relay with adjustable setting to suit the motor current. The relay shall be hand reset type, suitable for current. The relays shall be replaceable from front. The main contactor shall be electrically interlocked so that it cannot close unless all the motor overload relays are RESET and all controllers are in OFF position. The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

3.4.6 **Push button and lamp**

Push button shall be spring return type with 2 NO + 2 NC contacts, rated 10A, 240 V AC. Indicating lamps and lens shall be replaceable from front.

3.4.7 **Protective Panel**

3.4.7.1 The electrical protective panel shall be a cubicle fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick with lockable-hinged door. The control cabinet's door shall be interlocked with the operating handles of isolating switches of supply circuits so as to prevent opening of the door when an

isolating switch is closed. A device for bypassing the interlock shall also be provided. It shall be dust and vermin proof with degree of protection as IP-52 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipment and devices mounted there on.

The following minimum equipment shall be provided.

a) One triple pole air break type main contactor with thermal overload relay.

b) One triple pole main line connecting/disconnecting switch.

c) Emergency push button at convenient height for the operation for interruption of the entire power.

d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.

e) Contactors, timer and auxiliary contactors.

f) Portable Lighting Transformer rated for 415/24V.

g) Lighting Voltage Transformer with fuse 415/24V.

h) Control transformer with fuses.

i) Indicating lamps to indicate the live condition of all three phases.

j) Main supply ON/OFF lamps on the door of the protective panel.

k) Electrical interlock shall be provided to prevent the main contactor being closed unless all controllers are in OFF position.

l) Other equipment as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The main contacts shall have the rating for 5 Amps or as specified in the data sheet A. The contactor drop off voltage shall be between 45-50% of rated voltage.

m) All internal wiring shall be identified with numbering rules at both ends as per the relevant wiring diagram.

n) Each panel shall have internal illumination with fluorescent lamp. The inside of the panel shall be painted white.

o) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. At least 20% spare terminals for the wire terminations shall be provided in the cabinet.

3.4.8 Starter Panel

Separate panels shall be provided for CT, LT & hoist motion (Main and Auxiliary), with following type of items.

a. Contactors : AC4 duty for reversing applications

AC3 duty for non-reversing applications

b. Switches : AC23 for motor application.

AC22 for other application

c. Fuses : HRC

d. Overload relays: Temperature compensated bi-metallic with single phasing preventer.

3.4.9 **MOTOR CONTROL PANEL**

The motor control panels shall be dust and weatherproof to IP-54/55 or as specified in "Data Sheet A" & shall be provided separate for each motion. The panel shall contain minimum the following components.

a. Switch fuse unit with contacts of adequate rating for each motion.

b. Thermal overload relay for each drive. These shall be ambient temperature compensated adjustable type.

c. Contactors, timers and auxiliary contactors.

d. The panel shall be provided with space heater. The space heater with thermostat shall be located at the bottom of the panel and shall have individual ON/OFF switch.

e. Terminal blocks shall be stud or snap on type. A protective cover shall be fixed on top of terminal blocks to prevent accidental contact. A minimum of 20% spare terminals shall be provided.

f. Air break contactors shall be provided for main supply as well as for motors. They shall confirm to category AC-4 as per IS-1322. These shall have three main contacts and 2 No. & 2 NC auxiliary contacts.

g. The main contacts shall have the ratings as per duty requirement but auxiliary contact shall be rated for 5 amp 240V AC. The contactor drop off voltage shall be between 45-50% of rated voltage. The contactor coil shall be suitable for 240V AC supply.

h. The auxiliary contactors shall have 4 No. + 4 NC contacts for control and interlocking purposes. The contacts shall be convertible. The contacts rating shall be suitable for 5 amps at 240 Volts AC.

i. Adequate protection for overload and short circuit shall be provided for all the three phases of each motor.

j. Double pole switch fuse unit for control circuit of the contractor 'START (push button and a pilot lamp with the red lens for indicating the contactor "CLOSED" shall be furnished.

3.4.11 **Illumination**

Crane lighting and space heating system shall be designed for 240V, 1Phase 50Hz supply and receptacle system with 24V 1Phase 50Hz supply or as specified in the Data sheet A. Suitable dry type transformers shall be furnished for this purpose, complete with isolation facility and Primary/secondary fuses.

a. Branch Circuits for lighting and receptacles shall be individually protected by switch fuse units.
b. CFL fixtures shall be used for lighting operator's cabin and bridge platform.
c. 60W bulkhead fittings with fluorescent lamp shall be used for lighting bridge platform.
d. Four (4) no.s - 250 W HPSV lamps shall be provided under the bridge as specified in the data sheet “A”
e. All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
f. 24V - 5A - 3 pin industrial socket outlets shall be provided. Minimum four (4) on the bridge along the walk way on both sides of full length platforms.
g. One (1) portable 40 W hand lamp with min. half span length flexible cable for inspection of crane components.

3.4.13 **Grounding**

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

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

3.4.13.3 The crane structures, motor frames & metal of all electrical equipment on EOT crane shall be effectively grounded as per Indian Electricity Rules. Grounding of the crane to the nearest pit shall be in manufacturer’s scope.

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

3.4.15 **Wiring Systems**

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

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

c. For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.

d. Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.

e. Each motor shall be wired independently. Power and control wiring shall be effectively separated.

f. Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.

g. All wire termination to the panels shall be provided with clamp type connections screw. Screw Type terminals with screw directly impinging on conductors are not acceptable.

h. Multi way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring.

i. Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points

j. Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

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1.0 General

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

b) Inverter construction and related devices:

Construction shall be divided in 3 broad sections. Section one converts AC Supply into DC supply. Section 2 Converts and controls DC supply into AC Supply with regulation. Section 3 shall be used for braking action of the motor and Dynamic Braking Unit (DBU) can be inbuilt or external depending upon the drive capacity. VVVF can be used in open loop (without external speed feed back) like in Travel motions or close loop (With external speed feed back) like in Hoist motions. Chokes on input supply side are generally used in crane application for power regulation. Like all other electronic / electric devices VVVF drives are also protected by MCB / MCCB / Fuses. VVVF drives are sensitive to temperature and hence drive internal as well as external cooling fans are provided.

c) Programming of VVVF Drives.

VVVF drives shall be programmable and for that purpose detachable digital Operator display unit shall be supplied along with the VVVF having required buttons for setting the user constant, functions etc. The VVVF drive is to be fine tuned by matching the motor parameters and setting the parameters on full load.

d) VVVF drives shall be connected with power supply and these drives generate their own low voltage control supply. Potential free contacts shall be connected to this control supply and few programmable control terminals. Starting / stopping / set speeds operations of VVVF drive shall be achieved by above control connection.

e) VVVF shall give smooth control over acceleration and deceleration making the motion jerk free and using Variable voltage variable frequency limits the inrush current to the squirrel cage motors. VVVF provides controlled torque to the motor due to which crane operations are jerk free.

1.1 Experience

The Frequency Converter Manufacturer shall have adequate experience in frequency converter manufacturing and have adequate business volume in order to provide credibility in his commitments and a capability of long term support.

1.2 Local support

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The Supplier shall have a permanent representative office with a trained and skilled support staff, in the country where the goods are delivered, in order to prove his commitment for local support and to provide a channel for communication.

The engineers employed by the Supplier's regional office shall be certified by the Manufacturer and provide start-up service including physical inspection of the drive, connected wiring and final adjustments, to ensure that the AC Drive meets the required performance.

The Supplier shall be able to give basic drives training to the Customer's engineers, preferably on the site. The training shall, as a minimum, include system concepts and basic troubleshooting.

2.0 Basic requirements for the AC Drives

2.1 General requirements

The AC Drive shall comply with National(country of origin) and International standards and the recommendations for electrical industrial control devices (IEC, EN, UL, NFC, VDE).

The AC Drive shall be of the most modern design, yet user friendly and be simple to install, commission and maintain. The AC Drive shall be able to start and control the speed of a standard squirrel cage induction AC motor. The AC Drives shall be : CE marked, conforming to European Low Voltage (73/23/CEE and 93/68/CEE) and EMC (89/336/CEE) Directives, UL/CSA marked according to UL 508C.

The AC Drives have to be built to comply with the IEC standards.

The AC Drive shall be a digitally controlled drive, using, at least, the Pulse Width Modulation (PWM) with flux vector control open loop(for travel) and closed loop(for hoist). It shall have diodes / thyristors in rectifier and IGBT's in the inverter section in their entire power range, and it shall have the following minimum specifications.

Rated Input Voltages	380V -15% 480V +10%, three-phase
Rated Input Frequency	50Hz +/- 5%
Output Voltage	0 – Input voltage, three-phase
Output Frequency Range	0 to 400 Hz
Acceleration / Deceleration Time	0.01 – 999s, adjustable, linear, with S, with U or customised shapes
Overload capability (Constant Torque)	150% of nominal current for 1min.
Operating ambient Temperature	-10°C up to 50°C(shall be derated suitably

	if not rated at 50°C)
Storage ambient Temperature	-25°C up to 70 °C
Maximum operating altitude	1000 m without de-rating, 1000…3000 (shall be de-rated suitably)
Max. Relative Humidity	95 %, without condensation and dripping water.
Main Protections	Over current, short circuit between phase, short circuit between phase and ground, input phase loss, output phase loss, motor overload, over speed, over voltage, under voltage, drive over temperature

The AC Drive shall be able to give a 100 % output current continuously in the above specified conditions. In order to ensure that the drive can provide the required output current in the specified ambient conditions, the Manufacturer shall inform the required derating, if the ambient temperature given in the project-specific specification is higher than rated ambient of the drive or if the installation altitude is more than 1000 m above the sea level. The de-rating factor shall be specified so that neither the lifetime of the AC Drive nor the unit's performance, overload capability included, nor the reliability of the AC Drive shall suffer.

The VVVF drives shall have all necessary protections i.e input phase loss, earth fault, over voltage, output short circuit, load loss , input transient protection, overload etc

Suitable encoder shall be provided for all motions.

3.0 User interface

3.1 General

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

3.2 Inputs and outputs

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

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

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

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

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

All the control terminals shall be clearly marked.

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

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

3.4 Programming terminal

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

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

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

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

i) Input Voltage
ii) Input Frequency
iii) Output Frequency
iv) Output Power
v) Output Current

vi) Motor Speed

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

i) Drive Status

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

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

3.5 Application programming

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

3.6 PC Tools

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

4.0 Software features

A. Restart

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

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

5.0 Preferred makes:

As per attached sub-vendor list

PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane AREA :	QP NO. : REV. No. : 00 PAGE No. : 1 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS
1	RECEIPT & STORAGE EOT Crane after arrival at site.							
	a. Check manufacturers dispatch documents at site, MDCC, CHP etc. for completeness, identification.	Record Verification	Visual	B	100%	Drawings / Tech. Spec.	Protocol	
	b. Check for coating condition of rust inhibitor check and any transit damage	Visual	Visual	B	100%	Drawings/Tech. Spec/ No. Damage	Protocol	
	c. Storage condition of parts, rails, crane girders and structural parts shall be placed on the elevated surface. * Gear box, fasteners and wire ropes shall be stored in closed covered shed.	Physical	Visual	B	100%	Storage & Preservation Procedure.	Protocol	
	d.Electrical items like panel, cables, motor, controls & resistance block in closed, covered shed.	Physical	Visual	B	100%	Storage & Preservation Manual	Protocol	
2	PRE-ERECTION CHECK							
	a. For Gantry at every 5.0 M i.e. span, level, diagonals before taking over from Client	Measurement	Tape, Water level	A	100%	Drawings	Protocol	
	b. Web axes of gantry girders in a raw are aligned.	Measurement	Water level	B	100%	Drawings/ER Manual	Protocol	
	c. Center to center distance of gantry girders.	Measurement	Measuring Tape	B	100%	Drawings/ER Manual	Protocol	

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PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane AREA :	QP NO. : REV. No. : 00 PAGE No. : 2 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS
3	Check for Alignment of Rails							
	a. Straightness of gantry rails	Measurement	Piano Wire/ Twine	B	100%	Drawings/Erection Manual	Protocol	
	b. Level and Elevation of Gantry rails (top level of girder)	Measurement	Water level/ Measuring Tape	A	100%	Drawings/Erection Manual	Protocol	
	c. Distance between rails(every 5 M) (Tolerance.±. 6mm) including diagonal of gantry rails (Tolerance±. 5 mm)	Measurement	Measuring Tape	A	100%	Drawings/Erection Manual	Protocol	
	d. Bolting of rails and tightening	Measurement	Torque wrench	C	100%	Drawings	Protocol	
	e. End Stopper Arrangement	Physical	-	A	100%	Drawing	Protocol	
4	ERECTION CHECK FOR							
	a. Joining of Girders i.e. splice joints	Physical	-	B	100%	Tech. Spec.	Protocol	
	b. Placement of girder assembly on the gantry.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	
	c. Movement of wheels	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	
	d. Placement and positioning of electrical panel & trolley.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	

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PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane AREA :	QP NO. : REV. No. : 00 PAGE No. : 3 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS
	e. Movement of crab trolley on the crane girder	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	
	f. Deviation in the crane rail level at any point from true level tolerance .±. 10 mm	Measurement	Piano Wire / Twince	A	100%	Drawings/ Erection Manual	Protocol	
5	D.S.L.							
	a. Fixing arrangement	Visual	-	C	100%	Drawing	Protocol	
	b. Location with respect to gantry rail, spacing & alignment.	Measurement	Measuring Tape	B	100%	Drawing	Protocol	
	c. Continuity check & insulation Resistance	Measurement	Megger	A	100%	Minimum 5 Mega Ohms	Protocol	
6	Cable laying connections	Physical	-	B	100%	Drawing	Protocol	
7	Crab Clearances							
	a. Headroom, end clearance, hook approaches and height of lift and record.	Visual & Measurement	Measuring Tape	B	100%	Drawing	Protocol	
8	Gear Box							
	a.Check oil level	Measurement	Dip stick	B	100%	Drawing	Site log Book	
9	LT Machinery, Platform, cabin, Electrical equipment, other structural components, limit switch & Mechanical stopper.							
	a. Fit up	Visual	-	B	100%		Protocol	
	b. Alignment	Visual	-	B	100%	Drawing	Protocol	
10	COMMISSIONING CHECKS							

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PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane AREA :	QP NO. : REV. No. : 00 PAGE No. : 4 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS
	a. Power & control cable connections Insulation Resistance	Visual	Megger	A	100%	Min 5 Mega Ohms	Protocol	
	b. Control panel earthing Insulation resistance	Measurement	Megger	A	100%	Min 5 Mega Ohms	Protocol	
	Function & sequential operation	Physical		B				
	c. Resistance box earthing							
	IR value	Measurement	-	B	100%	Min 5 Mega Ohms	Protocol	
	Resistance	Measurement		B	100%	Drawing	Protocol	
	d. Operation of Brakes (Hoist motion, L.T. Motion & C.T. motion)	Physical	-	A	100%	O&M Manual	Protocol	
	e. Operation of limit Switch (Hoist & traveling motion brakes)	Physical	-	A	100%	O&M Manual	Protocol	
	f. Motors.		-					
	IR value	Measurement		B	100%	Min 5 Mega Ohms	Protocol	
	Earthing							
	g. At no load check							
	Motor Current	Measurement	-	A	100%	As per procedure	Protocol	
	Crane Speed	Measurement		A	100%			
	(only watching all motion)							
	h. At full load check / Load testing of crane (SWL):							
	Motor Current	Measurement		A	100%	As per procedure	Protocol	
	Crane Speed	Measurement		A	100%			
	Deflection.	Measurement		A	100%			
	i.At 25% Overload		-			As per procedure	Protocol	
	(only watching all motion)	Visual		A	100%			
	j. Touch Up Painting.	Visual	-	C		As per approved shade	Records	

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Check List for Operation & Maintenance Manual

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

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**Cover page**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**Index**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**Description of Plant/System**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	**Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)**				
4.1	Pre-Commissioning Checks				

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

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

Checked by
Dealing Engineer

Key Resource Person

Section Head

SECTION III

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

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

a. Signed and Stamped copy of Compliance cum Confirmation Certificate

b. Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format attached in the tender

   Or

   No deviation certificate

c. Un priced copy of price format indicating quoted/ not applicable against each row/column

d. PQR related documents

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS. DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.

TITLE: TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)
	SPEC. NO.: PE-TS-479-501-A401
	SECTION: III
	REV. NO. 0 DATE NOV 2020
	SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

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

k) As built drawings shall be submitted as and when required during the project execution.

TITLE: TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)
	SPEC. NO.: PE-TS-479-501-A401
	SECTION: III
	REV. NO. 0 DATE NOV 2020
	SHEET 2 OF 2

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

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

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

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

BHEL	TITLE: **TECHNICAL SPECIFICATION FOR EOT CRANE**	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)
		SPEC. NO.: PE-TS-479-501-A401
		SECTION: III
		REV 00 / DATE NOV 2020

PRE-BID CLARIFICATION SCHEDULE

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

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

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

	TITLE: TECHNICAL SPECIFICATION FOR EOT CRANE	PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20MW)
		SPEC. NO.: PE-TS-479-501-A401
		SECTION: III
		REV. NO. 0 DATE NOV 2020

#

SUB SECTION-IIIC
DEVIATION SCHEDULE

(REFER DEVIATION SCHEDULE-COST OF WITHDRAWAL FORMAT ENCLOSED IN GCC)