

**PUNJAB STATE POWER CORPORATION LIMITED**  
**206 MW SHAHPURKANDI HEP**


**TECHNICAL SPECIFICATION FOR DOUBLE GIRDER  
EOT CRANES ABOVE 100T**

**SPECIFICATION NO.: PE-TS-406-501-A501**



**BHARAT HEAVY ELECTRICALS LTD**  
**POWER SECTOR PROJECT ENGINEERING MANAGEMENT**  
**NOIDA (U.P.)**  
**INDIA**

SECTION	TITLE	PAGE No
<b>CONTENTS</b>		
<b>I</b>	<b>Specific Technical Requirement</b>	
IA	Specific Technical Requirement (Mechanical)	6-31
	- Customer specification	32-44
	- Annexure I- Makes of sub-vendor items	46-52
	- Annexure II- Mandatory spares	53
	- Annexure III- Maintenance Tools and Tackles	54
	- Annexure IV- Painting Specification	55
	- Annexure V- Drawings/ documents to be submitted after award of contract	56-58
	- Annexure VI-Packing Procedure	59
	- Annexure VII- Procedure for Load & Overload testing of Double Girder EOT at Manufacturer's Works	60-61
	- Annexure VIII- Format for O&M manual	62-64
	- Crane Clearance Diagram	65-67
IB	Specific Technical Requirement (Electrical)	68-96
IC	Data Sheet A	97-110
<b>II</b>	<b>Standard Technical Requirement</b>	
IIA	Standard Technical Requirement (Mechanical)	111-129
	Site Storage and Preservation Guidelines	130-144
	General Technical Requirement	145-198
<b>III</b>	<b>Documents to be submitted by the bidder</b>	<b>199</b>

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section Date DEC'21
	<b>CONTENTS</b>	Page 2 of 2
IIIA	List of documents to be submitted with the bid	200
IIIB	Compliance cum Confirmation Certificate	201-202
IIIC	Pre-bid Clarification Schedule	203
IIID	Deviation Format	204-205

647056/2022/PS-PEM-MAX



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

VOLUME: II B

REV 00

Section I A Date DEC'21

## PROJECT INFORMATION

## **BACKGROUND OF THE PROJECT**

The Shahpurkandi Hydro Electric Project (206MW) is a run-of- River scheme envisaged to utilize the drop of River Ravi from downstream of Ranjit Sagar Dam (already commissioned and in operation). The reservoir of Shahpurkandi Dam Project is proposed to act as a balancing reservoir and utilize the releases from Ranjit Sagar Dam to fulfill the Irrigation requirement of various commands through Irrigation Canals. The 7.7KM long concrete lined Head race Hydel Channel having 385 cumecs capacity shall carry water from Dam to UBDC Canal through Power House I & II. The installed capacity of Power House I is 3x33 MW and Power House II is 3x33+8 MW. The annual energy generation in 90% dependable year is estimated to be 999.49 MUs.

### **LOCATION:-**

The reservoir of the Project shall be located near Shahpurkandi in District Gurdaspur (Pb.).



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section I Date DEC'21

Page 1 of 1


## SECTION – I

### SPECIFIC TECHNICAL REQUIREMENTS

**SUB-SECTION IA – Specific Technical Requirement (Mechanical)**


**SUB-SECTION IB – Specific Technical Requirement (Electrical)**

**SUB-SECTION IC – Data Sheet A**

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	I A Date DEC'21
	<b>SPECIFIC TECHNICAL REQUIREMENTS</b>	Page 1 of 2	

## SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

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

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section I A Date DEC'21
	<b>SPECIFIC TECHNICAL REQUIREMENTS</b>	Page 2 of 2

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

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

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

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

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

**Note:**

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

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



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS


SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section I A Date DEC'21

Page 1 of 1

**SUB-SECTION IA**  
**SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)**

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

### 1.0.0. SCOPE OF WORK


#### 1.1.0. SCOPE OF SUPPLY


1.1.1. Equipment and services to be furnished by the bidder for the Two (2) nos. 150 T /40T capacity double girder EOT Cranes (One no. for power house- I & One no. for power house -II ) 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
- g. Earthing arrangement including connection to nearest risers
- h. Fill of lubricants till handing over.
- i. Painting of cranes and accessories including touch up painting at site.
- j. 2 Nos. Temporary cables for operation of crane during erection stage of the plant (85m)
- k. Rail complete with clamps etc. including all accessories and end stopper.
- l. Maintenance tools & Tackle
- m. Erection & Commissioning spares
- n. Mandatory Spares
- o. Operator's cabin.
- p. POWER cable from station board located in power house to Main Isolating switch in enclosure at operating floor for disconnecting supply to DSL.
- q. Slings and cradle for load testing
- r. Pair of wire rope slings as given below:-

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21
<p>Five (5) pairs of wire rope endless slings of suitable lengths tentative 12M for different loads (i.e. 188T, 100T, 50T, 40T &amp; 25T)</p> <p><b>1.1.4 Maintenance Tools and Tackles</b> As per Annexure III, section-IA of this specification</p> <p><b>1.1.5 Mandatory Spares</b> 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.</p> <p><b>1.1.6 Erection and Commissioning spares</b> The Bidder shall also supply erection &amp; 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 taking over of the cranes shall also be supplied by the bidder.</p> <p><b>1.1.7 Any supplies mentioned in GCC, SCC as relevant to the package</b></p> <p><b>1.2.0 Services to be provided by the bidder</b></p> <p>1.2.1. Packing, forwarding and transportation to site</p> <p>1.2.2. Development of storage space including ward &amp; watch of the equipment and handling at site.</p> <p>1.2.3 The PSPCL will provide Power as per relevant applicable tariff if demanded by the contractor but the cost of providing the Power will also be as per relevant regulations of the PSPCL. The Contractor shall also make arrangements for the full anticipated requirement of construction power by installing Diesel Generating Sets and operate these sets for his requirements of power at no extra cost to the Owner. Permission from State authorities, if required, for installing DG Sets shall be arranged by the Contractor for which Owner will issue necessary recommendation. The contractor at his own cost, shall provide and install all necessary electrical installations like HT/LT distribution lines/cables, switch gear, wiring, fixtures, bulbs and other temporary equipments for further distribution and utilization of Energy for power and lighting and shall remove the same on completion of work. All work areas shall be suitably lighted by the contractor at his own expenses for proper execution and inspection to the</p>		

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

satisfaction of the Engineer-in-charge in accordance with the provisions of the Indian Electricity Act/rules or any other laws in force. All electrical works of the contractor shall conform to the rules and regulations relating in such works in force from time to time as specified in the Indian Electricity Acts / Rules and to the satisfaction of the Engineer-in-charge. Exact location for installation of DG Sets will be decided by the contractor in consultation with the Engineer - in - charge, whose decision shall be final and binding on the contractor.

### 1.2.3. Arranging test load at site

Collecting the test load at site within a radius of 4-5 KM from owner's storage to final testing bed of crane shall be under bidder's scope of work. Test load in the form of rolled steel, plates, girder, angle etc., as available at the site shall be made available by the purchaser. The test load shall be put back to the place from where it was lifted by the vendor, after the load testing. Load testing sling, cradles and any other item required by the vendor during the load testing shall be arranged by the vendor at no extra cost to the purchaser.

### 1.2.4 Erection and Commissioning

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

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

### 1.2.7 Scope of Maintenance Services for tentatively 3 years after Load / Overload testing and release of Crane for operation

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
- b) Breakdown maintenance
- c) For checking healthiness of crane as per requirement of BHEL site office

a) Routine maintenance.

i- Frequency of visits:

Tentatively one visit in every 6 months which shall be as per intimation from site

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.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21
<p>iii- Healthiness of crane is to be ensured.</p> <p>b) Breakdown maintenance:</p> <p>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.</p> <p>ii- Any tools and tackles, consumables like oil, grease etc., spares required for replacement due to wear &amp; tear shall be in bidder's scope.</p> <p>iii- Healthiness of crane is to be ensured.</p> <p>d) For checking healthiness of crane as per requirement of BHEL site office</p> <p>i- Any tools and tackles, consumables like oil, grease etc., spares required for replacement due to wear &amp; tear shall be in bidder's scope and bidder has to ensure availability of the same before their arrival at site.</p> <p>ii- Healthiness of crane is to be ensured.</p> <p>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.</p> <p>Maintenance services may be extended beyond three years as per site requirement &amp; shall be intimated to bidder during execution.</p> <p>1.2.8 Any service mentioned in GCC &amp; SCC as relevant to the package.</p> <p>1.3.0. <b>PAINTING &amp; COLOUR SCHEME</b> As per Annexure IV, section-IA of this specification</p> <p>2.0.0. <b>Works Excluded</b></p> <p>Gantry girder</p> <p>Dead load for load/ overload testing at site</p> <p>Space for storage.</p> <p>Exclusion, if any, mentioned in GCC, SCC.</p> <p>3.0.0. <b>Drawing and documents submission schedule along with number of prints.</b></p> <p>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.</p> <p>4.0.0. <b>Deviations</b></p> <p>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</p>		

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501	
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA	Date DEC'21

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

#### 5.0.0. 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.

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

#### 7.0.0. Performance Test requirement

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

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


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

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

#### 7.1.0 Testing at site

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

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

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501	
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA	Date DEC'21

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

iii. All Other tests as per IS-3177.

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

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

vi. Brake test.


vii. Any other test as per IS-3177

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


**8.0 Consumables**

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

647056/2022/PS-PEM-MAX

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501	
	<b>206 MW SHAHPURKANDI HEP</b>	REV 00	
	<b>DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS</b>	Section IA	Date DEC'21

**QUALITY ASSURANCE AND INSPECTION REQUIREMENT**

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501	
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA	Date DEC'21

### 1.1.0. Inspection and Testing

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

#### 1.1.1. Inspection and testing at Manufacturer's works

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

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


#### STAGE INSPECTION


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


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

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21
<p>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.'</p> <p>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%.</p> <p>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 ASTM E 609.</p> <p>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.</p> <p>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.</p> <p>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).</p> <p>vii. Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification</p> <p><b>FINAL INSPECTION- Testing At Works.</b></p> <p>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:</p>		


	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21
<p>a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.</p> <p>b) Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.</p> <p>c) Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177</p> <p>d) All Other tests as per IS-3177.</p> <p><b><u>Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works &amp; Site</u></b></p> <p>Refer Testing requirement as mentioned at ANNEXURE-VII.</p>		
19 OF 256		

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

**Procedure No. PEM (Q)/001**

**SHOP TEST PROCEDURE FOR GEAR BOX**

1.0.0	<b>Scope: Acceptance Norms for Crane Gear Boxes</b>
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	<ul style="list-style-type: none"> <li>i. Diameter and keyway dimensions of input and output shafts.</li> <li>ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box.</li> <li>iii. Centre distance between input and output shafts.</li> <li>iv. Centre Height.</li> <li>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.</li> <li>vi. Overall dimensions</li> </ul>
3.0.0	<b>Backlash</b>
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	<b>Area of Contact:</b>
4.1.0	<p>Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2)</p> <p>For final stage of Hoist gearing:  <math>h / H</math> shall be more than 30%  <math>(a - c) / b</math> shall be more than 40%</p> <p>For all other gears:  <math>h / H</math> shall be more than 40%  <math>(a - c) / b</math> shall be more than 50%</p>
5.0.0	<b>Running Test</b>
5.1.0	The gear boxes shall be run under no-load condition at the rated speed for minimum four hours in each direction and the following are to be checked:

	<b>TITLE</b> <b>206 MW SHAHPURKANDI HEP</b>  <b>DOUBLE GIRDER EOT CRANES ABOVE 100T</b> <b>SPECIFIC TECHNICAL REQUIREMENTS</b>	SPECIFICATION NO. PE-TS-406-501-A501	
		REV 00	
		Section IA	Date DEC'21
	<ul style="list-style-type: none"> <li>i. All bolts at the joints remain tight</li> <li>ii. All gear mesh lines are getting enough lubrication</li> <li>iii. All bearings are getting enough lubrication</li> <li>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.</li> <li>v. Vibration : Maximum limit 125 microns (peak to peak)</li> <li>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.</li> <li>vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.</li> </ul>		
<b>6.0.0</b>	General		
6.1.0	<p>In addition to the above specific points, the following general points shall be ensured:</p> <ul style="list-style-type: none"> <li>i) Inspection pockets are provided as required.</li> <li>ii) Gear box casings are provided with at least two fit bolts/dowels at the parting line.</li> <li>iii) Dip sticks with minimum / maximum level markings are provided.</li> <li>iv) Drain plugs are provided at convenient locations preferably at vertical wall of the housing.</li> <li>v) Breathers are provided.</li> <li>vi) Lifting lugs or eye bolts are provided as required.</li> <li>vii) Wherever bearings have splash lubrication, oil retainers are provided.</li> <li>viii) Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint.</li> <li>ix) In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided.</li> </ul> <p>Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.</p>		



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T  
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section IA

Date DEC'21

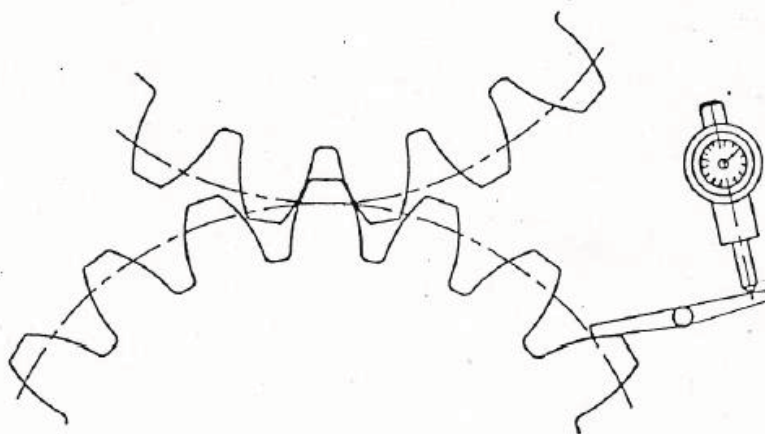


FIG.1 MEASUREMENT OF BACKLASH

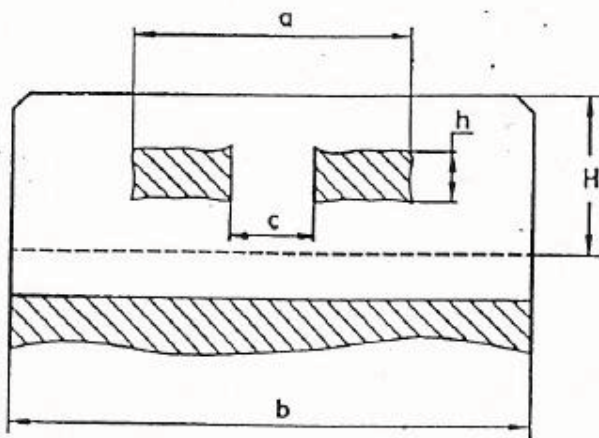


FIG.2 AREA OF CONTACT OF GEAR TEETH



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T  
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section IA

Date DEC'21

**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



MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN									
		PROJECT: 206 MW SHAHPURKANDI HEP PACKAGE : DOUBLE GIRDER CRANES									
		ITEM: QP NO : REV : 0 DATE :									
		CONTRACTOR : VENDOR'S QAP No :									
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS	
									M C N		
1		3	4 Critical	5	6 100%	7 ASME Sec-V	8 ASME Sec-VIII, Div-I, Appen - 8	9 DP Report	D-10 V P W V	11 DP test of fillet weld for rope drum to be conducted. After final machining random witness by BHEL	
d	fillet welds	Size and surface defects	Major	Visual	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	V P V V		
e	final insection of fabricated components listed in Sr.1 above	NDT Dimensions for Girder, end carriage rope drum etc. Camber, Verticality, bend etc	Major	DPT	10% RANDOM	ASME Sec-V	ASME Sec-VIII, Div-I, Appen - 8	Vendor inspection Report	V P W V		
f	Heat treatment of rope drum	Stress relieving	Major	Review of SR chart	100%	Approved drawing/relevant standard	Approved drawing/relevant standard	SR Chart	V P V V	If fabricated from M.S Plate	
3	Gear box casing	Surface condition	Major	Visual	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	V P V V	Refer note 1	
a	Material	Chemical & mech	Major	Measurement Correlation with T.C. Check test in absence of T.C. Correlation	100%	Manufacturing drawing/ IS: 2062	Manufacturing drawing/ IS: 2062	T.C. & I.R.	V P V V		






MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 206 MW SHAHPURKANDI HEP PACKAGE : DOUBLE GIRDER CRANES	
ITEM:		QP NO :		REFERENCE DOCUMENT		ACCEPTANCE NORMS		FORMAT OF RECORDS		AGENCY		REMARKS	
		REV : 0		Components Drawing		Components Drawing		9		M C N			
		DATE :		ASTM E-165		No linear indication		Vendor inspection Report		D** I O		11	
		QUANTUM OF CHECK		100%		100%		100%		P V V			
		TYPE PF CHECK		5		Major		Major		P V V			
		CLASS		4		Major		Major		P V V			
		CHARACTERISTICS		3		Major		Major		P V V			
		COMPONENTS & OPERATION		4		Major		Major		P V V			
		ii) Machined		a) Dimensions		Major		Major		P V V			
				b) DPT after machining.		Major		Major		P V V			
C		Gear box assy & idle running		Check for oil leakage, Noise level, vibration backlash, rise in temp. after 2 Hrs. of running, reduction ratio, backlash and contact pattern		Major		Major		P V V			
D		a) Top block, bottom block		dimensional conformity		Major		Major		P V V			
		b) Hook		i) Chemical composition, Heat treatment, Mechanical properties on integral test bar		Major		Major		P V V			
				ii) UT on raw material of hook		Major		Major		P V V			
				iii) Forging operation of hook		Major		Major		P V V			
				iv) Proof load test		Major		Major		P V V			
				v) UT & MPI after proof load test		Major		Major		P V V			
E		Rope drum assembly		Identification Punch (By BHEL &/or customer, after proof load & NDT witness)		Major		Major		P V V		CHP - Customer Hold Point	
12		Electrical components		Diemnsion		Major		Major		P V V			



MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN									
		PROJECT: 206 MW SHAHPURKANDI HEP PACKAGE : DOUBLE GIRDER CRANES									
		CONTRACT NO : CONTRACTOR : VENDOR'S QAP No :									
		ITEM:									
		QP NO : REV : 0 DATE :									
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS	
			4	5	6	7	8	9	M C N		
a)	Bridge with LT	Dimensions, wheel level alignment	Major	Measurement	100%	GA drg./S:3177	GA drg./S:3177	Insp. Report	V P W V	11	
b)	Crab assembly	Dimensions, wheel level alignment	Major	Measurement/ Vis	100%	GA drg./S:3177	GA drg./S:3177	Insp. Report	V P W V		
c)	Final Inspection ( at works) with actual panel and pendent	Overall dimension: Span, Diagonal dimension check, Wheel base & gauge, overhang, LT Stopper, headroom, lift, Eqp. Layout on bridge platform, , elevations /levels etc	Major	Measurement	100%	Approved drgs./S :3177	Approved drgs./S: 3177	Insp. Report	V P W W		
		<b>No Load &amp; Load Tests</b>									
		a) No load: Hoists,CT & current measurement, No Load running of LT machinery for direction and speed with VVVF	Major	Measurement	100%	Approved drgs	Approved drgs	Insp. Report	V P W W		
		b) SWL: Hoists, CT speed, current & Deflection measurement	Major	Operational Check & Measurement	100%	GA drg./S:3177/ Approved Drawing	GA drg./S:3177/ Approved Drawing	Insp. Report	V P W W		
		c) Overload: Hoisting, CT movement & current measurement (at 125% SWL)	Major	Operational Check & Measurement	100%	GA drg./S:3177/ Approved Drawing	GA drg./S:3177/ Approved Drawing	Insp. Report	V P W W		
		d) Operation check of brakes and limit switches .	Major	Operational Check	100%	GA drg./S:3177/ Approved Drawing	GA drg./S:3177/ Approved Drawing	Insp. Report	V P W W		
15	Painting	Surface preparation & Painting. DFT	Major	Visual	100%	Approved drgs/doc	Approved drgs/doc	Vendor's Report	P V		
		<b>Note 1 :</b> Original TCs / Photocopies certified in original by mill shall be furnished for review. Test in absence of correlated TCs Check test to be witnessed by BHEL 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.									
		<b>Note 2 :</b> 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 equivalent which gives enough readable and interpretable film quality to be used for clarity. All NDT shall be carried out by Qualified Level II personnel.									



647056/2022/PS-PEM-MAX

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	<b>206 MW SHAHPURKANDI HEP</b>	REV 00
	<b>DOUBLE GIRDER EOT CRANES ABOVE 100T</b>	Section IA Date DEC'21
	<b>SPECIFIC TECHNICAL REQUIREMENTS</b>	
<b>SECTION – IA</b> <b>CUSTOMER SPECIFICATION</b>		

## TECHNICAL SPECIFICATION

### 7.1 MECHANICAL AUXILIARIES

#### Scope of Supply

Mechanical Auxiliary Systems for the Two No. Power House (One set each) shall be provided as under:

- One(1) Power House / 40 T (~~tentative~~) or 10% more loading capacity of ~~heaviest load to be lifted in tones~~ EOT crane complete with Bridge, Operator's Cab. Trolley, Main Hoist, Electrical Controls, safety devices, fittings & connections and all necessary accessories to handle equipment.
- ~~Dewatering and drainage system for Power House,~~
- ~~Cooling Water System with water pipe lines and valves up to feeding points.~~
- ~~Low Pressure Compressed Air System with air pipe lines and valves.~~
- One (1) outdoor station centrifuge type Governor/lubricating oil purifier of suitable capacity to purify the complete oil of one unit in less than 24 hours, complete with motorized pumps, electric heaters, thermostatic control, instruments etc. including one (1) mobile transfer pump for filling the clean oil in drums for transfer to unit.
- Fire Protection System consisting of the following
  - a) Fire protection scheme for 11 KV, 33 & 8 MW (7 No.) Generators each.
  - b) Fire protection for generator transformers located in outdoor switchyard.
  - c) Fire protection of the area and equipment in power house not covered under above two groups.
- Ventilation and Air conditioning.

#### 7.1.1 Two (2) E.O.T. CRANES ONE FOR EACH POWER HOUSES

##### 7.1.1.1 Scope of Supply

- One (1) Power House / 40 T (~~tentative~~) or 10% more loading capacity of ~~heaviest load to be lifted in tones~~ crane complete with Bridge, Operator's Cab. Trolley, Main Hoist, Electrical Controls, safety devices, fittings & connections and all necessary accessories to handle equipment.
- One (1) cradle slings, etc. for load testing at site.  
Steel gantry girders are used
- One (1) set of main run way rails ~~with base plates~~, and or blots, rail clips, lock nuts end, stops, limit switches, striker plates, etc. for Power House
- One (1) set main run away conductors complete with brackets, fittings, inter connecting wiring etc. for Power House

- All special tools, devices, spanners etc. for assembly and installation of cranes.
- Wire ropes, for main hoists and Auxiliary hoists of cranes.
- One (1) set of spares for 5 years of normal operation of cranes.
- Any other items not specified above but are necessary for proper operation of cranes.

#### 7.1.1.2 Design Requirements

All parts of the crane and runway rails shall be designed to sustain the loads and the combination of loads listed below with due allowances for eccentricity of loading without exceeding safe permissible stresses. Mechanical parts of the crane including trucks and trolley frames shall be designed for the specific loads using a factor of safety of 5 (five) based on the ultimate strength.

- a) Loads :
- i) **Dead load:** The weight of all effective parts of the bridge structure, machinery parts and fixed equipment supported by the structure.
  - ii) **Live load:** The weight of trolley and lifted load (rated capacity) considered as concentrated moving loads at wheels in such positions as to produce the maximum moment and shear.
  - iii) **Vertical impact load:** 15 (fifteen) percent of the total live load.
  - iv) **Braking load:** The force produced on sudden application of bridge travel brakes when carrying rated load and traveling at full speed with the power off.
  - v) **Lateral load due to trolley tractive efforts:** 10 (ten) percent of the sum of trolley weight and the rated crane capacity applied equally on the trolley rails.
  - vi) **Longitudinal load due to bridge tractive effort:** (10 (ten) percent of the sum of the weight of crane and its rated capacity with the lifted load located at the extreme extent of travel of each end of bridge.
  - vii) **Earthquake load:** Earthquake force to be taken equivalent to 0.3g in horizontal direction and 0.3g in vertical direction.
  - viii) **Other loads:** Such as design floor load, special design load for horizontal frame design.
- b) **Combination of loads:** Unless otherwise stated, the crane shall be designed to sustain the combination of loads listed below without exceeding the safe permissible stresses.
- i) For crane in static hoisting position with dead load, live load and vertical impact load.
  - ii) For crane in motion with dead load, live load and any one horizontal load listed under lateral, longitudinal or specific design loads.

- iii) For crane in motion with a combination of dead load and braking load.
- iv) For crane in static position with dead load plus earthquake load.
- v) For crane in motion with dead load, live load and any (2) two or more horizontal loads listed under lateral longitudinal or special design loads with resulting unit stresses not more than 33-1/2 (Thirty three and one half) percent in excess of safe stress.
- vi) For crane in static hoisting condition, with a combination of load and forces produced by the maximum or breakdown torque of the main hoist motor with resulting stress not exceeding 90 (ninety) percent of the elastic limit of materials concerned.

#### 7.1.1.3 Safety Requirements

In the design of crane, all safety regulations as applicable with Factory Acts, Electricity Rules etc., as prevailing in the Purchaser's country and at the site of installation shall be taken in to consideration and provided for.

#### 7.1.1.4 Standards

Structural design of the crane shall be done in accordance with IS 807 – 1976 or relevant International Standards. The crane shall be designed as per IS 3177 – 1977 or relevant International Standards except as otherwise specified in these specifications. All equipment shall comply with the latest edition of the relevant Indian Standards specifications or relevant International Standards. When the equipments do not comply with the above standards, the salient points of difference between the standards adopted and the relevant Indian Standards or relevant International Standards shall be clearly brought out.

#### 7.1.1.5 Performance Requirements

The crane shall be capable of raising, lowering, holding and transporting its rated load without any damage or excessive deflection of any crane component.

The following tolerances shall be maintained in the operation of the crane.

- a) Smooth control of vertical movement to within 3 mm with hook carrying rated load and all hoist brakes properly adjusted at normal operation.
- b) Control of bridge and trolley motions to within 6 mm.
- c) The motor speed not to exceed 105 (one hundred and five) percent of synchronous speed while lowering a rated load.

#### 7.1.1.6 Technical Parameters

The Power House crane shall conform to the following requirements:

i.	Main hoist rated capacity	Min. 225 T (tentative) or 10% <del>more</del> loading capacity of heaviest load to be lifted in tones and should meet with requirement for handling the heaviest <del>assembly</del> of the Generating unit.
ii.	Auxiliary hoist rated capacity	40 Tones( <del>tentative</del> )
iii.	Main hoist normal speed	1.5/2.0 m/min( <del>tentative</del> )

REFER TECHNICAL DATA SHEET FOR OTHER TECHNICAL PARAMETERS/DETAIL

The creep motions of all movements shall be 10% of the main speed.

#### **7.1.1.7 Electrical Connections and Motors**

The main runway conductor system for supplying 415 V, 3 Phase 4 Wire 50 Hz power supply for the cranes shall consist of insulated rigid conductors, accessories and collectors. The conductor system for transmitting power and control commands to the trolley mounted equipment shall be of either festooned cable or insulated rigid conductors.

All motors shall be induction type with water tight terminals, antifriction bearings and built in totally enclosed fan ventilated enclosures. All motors speed shall not exceed 1500 rpm tentative. ~~Creep speed motors shall also be continuously rated.~~ All travels and hoists shall be provided with at least two sets of brakes working on different principles viz. electro magnetic, eddy current braking system etc.

All motions shall be provided with limit switches at both extreme ends of travel.

#### **7.1.1.8 Controls**

Master controllers shall be located in the operator's cabin. Indication and protections shall be provided on the control panel.

#### **7.1.1.9 Hoisting Ropes, Hooks, Lifting Beam**

Hoisting ropes shall be extra flexible having a breaking strength at least five times that of the maximum working load.

The crane shall be provided with a main hoist double hook of the ramshorn type and the auxiliary hoist hooks of the single type with a safety latch.

Main hook block shall incorporate a hole and pin for attaching lifting devices.

All the hooks shall be 360<sup>0</sup> swivel type rotating on antifriction bearings.  
One lifting beam adequate to lift the heaviest shall be provided.

**7.1.1.10 Runway Rails**

One set of runway rails and associated clamping devices with base plates, splice plates shall be included in the supply.

**7.1.1.11 Walkways, Platforms & Lighting**

Walkways, ladders, inspection platforms for allowing access to all parts of the crane shall be provided. Interior and exterior lighting inside the operator's cabin and on bridge shall be provided.

**7.1.1.12 Special Tools and Devices**

One set of all erection and maintenance tools special erection devices and testing devices shall be provided.

## FOR EACH CRANE

**1. SCOPE OF SUPPLY:**

- One (1)** No. EOT crane of T capacity, complete with bridge, main hoist, auxiliary hoist, electrical controls, VVVF drive, operator's cabin, safety devices, brakes, all fittings, connections & all necessary accessories to handle components and assemblies with in the powerhouse.
- One (1)** Set of main runway CR100 rails for EOT crane for the entire length of travel complete with ~~base/sole plates, anchor bolts~~, rail clamps, lock nuts, end stops, limit switches etc.
- One (1)** Set of bridge CR100 rails with rail clips, lock nut, end stops, limit switches, striker's plates, buffers etc.
- One (1)** Set of long travel DSL system shrouded copper conductor type, for crane complete with brackets, fittings, conductors, current collectors etc.
- One (1)** Lot of wire rope slings as per BIS 276.

**2. DESCRIPTION:**

**General:** The EOT Crane shall be electrically driven, single trolley, double girder, overhead traveling type. The crane shall operate on runway rails. The bridge of the crane shall be carried on sufficient number of wheels, mounted on trucks, designed to distribute the load equally on the truck beams & wheels and to allow the wheels to adjust themselves to the irregularities of the rail. Suitable platforms shall be provided for access to bridge trucks. Suitable walkways of sufficient width shall be attached to the outside of each bridge girder. Power shall be supplied from the festooned insulated wire type. Powerhouse EOT crane shall be cabin operated with Radio Remote Control for all motions of the crane.

**Standards:** EOT crane shall comply with the provisions and requirements of IS-3177, IS-807 and other National & International standard.

**EOT Crane:** Operator's cabin for Powerhouse EOT Cranes shall contain all the necessary controls for the operation of all the movements of Bridge, Trolley, main hoist, auxiliary hoist.

**Performance Criteria and Guarantee:** The crane shall be capable of raising, lowering holding and transporting their rated loads without any damage to or excessive deflection of any component.

The minimum possible travel as per project requirement shall be maintained in the operation of the Crane, with all brakes adjusted and functioning correctly and hook carrying rated load.



- The vertical deflection of crane girders caused by the rated load plus all dead load shall not exceed 1/1000 of the crane span.
- Minimum factor of safety of wire rope & slings shall be 6 and for structural members it shall be 5.

**Hook Reaches and Crane Clearances:** All these vital parameters shall be as per requirement & shall be finalized at the time of detail engineering stage. However, thrust shall be focused on the requirement of the project.

**Safety Requirements:** In the design of crane, all safety regulations as applicable with factory Acts, Indian Electricity rules etc. as prevailing in the country and the site of installation shall be taken into consideration and provided for.

**Design and Construction:**

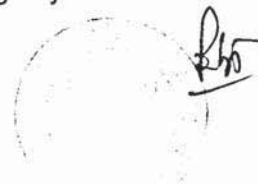
**Bridges:** The crane bridge, made of two girders as box type construction, reinforced with stiffening ribs, supported on end trucks, shall be designed to safely carry the full rated load without undue vertical or lateral deflection or vibration. The design shall ensure that girder vibrations are quickly dampened within 1 mm in 4 seconds. The bridge shall be designed taking into consideration the specified transport and handling limits in regard to size and weight of packages. Accordingly, the bridge shall be sectionalized into suitable but minimum no. of sections within the transport constraints as also of field erection & handling.

**Bridge Travel Mechanism:** The bridge travel mechanism shall comprise of electric motors for driving at least 25% of the bridge wheels on each rail. The motors shall be located near each end of the bridge and connected to separate gear reduction units. Longitudinal travel of the Crane shall be affected in such a manner that equal speed is ensured at each end trucks without skewing.

**Trolley:** The trolley shall consist of a welded form of structural steel section adequately braced to withstand vertical, lateral and torsional strains without undue deflection, and properly machined to receive the hoisting drums, wheel axles and motors for hoisting and cross travel. The trolley wheels and winding drums shall have heavy-duty roller bearings. Trolley wheels shall be made of rolled steel or forged steel. Each wheel shall be fitted with two roller bearings each mounted in a capsule housing held in place with two through bolts. Trolley wheels shall be double flanged. Bearing caps shall be provided with fittings for pressure lubrication.

**Trolley Drive Mechanism:** The trolley drive motors should be mounted on the trolley frame and arranged to drive at least one driving wheel on each side of the trolley frame through gearing and shafting. The trolley travel mechanism shall comprise of suitable nos. of electric motors and totally enclosed speed reduction gear unit, one for each end of the trolley to drive two trolley wheels, designed to ensure equal speed. The drive mechanism shall ensure steady motion, free from vibration and rocking. Two automatic electro mechanical brakes capable of bringing the motion of fully loaded trolley safely to rest, in the shortest possible time, with least possible shock shall be provided.

**End Carriages (Trucks):** The trucks of box type construction with openings at each end for receiving the truck wheels shall be either cast, or weld fabricated, or bolted, or riveted structure of steel and shall have adequate strength and stiffness. The ends of the trucks shall be shaped to form a hood over the truck wheels extending beyond them to



receive the track (rail) sweeps and bumpers. The trucks shall be arranged so that wear may be compensated in order to maintain the drive gear in proper mesh. The size of the journals shall be sufficient to carry the rated capacity load at specified speed without excessive heating during continuous operation.

**Wheels, Axles & Bearings:** The tread width shall have proper clearance for the railhead and shall be of sufficient size to withstand maximum static and rolling loads as per relevant International or Indian Standards. The tread diameter shall be as per relevant International or Indian Standards and preferably be standardized to size specified in relevant standards. The truck axles shall be made of forged carbon, or alloy steel and shall be accurately turned ground and polished at the wheels. All axles shall be forced fit into the wheel and the driving wheels shall be keyed to the axles in addition to the forced fit. Truck wheels shall be provided with roller bearings with high-pressure grease lubrication. All bridge truck bearings shall be interchangeable. Wheels bearings and journals shall be easily removable from the truck bodies.

**Slings:** Wire rope slings in pairs of suitable length and factor of safety not less than 6 for lifting specified load shall be furnished. Five pairs shall be provided for different loads up to the rated capacity of main hoist of crane.

**Hoisting Machinery:** The main hoist and auxiliary hoist (as applicable) shall be mounted on trolley framework. The hoists shall be driven by suitable motors, gears to obtain the required hoisting speed and VVVF drives. Each hoist shall be provided with two brakes working on different principles. Equalizers shall be included to assure that the tension in the rope is equalized.

**Lifting Tackle and Hook:** The lifting tackles shall consist of a lower block and hook, necessary sheaves, flexible steel wire rope etc. The lower block shall be a heavy steel housing to support the sheaves and hook. The load block shall be of enclosed design. The hook and block shall be arranged to lift without twisting and sidewise pull of load. The main hook shall be "Ramshorn" type conforming to International or Indian standards and auxiliary hook shall be of Shank type point hook conforming to International or Indian standards. Hooks shall be swivelled on antifricition thrust bearings and have adequate capacity to handle maximum load. The thrust bearings shall be provided with facilities for lubrication.

**Winding drums:** Winding drum shall have machined grooves to receive the full hoisting rope without overlapping. The drum shall be of such size that there will not be more than one layer of rope on the drum when the rope is in fully wound position and its length shall be such that each lead of rope has a minimum of 2.5 full turns on the drum left when the hook is in its lowest position and one spare groove for each rope lead off the drum when hook is at its highest position. The drums shall be designed to withstand the maximum compressive stresses and local bending stresses in the drum at the grooves when rope is wound on.

**Runway Rails:** The runway rails along with ~~sole plates~~, fixing clamps etc. for bridge travel, shall be designed and supplied as per relevant Indian and International Standards. The rails for shall extend to the full length of the powerhouse including the service bay. Bridge rails shall be laid on and fixed to the crane beam by means of anchor bolts.

A handwritten signature in black ink is located in the bottom right corner of the page. To the left of the signature is a faint, circular stamp or seal, which is mostly illegible due to its lightness and the overlapping of the signature.

**Operator's Cabin:** The power house EOT cranes shall be equipped with operator's cabin complete in all respects in accordance with relevant standards. The operator's cabin shall be of structural steel frame to give an aesthetic look and shall be of the open type, suitable for indoor service. The cabin shall be suspended from the outside girder of the crane and braced to the crane so as not to sway, swing or shake. The inside height of the cabin shall be greater than 1.9m.

**Walkways & Ladders:** Ladders, platforms, walkways, hand hold, foot hold etc. necessary to give safe access to and movement in the cabin, bridge drive and trolley drive mechanism, and all other components of the crane needing inspection maintenance, lubrication and repair shall be provided for. The walkways shall be of steel chequered plate.

**Shafts:** All shafts shall be designed and made with high tensile rolled steel or forged steel, Shaft shall have provision of key slot & splines, suitable shoulders/step up diameter etc for fitting of gears etc, fillets of suitable radius at all diametric changes in sections, shall be designed to limit deflection.

**Brakes:** Mechanical or hydraulic operated foot brake shall be provided for long travel, in addition to automatic electro-mechanical DC brake and electro hydraulic thruster brake for each motor of LT travel. An automatic electro-mechanical DC brake capable of bringing the motion of fully loaded trolley safely to rest shall be provided. In addition, a thruster brake shall also be provided for each motor of CT motion. All brakes provided on each bridge and trolley drive motor shall have a capacity not less than 150% of the full load torque of the bridge or trolley drive motor.

**Limit Switches:** Necessary limit switches shall be provided for the crane hoists to prevent over winding, over traversing and over travelling. At least the following limit switches shall be provided for the crane:

- Hoist driven limit switches for the upper and lower hook position,
- A back-up over travel limit switch for the extreme upper position of each hoist,
- Lever-operated limit switches for both end positions of all travel motions.

**Gears:** All gears shall be of cast steel/wrought steel, shall be designed for the specified crane duty, and shall conform to relevant International or Indian Standards. The gears and pinion for all the motions shall be herringbone or helical type. Gearbox casing shall be fabricated from tested quality cast steel or welded steel plates and duly stress relieved. The casing shall be effectively sealed against oil leakage. Gear cases shall be mounted on machined surfaces. Shims shall not be used.

**Drip Pans and Covers:** All bearing and gear cases shall be made oil tight. Suitable drip pans shall be provided to collect oil and grease, which may drip from bearings, gear cases and other components of the crane in case drip proof arrangement is not possible. Dust cover shall be provided where necessary to protect sliding and rotating parts and to prevent dust from mixing with lubricant.

**Sheaves :** Sheaves shall be manufactured from cast steel or forged steel or rolled steel. Sheave grooves shall be smooth and free from surface defects, which could cause rope damage. The cross sectional radius at the bottom of the groove shall be such as to form a close fitting saddle for the size of rope used, and the sides of the groove shall be tapered

outward to facilitate entrance of the rope into the groove. Flange corners shall be rounded, and the rims shall run true about the axis of rotation.

**Electrical Apparatus and Control:**

**Motors:** All the motors should be totally enclosed type and shall be strong and sturdy to withstand shock and vibrations transmitted to them. The enclosure protection class shall be IP 54 and winding insulation class 'F' with temperature rise limited to class 'B' insulation. The cranes shall also be equipped with "Soft-starts" starting the crane gradually from ramping speed of the motor to maximum, preventing load swing.

All motors shall at least be of 60 minutes (40% CDF) rating with pull-out torque at least 2.5 times the rated load torque for permanent operation. The motors shall be suitable for 150 (one hundred & fifty) starts per hour minimum. Electrical equipment mounted on bridge platform shall be enclosed type in sheet metal enclosure, with a provision for easy access to parts inside. The control panel shall be so spaced that efficient maintenance is possible and shall withstand the mechanical forces imposed by the crane under service condition.

**Drive Control:** All the drives (Main hoist, Auxiliary hoist, Bridge & Trolley travels) of each crane shall be supplied with variable voltage variable frequency (VVVF) for fine speed control of the drives.

Equipment for controlling this drive shall be a multi drive system, with inverters in one cabinet. Each cabinet consists of one common rectifier with a common DC-bus, with inverters connected. This system shall, in case braking energy is being supplied from one motor, supply the energy to the next motor connected to the DC-bus. If the braking energy exceeds the energy used by the other inverters, a braking chopper will open, and supply the energy to a braking resistor.

**Electrical Interlocks:** The main circuit breaker for power supply shall have interlock providing circuit breaker to be able to be closed only when all the control lever switches for the various motors are in "OFF" positions.

**Control Levers and Pushbuttons:** For individual independent control (start, stop and motor speed selection) of crane, suitable joysticks/control levers/push buttons shall be provided as described in this specifications.

**Long Travel Current Collection System:** A safe, robust and compact and completely covered, approved down shop leads (DSL) power supply system with suitable collector using latest technology shall be provided for the machine hall & unloading bay cranes on upstream side. It shall consist of substantial rolled copper conductors of adequate capacity with end brackets and insulators, straining bolts, intermediate brackets and insulators etc. to suit power house buildings. One end of each conductor shall be fitted with a terminal log to enable power and earth wires to be connected. There shall be no exposed conductor. The supply to D.S.L. shall be controlled by L.T. breakers installed at each end at a convenient place so as to receive the supply from L.T. Switchgear.

**Trolley Conductors:** Trolley power conductors shall be of the festooned insulated wire type. Each motor on the trolley shall have separate conductors for the power and in no case shall a power conductor be used as a common conductor for more than one circuit.

**Cable Wiring and Other Conductors:** All wiring shall be laid on perforated cable trays or clipped on the crane structure by suitable device. All the cables shall have sufficient current

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carrying capacity as per relevant Standard specification. Cables used for crane wiring shall comply with relevant Indian and International Standards specifications. Unless otherwise agreed, only copper cables shall be used for power & control wiring.

**Lighting & Convenience Outlets:** The permanent 230 volts lighting system of the crane shall consist of 4 nos. of 1000W of lighting units to illuminate uniformly the area under the crane and 2 nos. 100W tubes in operator's cabin. The ladders, platforms and walkways shall be equipped with vapour-tight incandescent industrial lighting fixtures with clamp or screw guards. The lighting fixtures shall be such that it must be able to withstand the shock and vibrations of the crane. Fixture units shall be furnished and mounted for general illumination under the crane. They shall be high-pressure mercury type, as specified in these specifications. Fixtures shall be mounted in a position that shall provide a uniform pattern of light for the length of the crane on the floor beneath it. They shall be mounted so that they produce no major shadows and are readily accessible for safe servicing.

**Alarm Gong:** An electrically operated alarm gong or buzzer, which will sound while the crane is in motion, shall be furnished with each crane. The alarm gong shall also be operable from a conveniently located switch when the crane is not in motion.

**Earthing:** 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 Indian Electricity rules 1956 and IS 3043.

**Emergency Push Button:** Emergency push button shall be provided in the controller for emergency tripping. The push button shall be so arranged as to immediately put off the main supply and apply all the brakes simultaneously irrespective of controller position.

**Painting:** Before delivery, all exposed, unfinished metal surfaces shall be cleaned and shop painted. Cleaning and Preparation of steel surfaces shall be in accordance with relevant standards and they shall be given at least one prime coat the same day. Paint shall be in accordance with applicable portions of relevant Indian Standards. The colors of the paint will be selected at the customer's option. All interior surfaces of the crane those are accessible for maintenance inspections shall also be completely painted.

#### **Quality Control and Assurance:**

**General:** Supply of equipments for EOT crane shall be of best quality. The shop assembly and tests shall be witnessed as per the requirement of customer's approval and Quality Assurance document. The complete EOT crane, components and materials shall be tested as described in the tender document.

**Installation and Commissioning:** All works related to assembly, erection, testing and commissioning including load tests etc. for the EOT crane of powerhouse and also including all work's related to erection of rails and current carrying leads shall be done. All type of consumables including electrodes for the above shall be supplied.

### **3. TEST SCHEDULE**

**All the tests shall be conducted as per Approved Quality Assurance Plan (QAP).**

#### **Shop Tests**

The customer or his authorized representative shall have access to the manufacturer's work at all reasonable times for the purpose of witnessing the manufacture, inspection of

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assembly, match marking etc. and testing of all the components, sub-assemblies and assemblies of complete crane. All shop tests as per IS 3177 (latest) shall be carried out.

**Field Test**

After installation at site, all the tests conducted earlier at works in accordance with tests specified shall be repeated. In addition, all the tests as specified in IS 3177 shall be conducted such as Insulation test, Motions and approach distances test, speeds test, tests for operation, deflection tests, overload tests etc.

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647056/2022/PS-PEM-MAX



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T


SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00


Section I A Date DEC'21

## SUB-SECTION IA ANNEXURES


	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

**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		
7.	BRAKES	ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
		PATHE		
8.	CONTACTOR	SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
		BCH		
9.	OVER LOAD RELAYS	SIEMENS		
		L&T		
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501	
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA	Date DEC'21

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


	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

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

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21


SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		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	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		<b>TITLE</b> <b>206 MW SHAHPURKANDI HEP</b>		SPECIFICATION NO. PE-TS-406-501-A501 REV 00
		<b>DOUBLE GIRDER EOT CRANES ABOVE 100T            SPECIFIC TECHNICAL REQUIREMENTS</b>		Section IA   Date DEC'21
		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.	<b>XLPE CONTROL CABLES</b>	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.	<b>CABLE GLAND</b>	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
25.	<b>PUSH BUTTONS</b>	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
26.	LIMIT SWITCHES	SPEED-O-CONTROL ELECTROMAG		
27.	MASTER CONTROLLER	SPEED-O-CONTROL ELECTROMAG		
28.	SAFETY SWITCHES	ALSTOM L&T SIEMENS		
29.	PENDENT PUSH BUTTON STATION	OEM		
30.	INDICATING LAMPS	TECKNIC BCH SIEMENS  STANDARD		
31.	MCB	MDS INDO COPP STANDARD SIEMENS L&T ABB SCHNEIDER		
32.	PANELS	OEM RITTAL PYROTECH		
33.	RESISTANCE BOXES	ENAPROS OEM		
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD. ASHOKA ENGINEERING COMPANY KANADIA FYR FYTER PVT. LTD NITIN FIRE PROTECTION INDUSTRIES LTD NEW ENGINEERING CORPORATION SAFEX FIRE SERVICES LTD UNITED FIRE EQUIPMENTS PVT. LTD ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	YASKAWA ABB SIEMENS SCHNIEDER FUJI ELECTRIC MITSUBISHI ELECTRIC		


647056/2022/PS-PEM-MAX

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

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

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21


## ANNEXURE-II MANDATORY SPARES

### MANDATORY SPARES:

Sl. no	Description Quantity	Quantity For PH- I	Quantity For PH- II
1	Pair of brake shoe	2 sets	2 sets
2	Pair of brake lining	1 set	1 set
3	Main spring for each size of brakes	1 no.	1 no.
4	Brake coil for each size of brakes	1 set	1 set
5	Thruster of each size	1 no.	1 no.
6	Pair of oil seal of gear box	1 set	1 set
7	Contactora of each size	1 set	1 set
8	Fixed & moving contacts of contactora	1 set	1 set
9	Coil of contactora	1 set	1 set
10	Over load relay for motor	2 nos.	2 nos.
11	Timer	2 nos.	2 nos.
12	Carbon brushes & holding for motor	1 set	1 set
13	Fuse link of each size	1 set	1 set
14	Resister element of each size	1 set	1 set

#### Note:-

1. "One (1) Set is defined as 100% requirement for one crane for the entire cranes of similar size & capacity.
2. The Bidder shall recommend additional spares for 5 years satisfactory operation and quote for all items other than mandatory spares separately.
3. All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then suitable applicable alternate spare have been offered / shall be supplied without any financial implication.
4. 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.
5. 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.
6. 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. The spare shall be treated and properly packed for long term storage.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501	
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA	Date DEC'21

7. 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.

8. 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.

### ANNEXURE III - TOOLS & TACKLES

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

S-No.	Description	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	Tool Box	1 No

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



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T  
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section IA

Date DEC'21

### ANNEXURE IV PAINTING SPECIFICATION

S. No.	Description	Surface preparation	Paint system	DFT in microns
1	External surfaces of Cranes, Fixed Hoist supports and other Drive Supports	Sa 2 1/2	Prime Coat: Red Oxide Zinc Chromate as per IS:2074 (alkyd medium)	2 X 25-35
			Finish Coat : Synthetic Enamel(alkyd Medium) as per IS	3 X 20-25
			Total	110-145
2	Control cabinets, Panels.	Seven Tank Process	Prime Coat: zinc phosphate (alkyd medium)	2 X 25-35
			Finish Coat : Synthetic Enamel (alkyd medium) as per IS: 2932	3 X 20-25
			Total	110-145

#### 1. Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	External surfaces of Cranes, Fixed Hoist supports and other Drive Supports.	Golden Yellow shade 356 as per IS-5	Colour band-Black
4	Control cabinets, panels	Light Gray (Powder coated) shade 631 as per IS-5	



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T  
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section IA

Date DEC'21

## ANNEXURE-V

**DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

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

**BASIC ENGINEERING DRAWINGS:**

S.N.	BHEL drawing No.	Title	Schedule date of submission from date of LOI.
1	PE-V0-406-501-A501	Manufacturing Quality Plan with sub vendor list For TG Hall Crane	2
2	PE-V0-406-501-A504	Mechanism Sizing Calculation Including storm brake calculation for TG Hall Crane	2
3	PE-V0-406-501-A505	General arrangement for TG Hall Crane with CT DSL details	2
4	PE-V0-406-501-A506	Crab sub assembly for TG Hall crane with CT wheel assembly	3
5	PE-V0-406-501-A509	Main and Auxiliary hook block assembly with details of hook, nut and check plate For TG Hall Crane	2

**OTHER DRAWING/DOCUMENTS**

1	PE-V0-406-501-A503	Data sheet of motors for TG Hall Crane	14 days after CAT II approval /clearance from BHEL on Mechanical sizing calculation
2	PE-V0-406-501-A508	General arrangement for PVC shrouded DSL for TG Hall crane	7 days after CAT II approval /clearance from BHEL on GA Drawing
3	PE-V0-406-501-A510	Long travel Machinery Assembly with LT wheel assembly For TG Hall Crane	7 days after CAT II approval /clearance from BHEL on GA Drawing
4	PE-V0-406-501-A512	Structural calculations For TG Hall Crane	7 days after CAT II approval /clearance from BHEL on GA Drawing
5	PE-V0-406-501-A514	O & M Manual For TG Hall Crane	14 days after CAT I approval Of all drawings
6	PE-V0-406-501-A516	Electrical equipment layout in cabin for TG Hall crane	10 days after CAT II approval /clearance from BHEL on GA Drawing
7	PE-V0-406-501-A517	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Aux. hoist panel & BOM d) Cross Traverse & BOM e) Long Traverse & BOM Including earthing diagram For TG Hall Crane"	7 days after CAT II approval /clearance from BHEL on Mechanical sizing calculation
8	PE-V0-406-501-A518	"General Arrangement of a) Protective panel b) Main hoist panel c) Aux. hoist panel d) Cross Travel panel e) Long Traverse travel panel.	7 days after CAT II approval /clearance from BHEL on Electrical Scheme



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T  
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00


Section IA


Date DEC'21

		f) Pendent g) Remote Radio Control For TG Hall Crane"	
9	PE-V0-406-501-A519	Cable Sizing and cable schedule For TG Hall Crane	7 days after CAT II approval /clearance from BHEL on Electrical Scheme
10	PE-V0-406-501-A521	Type test certificate (for motors) For TG Hall Crane	14 days after CAT II approval /clearance from BHEL on Mechanical sizing calculation
11	PE-V0-406-501-A525	Erection procedure For TG Hall Crane	28 days after CAT II approval /clearance from BHEL on GA, Mechanical sizing calculation, Scheme
12	PE-V0-406-501-A527	Data sheet of TG Hall Crane with painting details	7 days after CAT II approval /clearance from BHEL on GA Drawing & Sizing calculation
13	PE-V0-406-501-A532	Gantry Rail installation for TG Hall crane	7 days after CAT II approval /clearance from BHEL on GA Drawing
14	PE-V0-406-501-A550	Crane lubrication drawing For TG Hall Crane	14 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.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21
<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.</p> <p>i) Schedule of drawings submissions, comment incorporations &amp; 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.</p> <p>j) Bidder to follow the following the drawing submission schedule:</p> <ol style="list-style-type: none"> <li>i. 1st submission of drawings from date of LOI as per the submission schedule.</li> <li>ii. Every revised submission incorporating comments – within 7 days.</li> </ol> <p>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.</p>		

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21


## 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.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA   Date DEC'21

### ANNEXURE-VII

#### 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. Resistors 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.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501	
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	Section IA	Date DEC'21

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

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

Sl.no. & Sections	Description	Tick ( √ )if included in Manual			Remarks
		Yes	No	Not Applicable	
<b>1.</b>	<b>Cover page</b>				
<b>1.1</b>	Project Name				
<b>1.2</b>	Customer/consultant Name				
<b>1.3</b>	Name of Package				
<b>1.4</b>	Supplier details with phone, FAX ,email address , Emergency Contact number				
<b>1.5</b>	Name and sign of prepared by , checked by & approved by				
<b>1.6</b>	Revision history with approval Details				
<b>2.0</b>	<b>Index</b>				
<b>2.1</b>	showing the sections & related page nos All the pages should be numbered section wise				
<b>3.0</b>	<b>Description of Plant/System</b>				
<b>3.1</b>	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				
<b>3.2</b>	Equipment list and basic parameter with Tag numbers				
<b>3.3</b>	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
<b>3.4</b>	Associated other packages and Interface /terminal points				
<b>3.5</b>	P&ID & Process Diagrams				
<b>3.6</b>	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
<b>3.7</b>	Single line/wiring diagrams				
<b>3.8</b>	Control philosophy /control write-ups				

<b>4.0</b>	<b>Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)</b>				
<b>4.1</b>	Pre-Commissioning Checks				
<b>4.2</b>	handling of items at site				
<b>4.3</b>	Storage at site				
<b>4.4</b>	Unpacking & Installation procedure				
<b>5.0</b>	<b>Operation Guidelines for plant personal/user/operator</b>				
<b>5.1</b>	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.				
<b>5.2</b>	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.				
<b>5.3</b>	Do's & Don't of the equipments.				
<b>5.4</b>	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
<b>5.5</b>	Parameters to be monitored with normal values and limiting values				
<b>5.6</b>	Trouble shooting with causes and remedial measures				
<b>5.7</b>	Routine operational checks, recommended logs & records				
<b>5.8</b>	Changeover schedule if more than one auxiliary for the same purpose is given				
<b>5.9</b>	Painting requirement and schedule				
<b>5.10</b>	Inspection, repair , Testing and calibration procedures				
<b>6.0</b>	<b>Maintenance guidelines for plant personal</b>				
<b>6.1</b>	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
<b>6.2</b>	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	<b>Statutory and other specific requirements considerations.</b>				
8.0	<b>List of reference documents</b>				
9.0	<b>Binding as per requirement</b>				

647056/2022/PS-PEM-MAX



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

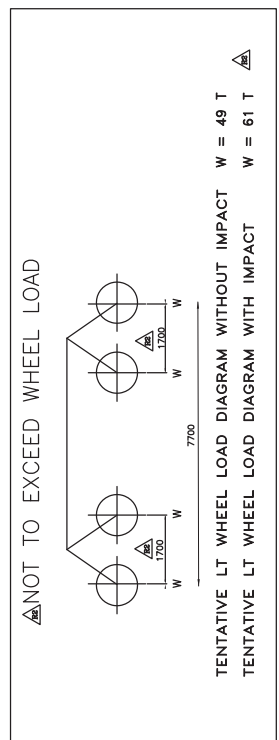
REV 00

Section IA Date DEC'21

SECTION – IA

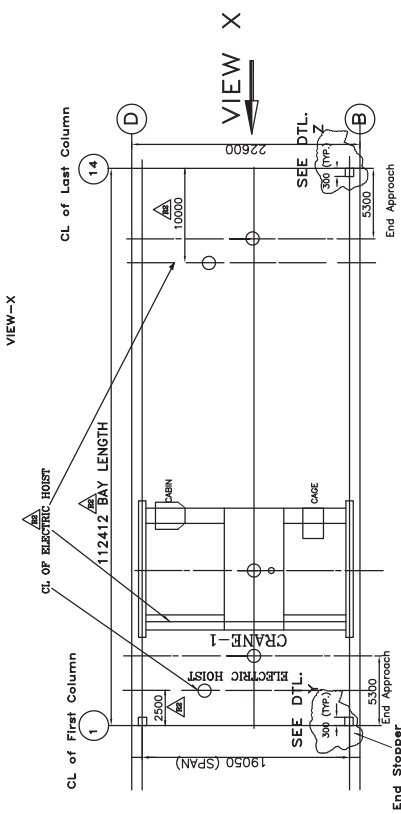
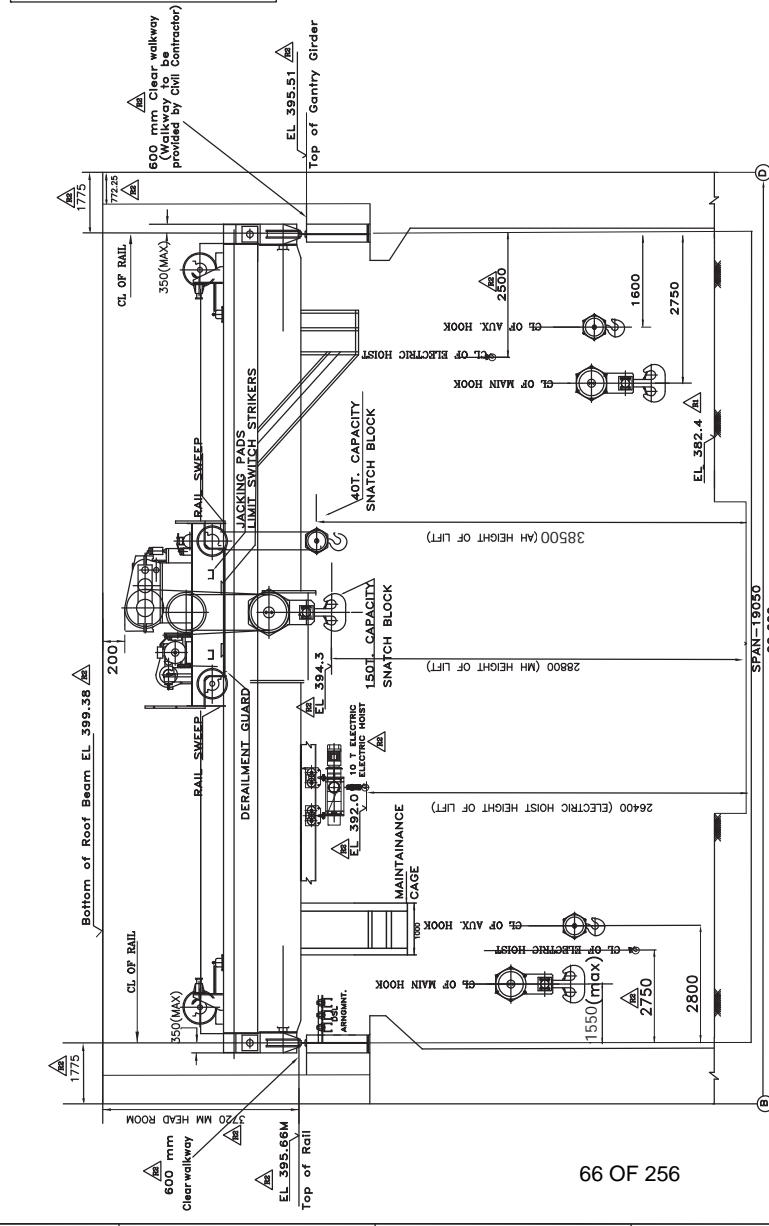
**CRANE CLEARANCE DIAGRAM**

REV. 1 100A-105-90G-40G-PE-3MD

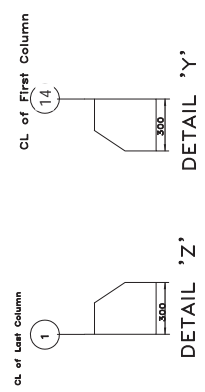


NOTES

- 1) DRAWING IS NOT AS PER THE SCALE.
- 2) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
- 3) NO. OF CRANES= 1



KEY PLAN



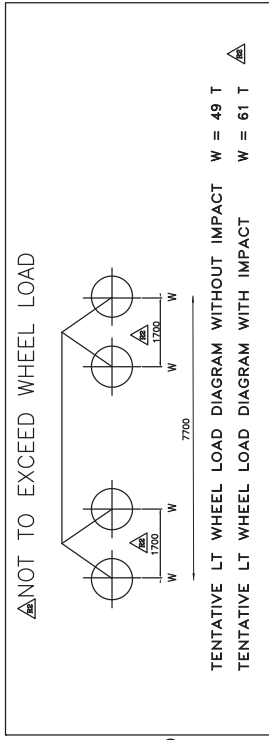
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FOR TENDER ONLY		
FOR CONSTRUCTION		
ARCHITECTURAL		
MECHANICAL		
ELECTRICAL		
PLUMBING		
PAINTING		
REVIEWED		
APPROVED		

APPROV.	MECH. INST.	ELEC.	STRUC.	ARCH.	NATURE OF REVISION & DESCRIPTION	DATE	REV.	DRAWN.

PROJECT	206 MW SHAHPURKANDI HEP-I
CUSTOMER	PSPCL PUNJAB
OWNER CONSULTANT	WAPCOS LIMITED
DESIGNER	BHARAT HEAVY ELECTRICALS LTD
PROJECT MANAGER	POWER SECTOR PROJECTS DIVISION, MANAGEMENT
TITLE:-	CRANE CLEARANCE DIAGRAM OF 160/40T POWER HOUSE BUILDING CRANE
SCALE:-	DATE:-
DRAWN BY:-	CHECKED BY:-
REVISED BY:-	DATE:-
APPROVED BY:-	DATE:-
JOB NO.	405
INEL. DRAWING NO.	PE-DG-40G-501-A001/1
REV.	02

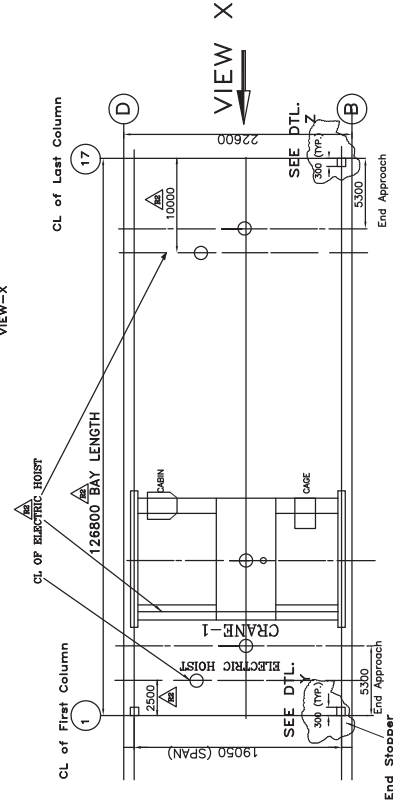
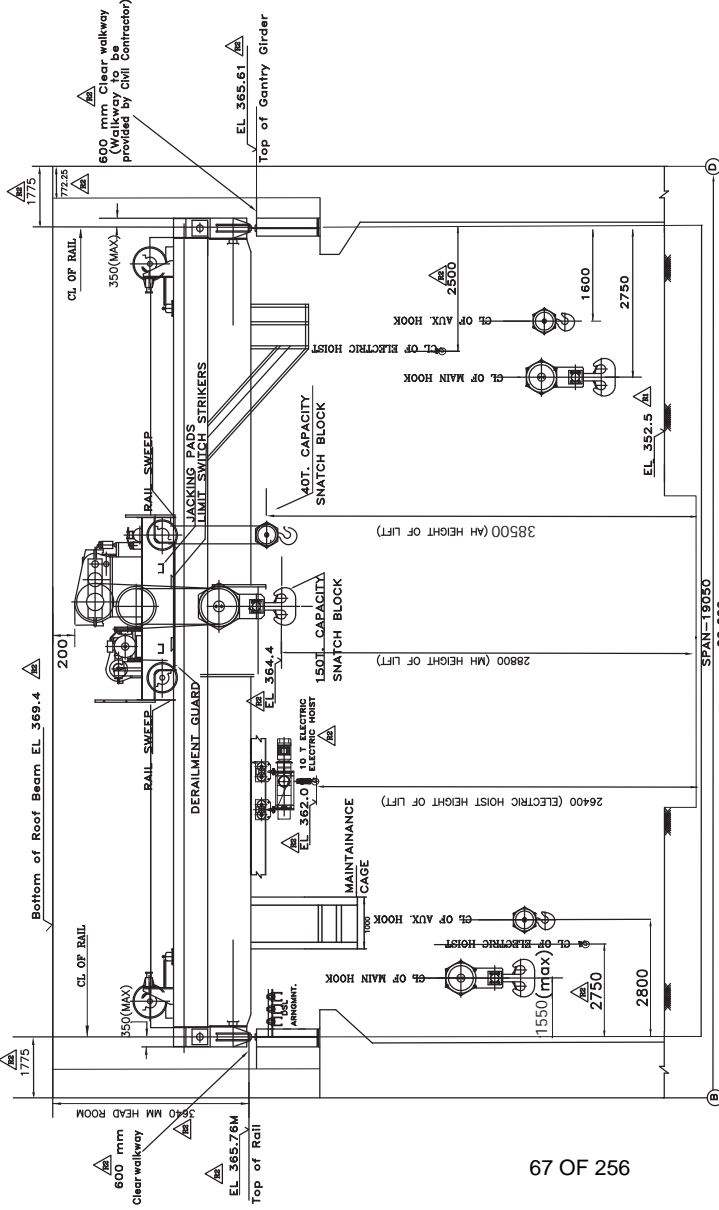
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REV. 1

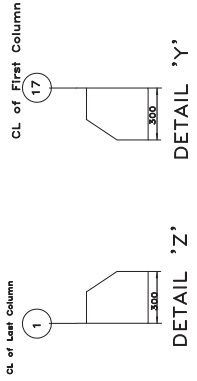


NOTES

- 1) DRAWING IS NOT AS PER THE SCALE.
- 2) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
- 3) NO. OF CRANES= 1



KEY PLAN



RELEASE STATUS	DATE	SIGNATURE
FOR TENDER ONLY		
FOR CONSTRUCTION		
ARCHITECTURAL		
MECHANICAL		
ELECTRICAL		
PLUMBING		
PAINTING		
INTERIOR		
EXTERIOR		
MECHANICAL		
ELECTRICAL		
PLUMBING		
PAINTING		
INTERIOR		
EXTERIOR		

PROJECT	206 MW SHAHPURKANDI HEP-II
CUSTOMER	PSPCL PUNJAB
OWNER CONSULTANT	WAPCOS LIMITED
DESIGNER	BHARAT HEAVY ELECTRICALS LTD
PROJECT MANAGER	POWER SECTOR PROJECTS
PROJECT SUPERVISOR	INDIA RAILWAYS MANAGEMENT
TITLE	CRANE CLEARANCE DIAGRAM OF 160/40T POWER HOUSE BUILDING CRANE
DRAWN	DRS
CHECKED	PRS
SCALE	1:1
DATE	27/08/21
APPROVED	DRS
JOB NO.	405
INEL DRAWING NO.	PE-DG-406-501-A001/2
REV.	02



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section I B Date DEC'21

Page 1 of 1

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



TITLE : <b>ELECTRICAL EQUIPMENT SPECIFICATION          FOR          EOT CRANE</b>	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION : C
	REV NO. : 00
	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

## ANNEXURE – I


## STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR


PACKAGE: EOT CRANES

SCOPE OF VENDOR: SUPPLY

PROJECT : 206 M SHAHP RKANDIHEP

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>REMARKS</u>
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			SPECIFICATION :					
		BIDDER/ VENDOR SYSTEM			TITLE			NUMBER :					
QUALITY PLAN		BIDDER/ VENDOR SYSTEM			QUALITY PLAN			SPECIFICATION					
SHEET 1 OF 2		CAT.			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	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 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE 1.SHADE	MA MA MA MA	VISUAL -DO- VISUAL VISUAL	100% -DO- 100% SAMPLE	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC./ RELEVANT IS	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC. RELEVANT IS BHEL SPEC. SAME AS COL.7	-DO- -DO- -DO- LOG BOOK	2 2 2 2	- - - -	- - - -		
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION	MA MA	-DO- MEASUREMENT & VISUAL	100% 100%	IS-325/ BHEL SPEC/ DATA SHEET APPROVED DRG/DATA SHEET	SAME AS COL.7 APPROVED DRG/DATA SHEET & RELEVANT IS	TEST REPORT INSPN. REPORT	2 2	1 1	- -	NOTE -1 & NOTE-3 NOTE -1 & NOTE-3	
BHEL		PARTICULARS			BIDDER/VENDOR								
		NAME											
		SIGNATURE											

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION :			
BIDDER/ :		QUALITY PLAN		NUMBER :		SPECIFICATION :		TITLE :			
SYSTEM VENDOR		NUMBER PED-506-00-Q-006, REV-01		ITEM AC.ELECT. MOTORS BELOW 55KW (LV)		SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS		
								P	W	V	
1	2	3	4	5	6	7	8	9	10	11	
	3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>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 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION. (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</li> <li>2. FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UP TO 1.5KW . ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</li> <li>3.</li> </ol> <p><u>Legends for Inspection agency</u></p> <ol style="list-style-type: none"> <li>1. BHEL/CUSTOMER</li> <li>2. VENDOR (MOTOR MANUFACTURER)</li> <li>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</li> </ol> <p>P. PERFORM W. WITNESS V. VERIFY</p>											
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
										BIDDER'S/VENDORS COMPANY SEAL	



## LV MOTORS

DATA SHEET-A

SPECIFICATION NO.

VOLUME II B

SECTION D


REV NO. 00 DATE

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	:	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.**


647056/2022/PS-PEM-MAX

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

S. No.	Description	Data to be filled by successful bidder
<b>A.</b>	<b>General</b>	
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>B.</b>	<b>Design and Performance Data</b>	
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			

647056/2022/PS-PEM-MAX

	TITLE	SPECIFICATION NO.
	<b>LV MOTOR DATA SHEET - C</b>	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	
<b>C.</b>	<b>Constructional Features</b>	
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)	
<b>D.</b>	<b>Characteristic curves/ drawings</b> (To be enclosed for motors of rating $\geq 55KW$ )	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

## **1.9 ELECTRICAL WORKS AS APPLICABLE**

### **1.9.1 General**

- The electrical items of Works of any electrical or mechanical installation to be provided under this Contract according to the Particular Technical Specifications shall - if not stated otherwise therein-fulfill the requirements of this Section.
- All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.
- The Works shall be pre-assembled to the highest possible extent in the Contractor or Sub-Contractor's workshop, complete with all devices and wired up to common terminal blocks.
- The power supply and control cables shall be laid up to these common terminal blocks. The required control and protection devices, instruments, etc., within the different scopes of work shall be supplied and connected by the relevant Contractor.
- Unless otherwise agreed, ratings of main electrical Works (in feeds, bus-ties) as selected or proposed by the Contractor, whether originally specified or not, shall generally include a safety margin of 10% under consideration of the worst case to be met in service. Prior to approval of such basic characteristics, the Contractor shall submit all relevant information such as consumer lists, short circuit calculations, de-rating factors, etc.
- Short-circuit calculations shall be evaluated giving full evidence that every electrical component can withstand the maximum stresses under fault conditions, for fault levels and durations obtained under the worst conditions, e.g., upon failure of the corresponding main protection device and time delayed fault clearing by the backup protection device.
- All Works shall be suitable for the prevailing climatic conditions.
- The Contractor shall ensure that all the supplied Works is insensitive to any signals emitted by wireless communication equipment.

### **1.9.2 Clearances**

The layout of the Equipment on the site shall provide for ready access for operation and maintenance whilst the remaining sections of Equipment are alive. Working clearance provided between isolated Equipment and nearest live metal work shall be as per Indian Electricity rules & Standards.

### **1.9.3 Electrical Supplies For Auxiliary Equipment**

The electricity supplies available for auxiliary Equipment will be :

- 415 V, 3-phase 50Hz, 4-wire for power
- 220 V, single phase, 50 Hz for lighting, indication, and anti-condensation heaters.
- 220 V D.C. for essential indication, controls, protection, alarms and circuit breaker closing and tripping supplies.
- 48 V D.C for PLCC and 24 V D.C for SCADA System.

#### 1.9.4 Alternating Current Supply Practice

- All mains supplies shall be switched and fuse in accordance with the requirements stated in the appropriate Section. Double-pole switches shall be used to break single-phase A.C. mains supplies.
- For multi-phase supplies, each phase shall be switched simultaneously and the neutral should preferably not be switched. If it is switched, it shall be opened after and closed before the phase-lines.
- All mains circuits shall be protected only in the phase-lines by fuses of suitable rating or by other suitably protective devices. The neutral shall be connected by a removable link located near the protective devices.
- All mains transformers shall have an electrostatic screen which shall be earthed.
- Except where the prior approval of the Engineer is obtained, wires external to the equipment shall be coloured in accordance with the current IEC or relevant IS recommendation.

#### 1.9.5 Direct Current Supply Practice

- It shall be possible to remove/replace cards from / to electronic equipment without damage and without interfering with the operation of the rest of the equipment or system; if necessary consideration should be given to switching off the supplies locally to a card to prevent inadvertent interference to the equipment or system during removing/replacing a card.
- Application of battery or earth via a test lamp to any external interface point or test point shall not lead to any component damage.
- Power supply bus bars in cubicles shall be carefully routed and each bus bar shall be shrouded. It shall not be possible to inadvertently short bus bars either between themselves or to earth.

#### 1.9.6 Electric Motors

##### General

- All motors shall be of approved manufacture high starting torque and shall comply - as far as applicable - with ISI standard motor dimensions.
- The general construction shall be stiff and rigid; no light metal alloy casings will be accepted. All precautions shall be taken to avoid any type of corrosion.
- All motors shall be fitted with approved types of lifting hooks or eyebolts as suitable.
- AC motors shall have squirrel cage type rotors. Motor Voltages and Power Ratings
- The service voltages and corresponding power ratings for electric motors to be used in the Project shall be as follows:
- - Motors up to 100 kW  
Service voltage: 3-phase AC 415/240 V, 50 HZ  
Mode of starting : direct-on-line up

- Motors up to 0.75 kW
- Service voltage : single-phase AC 240 V,50 HZ
- Mode of starting : condenser
  
- Motors intended to work on the DC System
  - Service voltage: 220 V D.C.
  - Mode of starting: resistor

### Rating

- The rating of the motors shall be adequate to meet the requirements of its associated equipment. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine at its expected maximum power demand, shall be applied as follows:

<u>Power Demand of Driven Machine</u>	<u>Service Factor</u>
Up to 5 kW	1.2
More than 5 kW	1.1

- A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient over voltage of 130% of the nominal voltage shall as well be sustained.
- Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.
- D.C. motors shall be capable of operating continuously under rated output conditions at any voltage between 90% and 110% of the nominal voltage with a fixed brush setting for all loads. Unless otherwise approved, the speed drop between no-load and full-load shall not exceed 10% of no-load speed.

### Starting

- A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite bus bar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary bus bars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.
- The maximum starting currents (without any tolerance) shall not exceed the following values:
  - 5 times of rated current for L.V. motors rated 100 kW or above
  - 2 times of rated current for D.C. motors (by means of starting resistors)

- Generally, all motors shall be able to withstand five cold starts per hour, equally spaced. In addition, each M.V. motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each L.V. motor shall be capable of withstanding three successive starts under the same conditions or once every fifteen minutes without detrimental heating.
- Motors for frequent automatic starting shall have an adequate rating. In the motor list the Contractor shall state the frequency of starts permitted in compliance with the motor design.

#### **Insulation Class**

- The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials. It shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapours and for considerable fluctuations in temperature.

#### **Ventilation and Type of Enclosure**

- All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 141. Cable termination points shall be of class IP55.
- They shall have a closed internal cooling air circuit re-cooled by an external cooling air circuit drawn from the opposite side of the driving end.
- Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

#### **Bearings**

- As far as possible, the motors shall have sealed ball or roller bearings lubricated for life. All other motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and preventing over lubrication. Additionally, the bearings shall be fitted with: grease nipples permitting the use of a universal grease gun.
- Vertical motors shall have approved thrust bearings.

#### **Terminal Boxes and Earthing**

- The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables as specified in these General Technical Specifications and in the Particular Technical Specifications.
- The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.
- The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.
- A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation,

this shall be clearly indicated.

- For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

### **Noise-Level and Vibrations**

- Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).
- In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced.

### **Tests**

- Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

#### Workshop Tests:

- Measurement of winding resistances
- No-load and short-circuit measurements
- Measurement of starting current and torque - Efficiency measurement (type test) - Heat test run
- Dielectric test
- Measurement of insulating resistance

### **1.9.7 Starters and Contactors**

- Motor starters and contactors shall be equipped with short circuit protection and local disconnecting devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/240 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts.
- Starters and contactors shall comply with IEC 292.1 or NEMA IC 1 or relevant IS and be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Engineer. The enclosures shall be complete with locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards, etc as required by the duty of the starter or contactor.
- Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage, for a period of 5 minutes at a voltage 25 percent below nominal, at nominal frequency.
- Thermal type overload and phase failure relays shall be supplied with

starters for motors of 7.5 kW or greater. For motors of less than 7.5 kW, suitable rated 3-phase thermal overloads will be acceptable. Ammeters to read current in one phase shall be provided for motors above 7.5 kW.

- Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts for Owner's use.

#### **1.9.8 Moulded Case Circuit Breakers**

- All moulded case circuit breakers shall be of 2 or 3-pole type as required, having thermal time delay and instantaneous trips with "On-Trip-Off", indicating/operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The breakers shall comply with applicable section of IEC 15 7/1 or relevant Indian Standards.

#### **1.9.9 Control Relays**

- Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of 10A over a range of 6 to 600 V AC.

#### **1.9.10 Terminal Blocks**

- All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.
- Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.
- Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.
- Terminal blocks shall conform to the applicable standards. The smallest size to be used shall be designated for 2.5 Sq mm FRLS wire and not more than two conductors shall be connected under one terminal clamp.
- Terminal identification shall be provided corresponding to wire number of connected leads.

- Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with non inflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

#### **1.9.11 Equipment Wiring**

- All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.
- Multi-conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilizing slip-on ferrules approved by the Engineer.
- Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.
- Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.
- All trip circuits shall employ markers having a red background.

#### **1.9.12 Cubicles And Control Panels**

Cubicles and control panel enclosures shall be of sheet steel with minimum thickness of 2.5 mm, of rigid, self-supporting construction and supplied with channel bases.

- Cubicles shall be fitted with close fitting, gasketed, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.
- Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.
- The cubicles and panels shall be adequately ventilated, if required, by vents or louvers. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.
- Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.
- Unless stated otherwise, all cubicles and panels shall be provided

with a ground bus with 40mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm<sup>2</sup>.

- All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.
- The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.
- The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.
- Switched interior light and socket outlets shall be provided for all cubicles and control panels.
- All cubicles and control panels shall be provided with nameplates, identifying the purpose of the panel and all of its components.

#### **1.9.13 Earthing**

- Provision shall be made for earthing all equipment intended for connection in an A.C. mains supply. All structural metal work and metal chassis shall be connected to earth. Connection between circuits and metal work shall only be made for reasons of safety and/or reduction of interference. Where such connections are made, they shall not be used as normal current-carrying earth returns.
- Earthing conductors shall be at least equal in cross-sectional area to the supply conductors and shall be capable of carrying the fault current.

#### **1.9.14 Labels And Plates**

- Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.
- The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer for approval.
- Labels written in the Contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible.
- Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified. Cubicles and similar units shall also bear this

identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.

- All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list, etc.).
- Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

#### **1.9.15 Warning Labels**

- Warning labels shall be made of synthetic resin with letters engraved in the Contract and selected local language, where required in particular cases.
- For indoor circuit breakers, starters, etc., transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

#### **1.9.16 Labels For Cables**

- Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer, noncorrosive labels detailing identification number of the cable, voltage, and conductor size.
- The cable identification numbers shall comply with those of the cable list.
- All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

#### **1.9.17 Single-Line Diagrams**

- Each switchgear room shall be furnished with a copy of the final as-built single-line diagram detailing all electrical data and denominations, separate for each individual switchgear / distribution board / MCC, placed under glass and frame/wall mounted at an approved location.
- The same applies to the Station Single-Line Diagram one copy of which shall be arranged in the control room(s).

#### **1.9.18 Key System for Electric Boards**

- Key interlocked switches shall be provided with approved locks for locking in the neutral position. Similar locks shall be provided for

selector switches for locking the switches in any of the positions.

- The locks or padlocks shall be co-ordinated for the different applications and shall be supplied with three keys. The cabinet door keys shall be similar and shall be six (6) in number.

**7.2.3.11 TERMINAL BLOCKS**

Terminal blocks shall be required for both P/H

**7.2.3.12 CABLE TERMINATION**

The switchgear shall be designed to facilitate PVC insulated and armoured cable entry from the rear bottom of the panel. Detachable gland plate of adequate thickness shall be provided to avoid sharp bending and easy connection. Compression type SIBG tinned brass cable gland shall be provided for all cable terminations. Crimping type tinned lugs for control and power cables up to 3 x 16 sq. mm PVC cables and 3 x 25 sq. mm and above that open close type soldering lugs (tinned copper) to be used for cable terminations. Suitable shrouds shall be provided to prevent accidental contact with live outgoing termination of other feeders while carrying out maintenance on one feeder.

**7.2.3.13 LABELS**

Name plates of approved design shall be provided to represent circuit designation for each feeder. Material for name plates shall be of PVC sheet with rear engraving. They shall be firmly secured with fasteners.

**7.2.3.14 PAINTING**

All metal surfaces shall be chemically cleaned, degreased and pickled in acid to produce a smooth clean surface, free of scale, grease and rust.

After cleaning, phosphating and passivation treatment, the surface shall be given two coats of zinc rich epoxy primer and baking in the oven.

After primer, it shall be given two coats of storing type enamel paint (shade as per IS – 5 shade 631).

Sufficient quantity of touch up paint shall be furnished for application at site.

**7.2.3.15 TESTS**

Equipment shall be tested as per the relevant IEC or applicable Indian Standards.

**7.2.3.16 SPARE PARTS AND SPECIAL TOOLS****7.2.3.17 SPARE PARTS: LIST AS PER SECTION 10**

All spare parts shall be electrically and mechanically identical to corresponding parts of the equipment supplied and shall be suitably packed and clearly marked. All ready for long term indoor storage.

Contractor shall submit to a complete and distinct list of spare parts that the recommends be added to the above mentioned list and indicate the unit prices.

PSPCL reserves the right to purchase or not the spare parts appearing on the lists. The spare parts that are purchased shall be delivered with the equipment specified in this specification.

**7.2.3.18 SPECIAL TOOLS: LIST AS PER SECTION 10****7.2.4 POWER AND CONTROL CABLES****7.2.4.1 SCOPE**

This section covers for PVC cables for Medium Voltage, XLPE cables for High Voltage Systems and cable accessories for high voltage systems. All cables shall be armored, HRFRR type.

**7.2.4.2 STANDARDS**

The cables shall comply with the latest edition standards:

IS : 1554 (Part I)	PVC insulated (heavy duty) electric cables - Part I for working voltages up to and including 1 100 V.
IS : 7098 (Part II)	Cross-linked Polyethylene insulated PVC sheathed cables: Part II for working voltages for 12.7/22 kV.
IS : 8130	Conductors for insulated electric cables and flexible cords.
IS : 5831	PVC insulation and sheath of electric cables.
IS : 3975	Mild steel wires, strips and tapes for armoring of cables.
IS 2633	Methods of testing weight, thickness and uniformity of coating on hot dipped galvanized articles.
IS : 209	Specification for Zinc.
IS : 3961 (Part II)	Recommended current ratings for cables: Part-II PVC insulated and PVC sheathed heavy duty cables.
IS : 1753	Aluminum conductors for insulated cables.
BS : 2782 Part - I	Methods 141A, British Standard methods of testing Plastics - Part-I thermal properties.
IEC : 754-1 <b>OR</b> relevant IS	Test on gases evolved during combustion of electric cables Part I - Determination of the amount of halogen acid gas evolved during the combustion of polymeric materials taken from cables.
IEC : 60502 Series <b>OR</b> relevant IS	Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV.
IEC : 60811 & 60885 Series <b>OR</b> relevant IS	Test methods for insulation and sheaths of electric cables and cords.
IS : 9968 (Part-I)	Elastomer insulated cables - for working voltage up to and including 1100 V.

#### 7.2.4.3 GENERAL CONSTRUCTION

##### 7.2.4.4 GENERAL

The cables shall be brand new and in good condition. These shall be suitable for laying in trays, trenches, ducts, conduits and underground buried installation with uncontrolled backfield and possibility of flooding by water. The terminating and straight through joint kits for the cables shall be suitable for the type of cables offered and for storage without deterioration up to 40 °C ambient temperature.

##### 7.2.4.5 PVC CABLES

Low voltage power cables shall be of aluminum and control cables shall be of copper. All conductor cable shall be of Stranded construction.

All power/control cables for use on low voltage systems shall be heavy duty type, 1100 V grade with aluminum/copper conductor, PVC insulated, inner sheathed, armoured and overall PVC sheathed as detailed below:

- The construction of the conductors shall be stranded for aluminum cables. Conductors of nominal area less than 25 sq. mm shall be circular only. Conductors of nominal area 25 sq. mm and above may be circular or shaped.
- The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirements of Type A compound of IS : 5831. Control cables having 6 cores and above shall be identified with prominent and indelible core nos. on the outer surface of the insulation. Color of the numbers shall be white with a spacing of maximum 500 mm between two consecutive numbers.

- The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type STI PVC compound of IS : 5831. The extruded inner sheath shall be of uniform thickness of size not less than 0.5 mm up to 16 sq. mm, 0.8 mm from 25 sq. mm up to 120 sq. mm and 1.0 mm above 120 sq. mm conductor size. Taped inner sheath is not acceptable.
- All cables used for electronic circuit shall be of 1.5 mm<sup>2</sup> copper screened cables. The screening shall be of copper foil with drain wire. The 1.5 mm<sup>2</sup> conductor shall be stranded.
- The outer sheath for the cable shall be applied by extrusion and shall be PVC compound conforming to the requirements of type ST1 compound IS: 5831. To protect the cables against rodent and termite attack, suitable chemicals shall be added into the PVC compound of the outer sheath.
- The dimensions of the insulation, armour, and outer sheath materials shall be governed by values given in Section VI of IS 1554 (Part-I).

#### 7.2.4.6 XLPE CABLES

Power cables for 11/12.7/22 kV system shall be with Aluminum Conductor, XLPE insulated, screened, sheathed, armoured and overall PVC sheathed as detailed below. Insulation level of the medium voltage cables shall be 11/12.7/22 kV suitable for a high resistance grounding system and continuous ground fault condition. Conductor sizing shall take into account the maximum available short circuit. Medium voltage cables shall have a one second withstand at the maximum available RMS short circuit.

The construction of the conductors shall be stranded and compacted circular for all cables.

All cable rated 3.8/6.6 kV and above shall be provided with both conductor shield and insulation screening. The conductors shall be provided with non-metallic extruded semi-conducting shielding.

The core insulation shall be with cross-linked polyethylene unfilled insulating compound. It shall be free from void and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

The insulation shielding shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic screening of copper. The insulation screen shall be strippable without application of heat. The copper screen shall be capable of carrying the single line to ground fault for duration of 1 second. The conductor screen XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be colored strips or by printed numerals. The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of Type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness of size not less than 0.7 mm for all sizes of cables.

The outer sheath for the cables shall be supplied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of Type ST 2

compound of IS: 5831. To protect cable against rodent and termite attack, suitable chemicals shall be added into the PVC compound of the outer sheath.

The dimensions of insulation, armour, outer sheathing materials shall be governed by values given in Tables 1.3 and 4 of IS: 7098 Part -II.

#### **7.2.4.7 CABLE ACCESSORIES**

The termination for use on medium voltage system shall be suitable for the type of cables offered as per this specification. The termination shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumable items. An installation instruction shall also be included in each kit. Makes of kits other than those specified may be considered by PSPCL if type test certificates accompany the offer. These kits are to be provided as back-up tools and are not to be used by Contractor. Joints are not permitted under any circumstances.

#### **7.2.4.8 TERMINATING KITS**

The terminating kits shall be suitable for termination of the cable in indoor switchgear or in a weather proof cable box of an outdoor mounted transformer/motor. The terminating kits shall preferably be one of the following types:

- “TAPEX” of M-SEAL make using non-linear resistance material for stress grading.
- “PUSH-ON” type of CCI make using factory moulded silicon rubber insulators.
- “TROPOLINK” type of CCI make.
- Heat - Shrink sleeve type of M/s Raychem.

For outdoor terminations, whether shields/sealing ends and any other accessories required shall also form part of the kit.

#### **7.2.4.9 TESTING AND INSPECTION**

##### **7.2.4.10 GENERAL**

The cables shall be tested and examined at the Contactor's works by the PSPCL. Contactor shall furnish all necessary information concerning the supply to PSPCL. The inspector shall have free access to the Contactor's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any wire or other material which appears to him to be of unsuitable description or of unsatisfactory quality.

##### **7.2.4.11 PVC & XLPE CABLES**

After completion of cables and prior to dispatch, cables shall be subjected to type, routine, acceptance and special tests as detailed below. PSPCL reserves the right to witness all tests with sufficient advance notice from Bidder. The test reports for all cables shall be submitted for approval by the PSPCL

All cables where 5 core cables used, the size of neutral conductor should be 1.7 time of phase conductor.

All routine tests, acceptance tests, type tests as well shall be carried out on cables as listed in IS: 1554 Part I and IS: 7098 Part-II.

The inner and outer sheath of XLPE cables shall be subjected to all the tests applicable for PVC cables. The test requirements for insulation and sheath of PVC cables shall be as per latest revision of IS: 5831.

In addition to above, the following special tests shall also be performed on the cables.

Accelerated water absorption test for insulation as per NEMA-WE-3.11.

Dielectric retention Test: The dielectric strength of the cable insulation tested in accordance with Cl. 6.7.4 of NEMA WE-5 at 75 +/- 1 °C shall not be less than 60% of the original dielectric strength.

Oxygen Index Test: The test shall be carried out as per ASTM D 2863 - 1974 and the minimum oxygen index number should be 30.

Test for rodent and termite repulsion property: Bidder shall furnish the test details to analyze the property to chemical method.

Medium voltage cables shall be subjected to hi-pot testing after installation and after completion of termination. First a 5 kV AC "MEGGER" test shall be done to establish cable soundness and note insulation resistance. Then a DC hi-pot test shall be conducted at a level of about 45 kV DC. Voltage shall be applied progressively in 10 steps with a 60-second wait at least in between. Test report shall be provided for approval of PSPCL.

#### **7.2.4.12 CABLE ACCESSORIES**

Type tests shall have to be carried out to prove the general qualities and design of a given type of termination/jointing system. The type test shall include the following tests conforming to the latest IEC 502-2, 466 **OR** relevant IS and VDE 0278 specifications. The type test certificates shall be submitted along with the offer.

- AC Voltage withstand dry test for 1 minute.
- Partial discharge test - Discharge magnitude shall be less than 20%.
- Impulse voltage withstand test with 10 impulses of each polarity.
- AC high voltage test following load cycling test with conductor temperature at 90 °C.
- Partial discharge test - Discharge magnitude shall be less than 20%.
- Thermal short circuit test at 250 Deg. C for 1 second.
- Impulse voltage withstand test with 10 impulses of each polarity.
- DC Voltage withstand test for 30 minutes.
- Humidity test.
- Dynamic short circuit test.
- Salt fog test.
- Impact test.
- ADD site testing.
- Megger testing of 1100 V cables.
- HIPOT and Megger testing of 11/12.7/22 kV cables.

#### **7.2.4.13 PACKING AND MARKING**

Cable shall be dispatched in wooden drum of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum.

On flange of the drum necessary information such as manufacturer's name, type size voltage grade of cable, length of cable in meters, drum No., cable code, ISI

Certification mark, gross weight, etc. shall be printed. An arrow shall be printed on the drum with suitable instruction to show the direction of rotation of the drum.

Cables shall be supplied in drum lengths as follows:

- Medium voltage power cables up to and including 6 sq. mm – 1000 M.
- Medium voltage power cables from 10 sq. mm up to and including 300 sq. mm – 500 M.
- Control cables up to and including 27 cores – 1000 M.
- 11/12.7/22 kV XLPE Cables – 500 M.

#### 7.2.4.14 INFORMATION REQUIRED WITH TENDER

Catalogue and brochure giving technical and physical details of the cable like current rating, derating factors, etc.

“Type Test” certificates and “Special Test” results for cables offered.

Shelf life of cable accessories for the ambient temperature specified in the Schedule of guaranteed Performance Particulars attached.

Extra requirement: All power and control cables have one drum extra as a spare.

#### 7.2.4.15 Cable Trays and Fittings

#### 7.2.4.16 SCOPE FOR EACH P/H

This section covers cable trays and fittings for installation.

#### 7.2.4.17 STANDARDS

Cable troughs and fittings shall conform with the latest edition of the applicable IEC standards **OR** relevant IS

#### 7.2.4.18 CHARACTERISTICS

The cable trays shall be ladder type with rung spacing of 300 mm. They shall be made of galvanized steel. Their sides shall be 114 mm high and their width shall be 300 mm, 600 mm or 750 mm as indicated in the bill of material. Rungs shall be welded to sides to provide optimum strength. The cable trays shall have the following tentative design characteristics/values:

Width	Design Support	Design Load
300 mm	6 m	67 kg/m
600 mm	6 m	67 kg/m
750 mm	6 m	112 kg/m

Horizontal and vertical elbows and tees shall have an inside turning radius of 600 or 900 mm according to indication in the bill of material.

All the above elbows shall be factory performed to provide a single welded unit. Elbows made with short lengths of cable trays and flexible slotted straps shall not be accepted.

Adjustable horizontal elbows shall be provided only as indicated in the bill of materials for angles of less than 10 degrees.

Adjustable vertical elbows shall be provided only as indicated in the bill of material for angles of less than 6 degrees.

Connectors shall be supplied complete with the necessary bolts, nuts and lock washers. Expansion joints shall provide for expansion of plus or minus 25 mm and shall not reduce the rigidity of the installation.

The barrier strips shall be made of sturdy aluminum 90 mm high and shall be provided complete with a strip clamp for every meter of length.

#### 7.2.4.19 TESTING

PSPCL shall require that a sample of cable trays be subjected to the Preece test detailed in ASTM A 239 standard.

### 7.2.5 Cabling, Earthing and Lightning Protection (for both P/H)

#### 7.2.5.1. Cabling

##### i) Scope

The specification covers design, supply, insulation, testing and commissioning of cabling, earthing and lightning protection at the both power houses

The complete cable support system shall be supplied and installed for the entire project. The system shall enable proper laying of all power, control, instrumentation and telephone cables, and shall provide necessary mechanical protection, ventilation and segregation for them. All hardware and anchoring arrangement shall be included. All steel members shall be hot dip galvanized.

##### ii) Design

The contractor shall furnish detailed design, Drawing and calculation for approval.

##### iii) General requirements

No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant and switchyard areas.

Interplant cabling for main routes shall be laid along overhead trestles/duct banks/directly buried. However, from tap-offs, same can be through shallow trenches with approval of Owner. Directly buried cable, if essential, shall not have concentration of more than four (4) cables. However, cables in switchyard area shall not be buried. Cables from main plant to switchyard control room shall be laid in duct bank/cable trenches.

In switchyard area, cables shall be laid in RCC concrete trenches with. Wherever false floors are envisaged for cabling, the cables can be directly laid on ground, neatly routed along grid spacing. The false floor shall be at least 1000 mm deep. False floor requirement shall be subject to Owner's approval.

Cable entry from outdoor underground/cable routes to the buildings, if any shall be above the finished floor level inside the building.

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

#### Cable trays, support system and pipes.

a)	support system for cable trays	Prefabricated out of sheet steel and fully galvanized flexible type consisting of channels, cantilever arms and associated brackets & hardware, installed at site by bolting or clamping. These shall be rigid enough to withstand max. possible loads
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b)	Type of cable trays	Ladder for power cables and perforated for control instrumentation cables, complete with all accessories, fittings and hardware.
c)	Material of cable trays	Rolled mild steel, min. 2 mm thick for trays and 3 mm thick for coupler plate.
d)	Finish of cable trays	Hot tip galvanized.
e)	Duct banks (if provided)	Heavy duty GI pipes/heavy duty PE pipes (10% spare of each size, subject to min 1) with suitable water-proof manholes. For corrosive areas, pipes shall have anti-corrosion Coating both inside & outside.
f)	Pipe size	Suitable with 40% fill criteria
	Junction and Pull boxes	Hot dip galvanized sheet steel of 2 mm thickness.
	Cable glands	Nickel chromium plated brass, heavy duty, and single compression type for unarmored and double compression type for armoured cables conforming to BS: 6121 <b>OR</b> relevant IS.
	Cable lugs	Solder less tinned copper crimping type. For HT cables, lugs shall be as per DIN 46329. For rest, it shall be as per relevant IS.
	HT cable terminations and joints	Proven design and type tested as per VDE 0278. Elastimold or equivalent fully insulated moulded terminations shall be preferred.

**Cable Lying:**

a)	Identification tags for cables	To be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray or buried run.
b)	Cable tray numbering	To be provided at every 10 m and at each end of cable way & branch connection.
c)	Joints	Joints for less than 250 m run of cable shall not be permitted.
d)	Buried cable protection	With concrete slabs; Route markers at every 20 m along the route & at every bend.
e)	Road crossings	Cables to pass through buried RCC Hume pipes.
f)	Transformer yard Handling area	RCC trenches to be filled with sand after cable laying.
g)	Separation	At least 300 mm between HT power & LT power cables, LT power & LT control/ instrumentation cables.
h)	Segregation	All cables associated with the unit shall be segregated from cables of other units. Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for ac drives and corresponding emergency ac or dc drives shall laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall

		be segregated from the other set. Segregation means physical isolation to prevent fire jumping or minimum one hour fire rating. In switchyard, control cables of each bay shall be laid on separate racks/trays.
i)	Cable clamping	To be suitably clamped/tied to the tray; For cables in trefoil formation, trefoil clamps as required.
j)	Fire protection	Fire proof cable penetration seals rated for one hour when cable passes through walls and/or floors. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-8) or equivalent standard.

#### 7.2.5.2 Earthing/Grounding/ Soil resistivity

Earthing system shall be designed as per IS: 3043 and IEEE: 80. Earthing system network/earth mat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The contractor shall furnish the detailed design and calculations for PSPCL approval.

Enclosures of all electrical equipment as well as all cabinets/boxes/ panels/etc. shall be earthed by two separate and distinct earth connections. Metallic pipes, conduits, cable tray section, etc. shall be bonded to ensure electrical continuity and earthed at regular intervals as well as at both ends. Metallic conduits, pipes, etc. shall not be used as earth continuity conductor. All hinged doors shall be earthed by flexible braids of adequate size.

All steel structures shall be duly earthed. Metallic sheaths and armour of all multi core cables shall also be earthed at both equipment and switchgear end. Earthing conductor shall be buried at least 2000 mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead. Earthing conductor embedded in the concrete floor shall have at least 50 mm concrete cover.

Earthing connections with equipment earthing pads shall be bolted type with at least two bolts, and joint surfaces shall be galvanised. The connections shall be painted with anti-corrosive paint after testing and checking.

Neutral of power transformers shall be directly connected to two rod electrodes in treated earth pits, which in turn shall be connected to station earthing grid.

The earthing terminal of surge arresters and voltage transformers, and lightning protection down conductors shall also be connected to station earthing grid through separate rod electrode.

**Soil resistivity;-** The Soil resistivity measurements shall be required to be taken at 20 locations at the two no. Power House site. These measurements shall require to be taken with ANALOG SOIL RESISTIVITY METER, ASHIDA make by four electrodes method with equal probe. The report must be declared satisfactory by PSPCL. It will be as guidance and actual measurements must be validated. Contractor to measure at site at min. 20 locations approved by Owner

**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 & FOUNDRY 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**

## 647056/2022/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



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section IC Date DEC'21

SUB-SECTION – IC

DATA SHEET

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

**DATA SHEET FOR TG HA EOT CRA E TH F DR ES**

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

Sr. No.	DESCRIPTION	TECHNICAL PARTICULARS
1.0.0	<b>General</b>	
1.1.0	<b>Name of manufacturer</b>	*
	a. EOT Crane	*
	b. Crane motors	*
	c. Runway conductors	*
1.2.0	<b>Weight of equipments</b>	
	a. Bridge assembly	*
	b. Trolley assembly	*
	c. Total crane weight	*
	d. Total weight of the gantry rail	*
	e. Total weight of DSL	*
	f. Total weight of all the equipments under this specification	*
1.3.0	<b>Design, fabrication and testing of the crane confirm to standard / code number</b>	Mechanical and Electrical as per IS: 3177-2020 & Structure design in accordance to IS 807:2006.
1.4.0	<b>Number of crane</b>	Two (2) nos. One no. for power house-I & One no. for power house-II
1.5.0	<b>Crane classification</b>	M3 (Mechanical and Electrical) as per IS: 807-2006 and 13834 (part-5)-1993
1.6.0	<b>Suitable for outdoor or indoor duty</b>	Indoor
1.7.0	<b>Capacity and lift</b>	150/40/10T
1.7.1	<b>Main hoist</b>	
	a. Rated SWC – tonnes	<b>150T</b>
	b. Test load SWC – tonnes	Rated SWC and over load test : 125% of SWC
1.7.2	<b>Aux. hoists</b>	
	a. Rated SWC – tonnes	<b>40T</b>
	b. Test load SWC – tonnes	Rated SWC and over load test : 125% of SWC
1.7.2	<b>Monorail hoists</b>	
	a. Rated SWC – tonnes	<b>10T</b>
	b. Test load SWC – tonnes	Rated SWC and over load test : 125% of SWC
1.8.0	<b>Span</b>	As per Crane Clearance Diagram
1.9.0	<b>Operation from</b>	Cabin + Pendent Push Button+ Radio remote control

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

2.00		CRANE PERFORMANCE																						
2.1.0		Crane speed with full load	<table border="1"> <thead> <tr> <th></th> <th>Full speed M/Min</th> <th>Creep speed M/Min</th> </tr> </thead> <tbody> <tr> <td>a. Main hoist</td> <td>1.5</td> <td>0.15(10% of main speed thru' VVVF drives)</td> </tr> <tr> <td>b. Aux. hoist</td> <td>5.0</td> <td>0.5 (10% of main speed thru' VVVF drives)</td> </tr> <tr> <td>c. Trolley travel (CT)</td> <td>10.0</td> <td>1.0 (10% of main speed thru' VVVF drives)</td> </tr> <tr> <td>d. Longitudinal bridge travel (LT)</td> <td>15.0</td> <td>1.5 (10% of main speed thru' VVVF drives)</td> </tr> <tr> <td>e. Monorail Hoist</td> <td>3.0</td> <td>0.3 (10% of main speed thru' VVVF drives)</td> </tr> <tr> <td>f. Monorail CT Motion</td> <td>10.0</td> <td></td> </tr> </tbody> </table>		Full speed M/Min	Creep speed M/Min	a. Main hoist	1.5	0.15(10% of main speed thru' VVVF drives)	b. Aux. hoist	5.0	0.5 (10% of main speed thru' VVVF drives)	c. Trolley travel (CT)	10.0	1.0 (10% of main speed thru' VVVF drives)	d. Longitudinal bridge travel (LT)	15.0	1.5 (10% of main speed thru' VVVF drives)	e. Monorail Hoist	3.0	0.3 (10% of main speed thru' VVVF drives)	f. Monorail CT Motion	10.0	
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2.2.0		Acceleration values	<table border="1"> <thead> <tr> <th></th> <th>LT motion (bridge travel)</th> <th>CT motion (trolley travel)</th> </tr> </thead> <tbody> <tr> <td></td> <td>As per IS: 3177</td> <td>As per IS: 3177</td> </tr> </tbody> </table>		LT motion (bridge travel)	CT motion (trolley travel)		As per IS: 3177	As per IS: 3177															
	LT motion (bridge travel)	CT motion (trolley travel)																						
	As per IS: 3177	As per IS: 3177																						
2.3.0		Lift in Metres																						
	a.	Main Hoist	As per Crane Clearance Diagram																					
	b.	Aux Hoist	As per Crane Clearance Diagram																					
2.4.0		Hook Approaches																						
	a.	Main hook (cabin end)	As per Crane clearance diagram																					
	b.	Aux. Hook (cabin-end)	As per Crane clearance diagram																					
	c.	Main hook (other end)	As per Crane clearance diagram																					
	d.	Aux. Hook (other end)	As per Crane clearance diagram																					
2.5.0		Hand Rail Pipes	32 mm NB Medium class of IS: 1161 having top and bottom rail at height of 1000 mm and 450 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick )																					
3.0.0		COMPONENT DETAILS																						
3.1.0		Trolley	The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction and should be covered by flooring as far as possible. On bottom of trolley frame, on each side a double spring bumper shall be provided to engage stops at each end of the bridge.																					

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	a.	Type	Fabricated	
	b.	Method of fabrication	Fusion welded	
	c.	Material	Mild Steel Gr-BR IS: 2062 100% killed, normalized & Ultrasonically tested	
	d.	Centre to centre distance of wheels (on the same rails)	*	
	e.	Whether jacking pads for lifting trolley provided or not	Yes	
<b>3.2.0</b>		<b>Rope drums</b>	<b>Main Hoist</b>	<b>Aux. Hoist</b>
	a.	Dimensions in mm length and diameter (PCD)	*	*
	b.	Material (Indicate IS)	Seamless pipe ASTM A -106 Gr. B or fabricated rolled section to IS: 2062 Gr. BR & stress relieved	
	c.	Flange / flangeless	Flanged	
	d.	Numbers provided	One for each hoist	
	e.	Number of grooves	*	*
	f.	Type of grooves	Identical Right hand and Left hand	
	g.	Diameter on bottom of grooves	*	*
<b>3.3.0</b>		<b>Rope details</b>		
	a.	Construction	Extra flexible plough steel , 6 x 36 or 6x37 construction	
	b.	Grade	*	
	c.	Standard conforming to	IS: 2266 (latest edition)	
	d.	Diameter in mm	*	*
	e.	Breaking strength	*	*
	f.	Tensile designation	*	*
	g.	Factor of safety	6	6
	h.	Type of core	Steel	Steel
	i.	Number of falls	*	*
	j.	Length of rope	*	*
<b>3.4.0</b>		<b>Sheaves details</b>	<b>Main hoist/monorail</b>	<b>Aux. Hoist</b>
	a.	Material	CS Gr. 280-520 IS: 1030 Design as per IS: 3177- 2020	
	b.	Diameter of main sheaves in mm on Root	*	*
	c.	Diameter of Equalizing sheaves (in mm) on Root	Equalizer sheaves will be with the same diameter as the running sheave.	
	d.	Type of guards provided	Fabricated from rolled steel plate	
<b>3.5.0</b>		<b>COUPLINGS &amp; SHAFTING</b>		

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

3.5.1		Coupling details (between motor and gear box)	Main hoist	Aux. Hoist	Cross Travel	Long Travel
	a.	Type	Flexible shock absorbing coupling excepting pin bush type			
	b.	Size & Torque rating	*			
	c.	Guards and enclosures	Provided			
	d.	Coupling material and hardness	All couplings shall be of cast, wrought or from forged steel, tooth portion to be heat treated to hardness HB241-280			
3.5.2		Coupling details (between gear box and wheels)	Cross Travel (CT)	Long Travel (LT)		
	a.	Type	Flexible geared type			
	b.	Size & Torque rating	*			
	c.	Guards and enclosures provided	Yes			
3.5.3		Coupling details (between gear box and rope drum)	Main hoist	Aux. Hoist		
	a.	Type	One of the following arrangements will be adopted for connecting the rope drum with the gear- box. 1. Flexible joint, incorporating flexible geared coupling housed within the drum. 2. Fully flexible geared coupling between the drum & gearbox.			
	b.	Size	*			
	c.	Guards and enclosures provided	Yes			
3.5.4		Shafting (Output)	Cross Travel	Long Travel		
	a.	Diameter in mm	*		*	
	b.	Factor of Safety	As per IS: 3177-2020			
	c.	Number of support bearings	*		*	
	d.	Type of support bearing	*		*	
	e.	Arrangement of lubrication	Grease cups / Nipple			
	f.	Type of lubricant	Grease			
	g.	Max unsupported length of shaft in mm	*		*	
3.6.0		Gear box details				
3.6.1		Hoist Motions	MH/MONORAIL	MH Micro	AH	AH micro
	a.	Type of mounting of gear box	Horizontal / Vertical			
	b.	Classification	Suitable for M5 duty			
	c.	Total number of reductions	*	Thru' VVVF drive	*	Thru' VVVF

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	d.	Type of gears	Helical / Spur		Helical / Spur	drive
	e.	Reduction ratio	*			
	f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	g.	Hardness (BHN) – gear	As per IS 3177-2020			
	h.	Hardness (BHN) – pinion	As per IS 3177-2020			
	i.	Difference in Gear and pinion hardness	Min 20 BHN			
	j.	Materials (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1or 2. Pinions En 19/EN 24. Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460			
	k.	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved			
	l.	Noise level	85 db		85 db	
	m.	Standard conforming to	IS: 4460 / AGMA			
<b>3.6.2</b>		<b>Travel Motions</b>	<b>CT/MONORAIL</b>	<b>CT micro</b>	<b>LT</b>	<b>LT micro</b>
	a.	Type of mounting gear box	Vertical/ Horizontal	NA	Vertical/ Horizontal	NA
	b.	Classification	M5 duty			
	c.	Total number of reduction	*	Thru' VVVF drive	*	Thru' VVVF drive
	d.	Type of gears	Helical / Spur		Helical / Spur	
	e.	Reduction ratio	*		*	
	f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	g.	Hardness (BHN) – gear	As per IS 3177-2020			
	h.	Hardness (BHN) – pinion	As per IS 3177-2020			
	i.	Difference in Gear and pinion hardness	Min 20 BHN			
	j.	Materials (gear / pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1or 2. Pinions En 19/EN 24. Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460			
	k.	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved			
	l.	Standard conforming to	IS: 4460 / AGMA			
<b>3.7.0</b>		<b>Wheels details</b>	<b>Cross travel</b>		<b>Long travel</b>	
	a.	Material	As per IS 3177-2020			
	b.	Hardness	300 – 350 BHN			
	c.	Depth of hardness	10 mm (min)			
	d.	Tread diameter in mm	*		*	
	e.	Tread width in mm	*		*	

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	f.	Process of hardening	Volume hardening		
	g.	Type	Double flanged		
	h.	Numbers provided	4 nos.	8 nos.	
	i.	Specification conforming to	IS: 3177		
	j.	Arrangement of lubrication	Grease		
<b>3.8.0</b>		<b><u>Lifting hooks</u></b>	<b>MH</b>	<b>AH</b>	<b>Monorail</b>
	a.	Type	Ramshorn shank with safety latch swivelling type as per latest edition of IS: 5749	Plain with safety latch swivelling type as per latest edition of IS: 15560	
	b.	Safe lifting capacity	150 T as per IS 5749	40 T	10 T
	c.	Material	<ul style="list-style-type: none"> <li>✓ Class 2 as per IS 1875:1992 (re affirmed 2004) for hooks conforming to IS : 5749</li> <li>✓ Class 1A or class 3 for hook of grades L &amp; M respectively as per IS 1875:1992 for hooks conforming to IS : 15560</li> </ul>		
	d.	Standard conforming to	IS: 5749	IS: 15560	
	e.	Hook can rotate	Yes		
	f.	Safety latch on hook provided	Yes		
	g.	Locking device on swivelling hook required or not	Provided		
<b>3.9.0</b>		<b>Buffers</b>	<b>Cross travel</b>	<b>Long travel</b>	
	a.	Type	Spring loaded type. To be designed to bring the loaded crane to rest from speed of 100% of the rated speed.		
	b.	Numbers provided	4	4	
	c.	Details of end stop	Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate.		
<b>3.10.0</b>		<b>Brakes</b>			
<b>3.10.1</b>		<b>Hoist Motions</b>	<b>MH</b>	<b>AH</b>	<b>Monorail</b>
	a.	Type of brake	AC Electro-Hydraulic Thruster operated & Electro mechanical DC		<b>DCEM</b>
	b.	Diameter of brake in mm	*	*	*
	c.	Torque rating Kg. M	*	*	*
	d.	Number provided per motor		1+1	
	e.	Braking capacity (% of torque transmitted to the brake drum with full load.)		150 %	

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	f.	Braking torque actually required	*	*	*		
	g.	Material					
		• Brake liners	Ferrodo liners				
		• Drum	CS IS : 1030 / CL 4 IS : 1875				
		• Springs	As per manufacturers standard				
	h.	Braking distance in mm	*				
<b>3.10.2</b>		<b>Travel Motions</b>	<b>CT</b>	<b>CT Monorail</b>	<b>LT</b>		
	a.	Type of brake (ac / dc / thruster)	AC Electro-Hydraulic Thruster operated & Electro mechanical DC	DCEM	Electro mechanical DC & AC Electro-Hydraulic Thruster operated+ Hydraulic Thruster (foot operated)		
	b.	Dia. of brake in mm	*	*	*		
	c.	Torque rating Kg-M	*	*	*		
	d.	Number provided per motor	1+1				
	e.	Braking capacity (% of motor rated torque before derating)	125%				
	f.	Braking torque actually required	*		*		
	g.	Material					
		• Brake liners	Ferrodo liners				
		• Drum	CS IS : 1030 / CL4 IS : 1875				
		• Springs	As per manufacturers standard				
		• Thrusters	*				
	h.	Braking distance in mm	*				
<b>3.11.0</b>		<b>Drive system for hoisting</b>					
	a.	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box				
	b.	Arrangement of drive from pony motor to rope drum (creep speed)	NA				
<b>3.12.0</b>		<b>Bearings</b>	<b>Crane hook</b>	<b>Trolley wheels</b>	<b>Rope drum</b>	<b>Gear box</b>	<b>Any other assembly</b>
	a.	Type	Antifriction ball / roller bearings				
	b.	Number provided for each	As per assembly requirements				
	c.	Method of lubrication	Centralised grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.				

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	d	Bearing life	10,000 working hours.
<b>3.13.0</b>		<b>Bridge girder</b>	
	a.	Type & Quantity	Box type – 2 nos. Material: Mild steel, grade 'BR' of IS 2062 in 100%killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate.
	b.	Size	*
	c.	Vertical Deflection	Span / 1000
	d.	Type of connection to end carriage	By fitted bolts
	e.	Width	*
	f.	Length	*
<b>3.14.0</b>		<b>Rails</b>	
	a.	Type / section	Rails sections as per IS: 3443 Grade 50 C 12/ 55 C11
	b.	Standard conforming to	IS: 3443
	c.	Weight per metre	*
	d.	Material	50C12 / 55 C11
	e.	Top width in mm	*
	f.	Height in mm	*
<b>3.15.0</b>		<b>Type of platform required on the bridge</b>	Chequered plate platform 6mm thick over plain as per IS : 3502
	a.	Length	Full span length
	b.	Walkways	Access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways.
	c.	Type of access from gantry girder level to crane bridge	Rung ladder at ends from gantry girder level walkway to crane bridges walkway
	d.	Type of access to maintenance cage from crane bridges walkway	Rung ladder
	e.	Type of access to Cabin from crane bridges walkway	By Staircase
	f.	Provided at both ends	Yes
<b>3.16.0</b>		<b>Operators cabin</b>	
	a.	Type of construction	Fixed open type suitable for indoor operation of structural steel frame or closed type with AC

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	b.	Area and minimum clear height	2500x1850 mm with a head room of 2000 mm		
	c.	Operator's seat	Revolving type		
	d.	Warning gong	A foot operated electric warning horn of double bell type suitable for 240 V AC. of noise level 95 dB at 3.5 m. One brass gong suspended outside the Cabin and operated from inside.		
			A distinct type alarm with conspicuous warning lights on either side of the crane bridge to indicate overloading of crane.		
	e.	Position of controllers	In front/ side of operator's chair		
	f.	Ventilation	One no non oscillating ventilating electric fan in cabin		
	g.	Siren	One (1) heavy duty type industrial siren shall be provided with Each crane. The siren shall be operated from foot-switch in the Operator's cabin.		
<b>3.17.0</b>		<b>End carriage span (wheel base)</b>	As per IS 807 (latest edition)		
<b>3.18.0</b>		<b>Motors</b>			
<b>3.18.1</b>		<b>Hoist Motions</b>	<b>MH</b>	<b>AH</b>	<b>Monorail</b>
	a.	Type	Three phase squirrel cage induction motors to be operated from VFD system. Motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for inverter duty		
	b.	Enclosure			
	c.	Numbers furnished	One per motion		
	d.	Voltage, phase and frequency	415V $\pm$ 10%, 3 Ph., 4 wire, 50 Hz, $\pm$ 5 % Combined voltage & frequency variation = 10% absolute		
	e.	Class of protection	IP – 55		
	f.	Rated capacity (KW)	Maximum continuous motor ratings shall be 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.		
	g.	Duration factor/duty	40 % CDF / S-4		
	h.	Speed (rpm)	*		
	i.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B		
	j.	Number of starts/ hour	150 starts / hr.		
	k.	Contactors for motor	*		
	l.	Overload protection for motors provided	Yes		
	m.	Space heater requirements	For motors of rating 30 KW and above		
<b>3.18.2</b>		<b>Travel Motions</b>	<b>CT</b>	<b>CT Monorail</b>	<b>LT</b>

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	a.	Type	Three phase squirrel cage induction motors to be operated from VFD system. Motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for inverter duty.			
	b.	Enclosure	TEFC	TEFC	TEFC	
	c.	Numbers furnished	1	1	2	
	d.	Voltage, phase and frequency	415V + 10%, 3 Ph., 4 wire, 50 Hz, $\pm 5\%$ Combined voltage & frequency variation = 10% absolute			
	e.	Class of protection	IP – 55			
	f.	Rated capacity (KW)	Maximum continuous motor ratings shall be 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.			
	g.	Duration factor/duty	40 % CDF / S-4			
	h.	Speed (rpm)	*			
	i.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B			
	j.	Number of starts/ hour	150 starts / hr.			
	k.	Contactors for motor	*			
	l.	Overload protection for motors provided	Yes			
	m.	Space heater requirement	For motors of rating 30 KW and above			
<b>3.18.3</b>		Motor Duty and pull out torque	Duty S4 and pull out torque 250% of full load torque			
<b>3.19.0</b>		<b>Limit switches</b>	<b>Main hoist</b>	<b>Aux. hoist</b>	<b>Monorail</b>	<b>Cross Travel &amp; Monorail Travel</b>
	a.	Type	Rotary gear + Gravity			Lever type (one way/ two way)
	b.	Number provided	1+1			2/1      2
	c.	Rating of contacts	*			
	d.	Material of contacts	Double break Silver Cadmium			
	e.	Control voltage / Enclosure	110 V/ IP 55			
<b>3.20.0</b>		<b>Power conductors (DSL)</b>				
	a.	Type	LT: PVC shrouded Cu conductor bus bar. CT: Flexible trailing cable mounting on retracting support (Festoon type) 1100V-(E) grade power & control flexible trailing, annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed and shall have conductor screen of rubber. Cables shall conform to IS requirements and any other applicable standards.			
	b.	Size	Shall be sized with a margin of 20% over load requirement. Voltage drop at motor terminal shall be limited to 3% at extreme positions of cranes. Protective cover over DSL to be provided.			

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	c.	Material	*			
	d.	Numbers	*			
	e.	Length	Suitable for bay length			
	f.	Guard provided	Yes			
<b>3.21.0</b>		<b>Protective Panel</b>				
	a.	Make	OEM			
	b.	Size	*			
	c.	Material	Sheet steel 2 mm size			
	d.	Numbers and location	One number located in cabin with space heaters.			
	e.	DOP	IP 54			
<b>3.22.0</b>		<b>Control panel</b>				
	a.	Make	OEM			
	b.	Size	*			
	c.	Material	Cold Rolled sheet steel 2mm size			
	d.	Numbers and location	One each for MH, AH, CT and LT located on bridge platform with space heaters.			
	e.	Degree of protection	IP 54			
<b>3.23.0</b>		<b>Master Controllers ( Desk Type)</b>	<b>Main Hoist</b>	<b>Aux Hoist</b>	<b>Cross Travel</b>	<b>Long Travel</b>
	a.	Number of steps	5	5	4	4
	b.	Voltage & current rating	415 V/10 A			
	c.	Type	Heavy duty type having DOP IP54. Release of operators' hand from the controls shall stop motion and set brakes automatically.			
	d.	Location	In cabin			
<b>3.24.0</b>		<b>Control for Hoists /CT/LT operations</b>	Through Variable Voltage Variable frequency drive			
	a.	Speed control	Thru' VVVF with minimum 6 pulse design			
	b.	Starting torque of VVVF	Up to 200 % typical with encoder			
	c.	Starting current	Less than 150 % of rated torque.			
	d.	Temperature	VVVF system shall be capable of withstanding up to 50 ° C without derating.			
<b>3.25.0</b>		<b>Cable</b>	<b>Power</b>	<b>Control</b>		
	a.	Material	Copper / Aluminium		Copper	
	b.	Type	All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductors.			
	c.	Size	Min. 2.5 mm <sup>2</sup> for Cu./ Min.6 mm <sup>2</sup> for		Min. 2.5 mm <sup>2</sup> for Cu.	
	d.	Voltage grade	1100 V			

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

	e.	Voltage drop	Cable from MCC board to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage. Max. voltage drop during starting operation while the cranes are in extreme position is limited to 10%
<b>3.26.0</b>		<b>Earthing</b>	Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be effectively earthed.
	a.	Material of earthing	G.I / Copper
	b.	Earthing as per specification	Yes
<b>3.27.0</b>	a.	<b>Contactors</b>	AC 4 duty for reversing application. AC 3 duty for non-reversing application
	b.	<b>Switches</b>	AC 23 for motor application, AC 22 for other application.
	c.	<b>Fuses</b>	HRC
	d.	<b>Overload relay</b>	Temperature compensated bi-metallic with single phasing preventor.
<b>3.28.0</b>		<b>Power supply</b>	Owner shall provide one (1) no. 415 V, 3 phase, 4 wire supply at MCC. Cable from MCC to isolating switch (located at operating floor of power house) and isolating switch are in supplier scope.
<b>3.29.0</b>		<b>Transformer</b>	Dry type, with insulation class B or better.
	a.	Quantity	2 X 100 % for control, 1 no for lighting & 1 no for hand lamp.
	b.	Voltage Rating	Control 415/110V, Lighting 415/240V and hand lamp 415/24V.
	c.	KVA rating	20% over loading to be considered while sizing the rating
<b>3.30.0</b>		<b>Illumination</b>	
	a.	In cabin	40W florescent tube + bulk head fitting with 60 incandescent lamp - 1 each
	b.	Over Bridge	4 nos. 100 W bulk head fittings with vapour tight incandescent lamps and 4nos.24V – 5A – 3 pin industrial socket
	c.	Under bridge	4 nos. 250 W HPSV lamps along with shock absorbing and anti-swing suspension arrangement
	d.	For inspection of crane components	One (1) portable 40W hand lamp with min. half span length flexible cable for inspection of crane components
	e.	Hand lamp socket and hand tool sockets	Hand lamp socket outlets (2 pin, 10A, 24V) and power socket outlets (3 pin, 20A, 240V) shall be provided for use of hand tools along with switches.
<b>3.31.0</b>		<b>Fire Extinguisher</b>	
	a.	Type and size	4.5 kg CO <sub>2</sub> type
	b.	Location	One in cabin and Two on bridge
<b>3.32.0</b>		<b>Maintenance cage</b>	Suitable inspection cages to accommodate two persons to facilitate inspection of down shop lead.
<b>3.33.0</b>		<b>Type of control for Hoists/ CT/LT operation</b>	Through VVVF drive
<b>3.34.0</b>		<b>VVVF Drive</b>	Minimum 6 pulses and necessary input and output devices to reduce the Harmonics as per IEEE 519. It shall be capable of providing Pull out torque 200% of Starting torque with taking less than 150% of Full load current during starting.
<b>3.35.0</b>		<b>Mechanical overload protection (Load Cell)</b>	To be provided for hoist mode
<b>3.36.0</b>		<b>Painting</b>	As per Annexure- IV

647056/2022/PS-PEM-MAX

PEM-6666



**TECH CA SPEC F CAT O FOR**  
**T TG HA EOT CRA E**  
**SHAHPUR A D HEP**

SPECIFICATION NO. PE-TS-406-501-A501

SECTION - I

SECTION - I C

REV 00

DATE DEC 2021

3.37.0		RRC	Radio remote control operating at 110V AC, Single phase. Microprocessor based digital technology
		Communication	Up to 100 m approx.
		Local unit	One local unit (receiver side) with selector switch for operation either from cabin or radio remote unit.
		Other features	The remote unit shall have transmitter which can be mounted on shoulder by suitable belt. The remote unit shall have safety key to prevent any unauthorized operation. All the crane operations will stop at once the communication break -down occurs.
3.38.0		Whether tandem operation envisaged	No

**Note: Other requirements for the system.**

- Centralized grease lubrication with hand operated grease pump for all bearings.
- The crane electrical shall be designed for ambient air temperature of 45 Deg. C relative humidity of 100%. The equipment shall operate in highly polluted environment.
- All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- Emergency Switch-Mushroom type emergency STOP push buttons to open the main contactor shall be furnished at least one in operator's cabin and two on bridge platform within easy reach.
- DSL phase indicating lamps to be provided.
- Pull out torque of motor at rated voltage shall be 250% of full load torque.
- Additional features in operator's cabin and on pendant push button:

Emergency Push Button

Switches for lights and bells

Lamps for Power 'ON' indication and emergency corner switch operation

647056/2022/PS-PEM-MAX



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

STANDARD TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-406-501-A501


REV 00

Section IIA Date DEC'21

## SECTION – II

### STANDARD TECHNICAL SPECIFICATION

#### SUB-SECTION IIA – Standard Technical Requirement (Mechanical)

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	STANDARD TECHNICAL REQUIREMENTS		

## 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  |

TITLE		SPECIFICATION NO.
 <p><b>206 MW SHAHPURKANDI HEP</b></p> <p><b>DOUBLE GIRDER EOT CRANES ABOVE 100T</b></p> <p><b>STANDARD TECHNICAL REQUIREMENTS</b></p>		PE-TS-406-501-A501
		REV 00
		Section IIA Date DEC'21
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

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	STANDARD TECHNICAL REQUIREMENTS		

### Indian electricity rules - 1956.

In the event of any conflict between the specification and standards mentioned above, 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: 3613.4e

3.1.5 VOID

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

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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%.

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		
<p>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.</p> <p>3.2.1.3 Bolts used in shear shall be fitted in to reamed hole.</p> <p>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</p> <p>3.2.1.5 Transverse filled welding on load carrying member shall be avoided.</p> <p>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.</p> <p>3.2.1.7 Fillet welding on load carrying members shall be avoided.</p> <p>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 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8mm.</p> <p>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.</p> <p>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.</p> <p>3.2.1.11 Splice shall be designed to resist all the forces and moments to which it is subjected to plus 50% thereof.</p> <p>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.</p> <p>3.2.1.13 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 material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must.</p> <p>3.2.1.14 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</p>			

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>	

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 Plate Girder shall be 25 or as per IS 807 latest edition.

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 1/6th of the span up to 20m, 3.5m for spans above 21m but less than 24.5m & 1/7<sup>th</sup> of span above 24.5m (as per IS 807 latest edition). 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**

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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 1500 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 is 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.

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

The pitch diameter of the drum shall be as per IS - 3177 or as specified elsewhere. The depth of the groove 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. 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

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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 without 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 whichever ever is 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.

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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-gear 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

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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.

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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 3% 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.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>	


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.

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	STANDARD TECHNICAL REQUIREMENTS		

#### 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-54 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.

	TITLE	SPECIFICATION NO. PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>	

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 conform to category AC-4 as per IS-1322. These shall have

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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.
- b) 60W bulkhead fittings with fluorescent lamp shall be used for lighting bridge platform.
- c) Four (4) no.s - 250 W HPSV lamps shall be provided under the bridge as specified in the data sheet "A"
- d) All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
- e) 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.
- f) One (1) portable 40 W hand lamp with min. half span length flexible cable for inspection of crane components.

#### 3.4.13 Grounding

	TITLE	SPECIFICATION NO.	PE-TS-406-501-A501
	206 MW SHAHPURKANDI HEP	REV 00	
	DOUBLE GIRDER EOT CRANES ABOVE 100T	Section	IIA Date DEC'21
	<b>STANDARD TECHNICAL REQUIREMENTS</b>		

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. Pendant push button station shall be earthed Separately.

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.

	TITLE	SPECIFICATION NO.
	DOUBLE GIRDER EOT CRANES ABOVE 100T	REV 00
	STANDARD TECHNICAL REQUIREMENTS	Section II

## SECTION – II

### Site Storage and Preservation Guidelines

## CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
  - a) GENERAL STORAGE REQUIREMENTS
  - b) GENERAL PRESERVATION REQUIREMENTS
  - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

## 1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

## 2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

## 3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

### a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

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preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

**b) GENERAL PRESERVATION REQUIREMENTS**

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

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10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
  - a. Rust preventive fluid (RPF)
  - b. Rust protective paints
  - c. Tarpaulin covers, in case of outdoor storage
  - d. De-oxy aluminate for weld-ments

**c) GENERAL INSPECTION REQUIREMENTS**

1. Period inspection of materials with specific reference to –
  - Ingress of moisture and corrosion damages.
  - Damage to protective coating.
  - Open ends in pipes, vessels and equipment -
    - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
  - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
  - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

#### 4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C )**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O )

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



## 647056/2022/PS-PEM-MAX

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
<b>Raw material /mechanical items like pipes, plates, structure sections etc.)</b>				
1.	Steel pipes ( lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
<b>Fabricated mechanical items (pressure vessels, tanks etc.)</b>				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

## 647056/2022/PS-PEM-MAX

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
<b>Mechanical components like valves, fittings, cables glands, spares etc.)</b>				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
<b>Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)</b>				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers( INTERNALS)	S	Damage , packing	
50.	Air conditioners ( split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators( CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
<b>Miscellaneous items like chain pulley blocks, hoists etc.</b>				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
<b>Chemicals and consumables ( acid, alkali, paints, oils, reagents and special chemicals)</b>				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H <sub>2</sub> SO <sub>4</sub> )	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals( powder)	C	Damage, Packing self- life	
77.	Laboratory chemicals( liquid)	C	Damage, Packing self- life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
<b>Electrical and C &amp; I items (motors, cables etc.)</b>				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments( gauges/analysers)	C	Damage	
<b>Special items</b>		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

## 5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

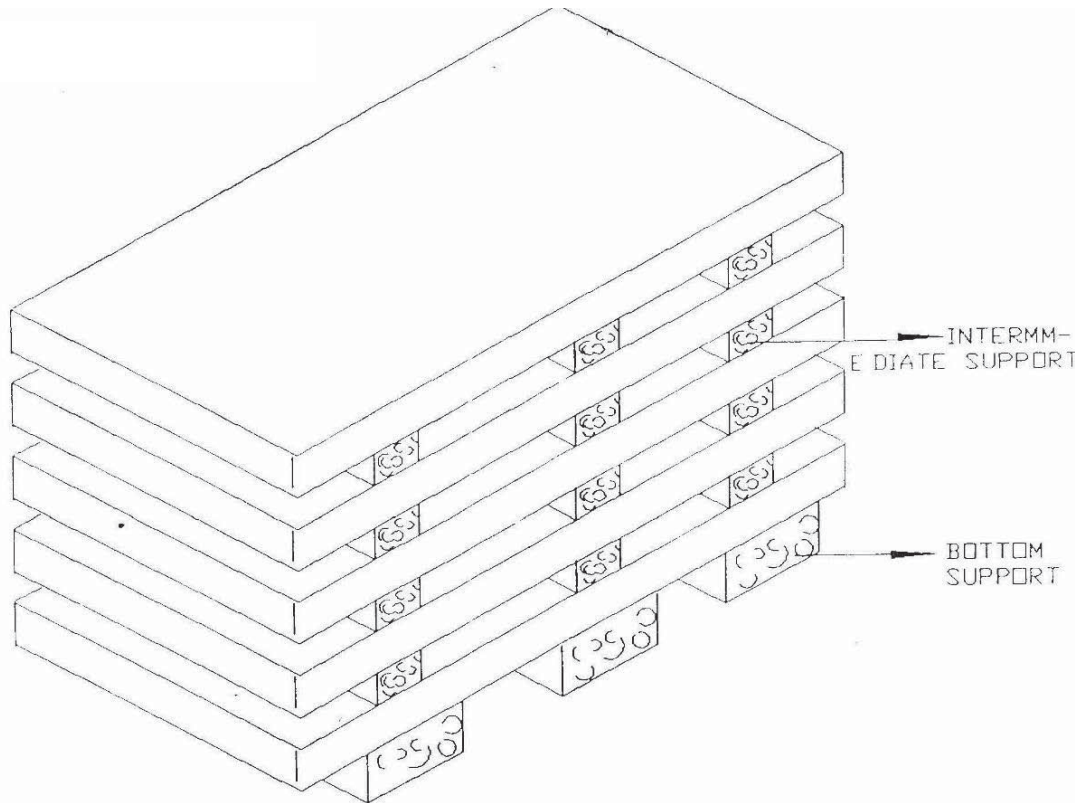


Figure – 1 – PLATE STACKING ARRANGEMENT

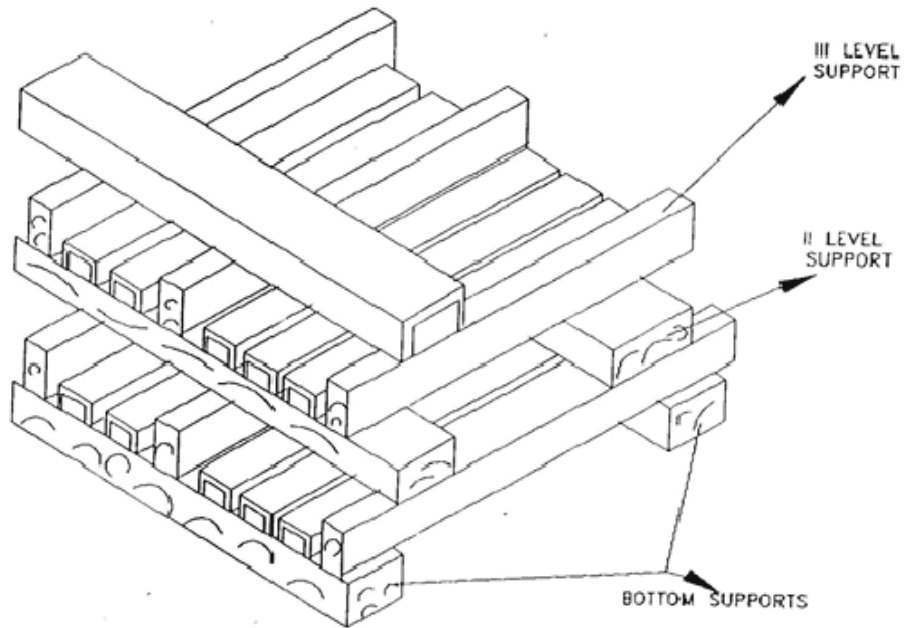


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

## **General Technical Specifications AS APPLICABLE**

### **1.1 INTRODUCTION**

The Contractor shall strictly observe this General Technical Specification in conjunction with the Particular Technical Specifications. He shall carry out all work in a skilled and workman like manner in compliance with modern methods of engineering. All design calculations, materials, works; manufacture and testing shall conform to the latest applicable standards.

Whenever a Bidder deviates from these Specifications, he shall furnish the data called for in the Technical Data Schedules and give a summary of and the reasons for all deviations in the "**List of Deviations**". Failure to accomplish this may cause the elimination of his Tender, especially when a major deviation is involved.

In addition, the Contractor shall conform to all applicable regulations regarding the execution of construction and installation work, and shall follow all instructions issued by the competent Authorities, and the Engineer.

### **1.2 SCOPE OF WORK**

The scope of work in this Contract is established in the Particular Technical Specifications. The Contractor shall design, supply, erect, test & commission and hand-over to Owner and guarantee for two years after commissioning all works complete in every respect with all necessary accessories for reliable continuous operation as per the detailed particular technical specifications.

These Specifications include the performance of all works and the provision of all labours, materials, permanent and temporary equipment, tools, accessories for transport to the site, including loading, unloading, if necessary reloading in the port of arrival, complete installation, painting, testing and commissioning of all works and accessories of the works.

The Contractor shall make competent and experienced staff available for the training and assistance of the operating staff during commissioning and trial operation and, if required by the Owner, for a period after completion of the trial operation which, shall be agreed separately.

### **1.3 PROJECT DETAILS AND DRAWINGS**

#### **1.3.1 INTRODUCTION**

PSPCL hereinafter referred to as owner, is setting up a Hydro Electric Project, named Shahpurkandi HEP of capacity 206 MW 3x33 MW + (3x33+8) MW. The Shahpurkandi Project has been accorded techno economic approval by the Central Electricity Authority. The DPR of the Project has been updated upto April.2008 price level. The Project is scheduled for commissioning during the 11th Plan period (2015-16).

## **BACKGROUND OF THE PROJECT**

The Shahpurkandi Hydro Electric Project (206MW) is a run-of- River scheme envisaged to utilize the drop of River Ravi from downstream of Ranjit Sagar Dam (already commissioned and in operation). The reservoir of Shahpurkandi Dam Project is proposed to act as a balancing reservoir and utilize the releases from Ranjit Sagar Dam to fulfill the Irrigation requirement of various commands through Irrigation Canals. The 7.7KM long concrete lined Head race Hydel Channel having 385 cumecs capacity shall carry water from Dam to UBDC Canal through Power House I & II. The installed capacity of Power House I is 3x33 MW and Power House II is 3x33+8 MW. The annual energy generation in 90% dependable year is estimated to be 999.49 MUs.

### **LOCATION:-**

The reservoir of the Project shall be located near Shahpurkandi in District Gurdaspur (Pb.).

### **1.3.2 Drawings**

- (a) The work shall conform to the drawings as per key diagram starting from turbine to evacuation, starting /stopping sequences, SCADA control room, Generator interconnection is enclosed with the specification. The final design of the power plant will be modified in so far as practicable to suit the equipment furnished and layout plans recommended by the Bidder.
- (b) Other drawings i.e. complete. Protection system, C & R panels, D.C system, 415 V LT system , 11 KV system , interconnection with grid , layout of power plant equipment , switchyard equipments , electrical & Mechanical auxiliary equipment schematic diagram will be submitted by the contractor comprehensibly as per the Power Houses requirements /layout, general arrangement of the power plant, turbines, generators and auxiliaries.

### **1.3.3 CONTROL OF UNIT OPERATION**

The Provision is also to be made for starting and stopping of machines from the main control room as well from T.G panels. Emergency manual control as well as supervisory control and data acquisition in the centralized control room of Power House.

### **1.3.4 STANDARDS**

Although European or IEC standards for design, testing, workmanship, material and Works have been mostly selected in these specifications as a basis of reference, other standards and recommendations of standard international organizations will be acceptable provided they ensure equal or higher quality than those specified, and provided, furthermore, that the Contractor submits for approval detailed standards which he proposes to use. When IEC or ISO Recommendations or other Standards are referred to, the Edition shall be that latest at the time of issue of Tender Documents, together with any Amendments issued to that date.

If requested by the Engineer the Contractor shall supply at his own expense three copies in English and one in the original language of any national

standards, which are applicable to the Contract.

Standard publications issued by the following organizations of standardization are considered being approved standards for the works:

#### **STANDARDS FOR GENERAL APPLICATION**

- AISI American Iron and Steel Institute.
- ANSI American National Standards Institute
- ASME American Society of Mechanical Engineers
- ASTM American Society for Testing and Materials
- AWS American Welding Society
- BS British Standards
- CMAA Crane Manufacturers Association of America
- DIN Deutsche Institute fur Normung
- IEC International Electro technical Commission
- IEEE Institute of Electrical and Electronic Engineers
- IPCEA Insulated Power Cable Engineer's Association
- IS Indian Standards
- ISO International Standards Organisation
- JEC Standards of the Japanese Electrotechnical Committee
- JIS Japan Industrial Standards
- NEMA National Electrical Manufacturers Association
- VDE Verein Deutscher Elektroingenieure
- VDI Verein Deutscher Ingenieure

"Notwithstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable".

List of applicable standards is being provided in this section.

### **1.3.5 TECHNICAL DOCUMENTS**

#### **1.3.5.1 General**

The specification is indicative/tentative. The Contractors should verify/ work out the design parameters keeping in view the design aspect and site condition and get the same approved from PSPCL.

This Chapter specifies the general scope of the documents which, together with those listed in the Particular Specifications, shall be delivered by the Contractor to the Engineer within the periods, and in a number and quality as specified in the General Contract Conditions.

The Engineer reserves the right to request the Contractor for additional documents as may be required for proper understanding and definition of constructional, operational, co-ordination or other matters.

All documents to be supplied shall be submitted in accordance with the agreed programme so that any comment and change requested by the Engineer can be taken into account before starting of the manufacture in the workshop and / or erection at the site. The Contractor shall not be released of his responsibility and guarantee after drawings and computations have been approved by the Engineer.

### 1.3.5.2 Drawings

All the drawings shall be worked out on computers using latest version of AutoCAD on maximum A-1 size. All electrical drawings including schematic drawings block diagrams, flow diagrams, terminal details, panel outline drawings, circuit diagrams etc. shall be worked out on A-3 size. All drawings shall have a uniform title-block as approved by the Engineer. Beginning with the very first submittal to the Engineer, the Contractor's drawings shall bear a serial number corresponding to a drawing classification plan to be agreed upon by the Contractor and the Engineer. The drawings of bought out items shall also be preferred in AUTOCAD version, however, their scanned version will be allowed. Catalogue sheets, illustrations, printed specifications, etc., shall be checked and prepared by the Contractor in such a way that the figures, statements and data valid for the delivered sizes and types of the works concerned are clearly marked. These documents also shall be scanned and stored on CD.

Four sets of hard copies of the, drawings shall be submitted to the Engineer for comments / approval. The comments shall be marked on one set of hard copy and returned to Contractor for necessary correction in original drawings. Corrected drawings replacing previously submitted drawings should be marked accordingly. The final approved drawings shall be submitted on CD with eight sets of hard copies in product wise folders.

If the Engineer feels it necessary to give any comment on a drawing submitted "For Information Only", the same shall be entertained by the Contractor as "Drawing for Approval".

If any revision is required in the approved drawings by Contractor or the engineer, the same shall be got approved again and revised drawing shall bear revision number.

Drawings in respect of the following shall be supplied:

#### Foundation Drawings

If a piece of Works requires its own foundation or needs a special area for installation, the Contractor shall submit drawings indicating all pertinent dimensions, static and dynamic loads, etc. They shall include all essential details required for proper design and construction of the foundations and/or buildings.

In addition, they shall include openings, sleeves, and details of conduits, slopes and the arrangement of any supporting structure, i.e. base-frames or other steel constructions for permanent fixing or erection purposes.

#### Arrangement and Layout Drawings

All arrangement and layout drawings shall be drawn to scale. The General Arrangement Drawings shall show the physical arrangement of Works and their layout in the Power House, switchyard and appurtenances.

### **Assembly and sub-Assembly Drawings**

The assembly drawings shall show all elements and the main dimensions of individual components in plan view, cross-section, side and top views. The assembly drawings shall include erection drawings, piping diagrams and piping arrangement drawings, etc., showing the dimensions, design and data of all constructions, apparatus and Works to be furnished under this Contract.

These drawings shall show:

- Assembly of the Works in plan, elevation and detail views with main dimensions
- Sub-assembly of the principal components of the Works which shall require dismantling, assembly and adjustments at site for maintenance, giving overall dimensions, adjustment, clearances and fitting tolerances
- Sub-assemblies in which the Contractor proposes to ship the Works
- Instructions for heat treatment, pressure tests, surface preparation and anticorrosive protection
- Full details of parts for which adjustment is provided or which are subject to wear
- Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

### **Block Diagrams**

The Block Diagrams shall be used to show in a simplified manner the main inter-relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components, e.g. servomotors, computing modules, etc., shall clearly be explained on the diagram or on an attached legend.

### **Logic Diagrams**

The Logic or Functional Diagrams shall be used for representation of logic and sequence controls and inter locking by showing only binary logic elements and their effect on the various process equipment disregarding their electrical realization. Logic function elements (AND, OR, NOR, NAND, STORAGE, etc.) shall be used for processing and combining binary signals.

### **Terminal Diagrams**

- Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected to them.
- The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:
- Terminal number of terminal board with targets (terminal number and current path) of incoming and outgoing cables and wires
- - Cable designation

- - Type of cable
- - Number and cross-section of conductors

### 1.3.6 Lists and Schedules

Following lists and schedules shall be supplied:

#### i) **Cable Lists / Interconnection Lists**

- The Cable Lists shall include for each individual cable the following as a minimum:
  - Cable number, in accordance with Identification System.
  - Cable type
  - Rated voltage
  - Number and size of conductors
  - Overall diameter
  - Cable termination at each end.
  - Connection point at each end with cubicle/Works identification and terminal numbers
  - Cable routing

In case interconnecting cubicles are used, the lists shall be prepared to show:

- Cable termination for incoming and out coming cables
- Interconnection wiring

#### ii) **Alarm Lists**

These lists shall indicate all alarms and shall contain at least:

- Description and denomination of alarm
- Data of alarm detector (contact) referring to applicable circuit diagram.
- Data of alarm annunciator (location and clear text abeling)

### List of Final Control Elements

This list shall indicate all control actuators and control valves and shall contain at least:

- Data of pipe and valve connections
- Data of valve layout
- Maximal required and rated power

### 1.3.7. Calculations

In addition to the drawings or whenever the contractual documents do so require, the Contractor shall submit to the Engineer for checking, the appropriate calculations for determining the main sizes, stress levels, dimensions and operational characteristics, safety factors, clearly indicating the principles on which the calculations were based. The calculations shall include the formulae, standards, test results, basic assumptions, etc. Submission of computer calculations without baseline information such as derivation of the calculation method, applied formulas, definition of variables and constants, explanation of abbreviations etc., will not be accepted.

#### **Short-Circuit Calculations**

The short-circuit calculations shall be performed in accordance with VDE Standard 0102; part I/ IEEE 242 and 399.

### 1.3.8 Operation and Maintenance Manuals

The Operation and Maintenance Manuals shall be prepared in latest version of MS Word with enclosures in the form of computerized drawings and

scanned figures. They shall be supplied on CD along with Ten (10) hard copies in properly bound form. The O& M manuals shall contain the following information in sufficient detail to enable the Owner to maintain, dismantle, reassemble, adjust and operate the Works with all its items of Works and installations:

a) Table of Contents

b) List of Illustrations

c) Introduction

d) Detailed Description

Detailed description shall contain a complete and accurate description of the Works, all components and ancillaries, their assembling and dismantling. An accurate list stating clearances, tolerances, temperatures, fits, etc. shall be included.

e) Operating Principles and Characteristics

A brief summary of the technical operating principles of the Works, including diagrams, circuit diagrams, sequence diagrams, piping, etc.

f) Operating Instructions

The instructions shall contain the sequence of individual manipulations required for operation. Tables, lists and graphic presentations should be used whenever possible for making the description readily understandable. An appropriate trouble-shooting list shall be included in this chapter.

g) Testing and Adjustment

The entire testing and adjustment procedure required for the Works after overhauls and during operation shall be described.

h) Maintenance Instructions

This section is divided into five paragraphs:

hi) Preventive maintenance, indicating the inspections required at regular intervals, the routine cleaning and lubricating operations, the regular safety checks and similar steps.

The maintenance instructions shall include a tabular summary of the required activities sorted according to

- Daily
- Weekly
- Monthly
- Quarterly
- Yearly

(Or other) cycles as applicable.

h2) Repair and adjustment procedures including fault tracing

h3) Spare part lists, containing all the necessary data for ordering spare parts. These lists shall include all spare parts, those to be supplied and those not to be supplied under the present Contract. *Detailed drawing for each item of spare parts shall be supplied.* The above list should include minimum and maximum quantities of spares to be

maintained by the project.

- h4) Tool lists, containing all necessary data for identification of tools to be delivered under the present Contract.
- h5) List of Contractors of bought out items and their addresses.
- j) As-built drawings

### **1.3.9 Installation and Commissioning Manuals**

The Manuals of Installation and Commissioning Procedures shall be prepared in latest version of MS Word with enclosures in the form of computerized drawings and scanned figures. They shall be supplied on CD along with 10 (Ten) hard copies in properly bound form. These manuals shall contain the following information in detail:

#### **Installation Procedures**

The installations procedures shall describe in sequential steps the erection of major equipment and shall contain sufficient details such as equipment preparation on erection bay, handling of large and heavy pieces, levelling, anchoring, site welding, site painting, erection checks, site pressure tests, site flushing and cleaning of hydraulic systems, alignment and run out checks to allow the Engineer /Owner to plan and supervise the Works at site, if required. The manuals shall contain the 'Log Sheets for taking measurements during installation.

#### **Pre-Commissioning Tests and Procedures**

Pre-commissioning tests and procedures shall be described in sequential steps for the pre-commissioning of all electrical and mechanical equipments and shall also contain sufficient details viz. checking of installations, ratings, cable terminal checking and operation test of all auxiliary equipments etc. necessary Log Sheets shall be annexed to facilitate proper recording of test results.

#### **Commissioning Procedures**

The commissioning procedures shall sequentially and in sufficient detail describe activities and tests for all systems covered by the Contract Document.

### **1.3.10 Progress Reports during Design and Manufacturing**

During design and manufacturing the Contractor shall quarterly submit four (4) copies of the progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding period. The report shall contain (but not be limited to) the following information:

- A general description of the Works performed during the reporting period on each main activity, and include any notable problems, which were encountered.
- The total overall percentages of design and manufacturing works completed, with reference to the CPM programme. Appropriate comments shall explain any differences.
- The percentages of each main work activity completed during the

reported quarter with reference versus the scheduled programme. Appropriate comments shall explain any differences.

- A list of activities scheduled to be started within the next period of two (2) months, with expected starting and completion dates. If the expected starting and/or completion dates are different from those shown on the CPM programme, an explanation shall be given.

#### **1.3.11 Progress Reports during Installation at Site**

During erection the Contractor shall, before the tenth (10th) day of each calendar month, submit four (4) copies of the monthly progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding month. The report shall contain (but not be limited to) the following information:

- A general description of the Works performed during the reporting period on each main activity, and include any notable problems, which were encountered.
- The total overall percentages of erection works completed, with reference to the CPM programme. Appropriate comments shall explain any differences.
- The percentages of each main work activity completed during the reported month with reference versus the scheduled programme. Appropriate comments shall explain any differences.
- A list of activities scheduled to be started within the next period of two (2) months, with expected starting and completion dates. If the expected starting and/or completion dates are different from those shown on the CPM programme, an explanation shall be given.
- A list of local manpower (by trade classification) employed during the reporting period.
- A list of expatriate personnel (by position) employed during the reporting period.
- A list of the Contractor's Equipment and materials presently located at the Site.
- Progress photographs of significant events. The Engineer may direct the inclusion of specific photographs if deemed necessary.
- A statement detailing the status of progress on the overall programme and how to regain any lost time or setbacks which may have occurred.
- A list of inoperable temporary equipment, and the estimated date when the repair will be completed.
- A statement concerning potential problems and recommendations on how they could be resolved.

#### **1.3.12 Quality Assurance Plan for Manufacturing Works**

Four copies of 'Quality Assurance Plan giving details of inspection, tests and customer witness / hold points shall be submitted with the bids. The quality plan shall contain the details of inspection and tests to be carried out' for

each major component of each functional assembly as recommended by the manufacturer as per their standard practice. The tests will include material composition and its properties, NDT, X-ray, hydraulic tests, leakage tests, insulation, high voltage tests and functional tests etc. along with the applicable standards and acceptance criteria.

The Contractor shall get the quality plans finalized and approved after the award of the Contract . The approved quality plan shall form the basis for inspection and acceptance of the equipment. The Engineer shall have the right to ask for more relevant tests if the same could not be included in the quality assurance plan at the time of their approval due to non availability of final design drawings.

### **1.3.13 Quality Assurance Plan for Site Installation & Commissioning**

Four copies of Quality Assurance Plan giving details of stage inspection during installation, pre-commissioning and commissioning tests and customer witness / hold points shall be submitted with the bids. The quality plan shall contain the details of inspection and tests to be carried out for each major component of each functional assembly as recommended by the manufacturer as per their standard practice. Test Procedure shall be specified giving for each test item (kind of test) a description, test method / standards, used instruments, sample/routine test, test judgment.

The tests will necessarily include NDT, X-ray, hydraulic tests, leakage tests, insulation, high voltage tests and functional tests etc. along with the applicable standards and acceptance criteria.

The Contractor shall get the quality plans finalised and approved after the award of the Contract. The approved quality plan shall form the basis for inspection and acceptance of the equipment at site. The Engineer shall have the right to ask for more relevant tests if the same could not be included in the quality assurance plan at the time of their approval due to oversight and/or non availability of final design drawings.

## **1.4.1 SPARE PARTS, TOOLS AND SITE CONSUMABLES**

### **1.4.1.1 Spare Parts**

All spare parts to be supplied shall be interchangeable with the corresponding parts of all the Works supplied under these Specifications and shall be of the same material and workmanship. They shall be replaceable without cutting or destruction of adjacent components.

All spare parts shall be protected against corrosion and shall be marked with identification labels. The identification scheme for spares shall be sent for Owner's approval before dispatch of any spare.

All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage.

Spare parts supplied under this contract shall not be given to the Contractor for use during erection and commissioning for replacing the defective or damaged original components of his supplies of works. The Contractor will arrange the spares required during the erection and guarantee period at his own.

The required list of spare parts has been given in Technical Specifications of respective equipment/works. The Bidders will give a separate list of spares

recommend by them in addition to the list given in particular specifications and offer the price of the same separately in schedule of prices for spares. Sufficient quantity of spares will be included for parts which are more prone to frequent wear and tear and can be replaced easily without involving long shutdowns.

The Contractor shall provide 5%, but at least two pieces of all types of bolts, screws, nuts, washers, spanner rings and cotters. The quantity may be taken from the surplus handed over to the Owner after completion of the installation.

#### **1.4.2 Tools and Appliances**

The scope of work shall include all customary and special tools, as well as auxiliary devices including lifting devices, ropes, etc. necessary for total assembly and disassembly of all parts of the supplied Works. Furthermore, all accessories for maintenance shall be supplied and included in the Tender. The total price for tools and devices as required by this article shall be included in the Total Tender Price. The special lifting devices and tools designed and supplied for the project, can be used by the Contractor during erection and will be handed over to Owner in good working condition without any wear and tear. However, ropes, slings, small hoists and winches etc. shall be handed over in new condition. All lifting devices and wire ropes slings to be used at site shall be tested at works and test certificate shall be supplied to the Engineer. Suitable toolboxes shall also be included in the delivery. An item wise list and description of all provided tools, auxiliary devices, etc. shall be included in the Tender. The Owner shall be entitled to take over from the Contractor the entire erection tools, appliances, instruments at mutually agreed conditions.

The scope of work shall include, 6 (six) number Pentium-IV computer sets each with CD drive and multi-media facility, 19" colour LED monitor, suitable UPS, external modems, A3 size laser printer and A1 size plotter.

#### **1.4.3 Site Consumables, Lubricating Oil and Grease for First Filling**

Scope of work shall include all site consumables like welding electrodes, brazing materials, insulating materials, sealants, cleaning agents, paints and varnishes, grinding wheels/discs, fasteners and raw materials etc in fairly sufficient quantity so that erection and commissioning activity is not held up for want of these items.

For all items under this Contract, the Contractor shall deliver 5 % of the quantity of painting material, but at least one litre, in new sealed containers, for later repair works other than the Contractor's.

Lubricating oils, insulating oils and greases etc. required for first filling in the plant and equipment supplied by the Contractor under this Contract shall be supplied in quantity 20 %(twenty percent higher than the actual capacity for first filling. These items shall be supplied as per site requirement and shall not be stocked with main equipment.

### **1.5. DESIGN REQUIREMENTS**

#### **1.5.1 General**

The equipment shall be designed and manufactured to provide most

optimum functional value and neat appearance. All major assemblies or equipment shall be designed to facilitate easy and quick surveillance, maintenance and optimum operation. All control sequences shall be simple and rational.

All live, moving and rotating parts shall be adequately secured in order to avoid danger to the operating staff. All electrical components shall be electrically earthed.

Suitable lifting eyes and forcing off bolts shall be provided where required or where they will be useful for erection and dismantling.

Any changes of the design of any part of the equipment, which may become necessary after signing the Contract have to be submitted in writing to the Engineer for approval, being sufficiently substantiated and justified.

Additional cost can only be accepted after mutual discussion; in case of a basic design the Engineer suggests change after award of Contract.

### **1.5.2 Design Responsibility**

The contractor shall assume full responsibility for a coordinated and adequate design of all equipment specified and shall ensure that such equipment conforms to the best engineering practice for the operating conditions specified. When requested by the Engineer, the Contractor shall furnish complete information as to the maximum stress and other criteria used in the design.

### **1.5.3 Working Stress**

Adequate factors of safety shall be used throughout the design, especially in the design of parts subject to alternating stresses, vibration, impact, or shock. The design of the equipment shall include seismic loads as specified in the clause 1.6.9 "seismic design". Under the most severe conditions of loading expected in normal operation, stresses in the materials shall not exceed the values listed below except that appropriately lower values shall be used where loading characteristics could cause fatigue failure or excessive deflections. The design stresses for materials not listed herein shall be selected by the Contractor, but the maximum stresses in tension or compression shall not exceed one-third of the yield strength or one-fifth of the ultimate strength.

#### **Direct or combined steady stresses**

- ◆ For materials used in the construction of the equipment, unless otherwise specified, the maximum stress due to maximum normal rated load operating conditions shall not exceed one-third of the minimum yield point or one-fifth of the minimum ultimate strength of the material, whichever is lower.
- ◆ Maximum unit stresses in rotating parts of the turbine due to maximum runaway speed or in parts under hydrostatic test conditions shall not exceed two-thirds of the minimum yield point.
- ◆ Maximum unit stresses in rotating parts of the generator due to maximum runaway speed shall not exceed three-quarters of the

minimum yield point.

- ◆ Maximum unit stresses in parts of that equipment which is subject to the maximum normal operating conditions, shall not exceed the values in the following table:

Material	Maximum allowable stresses	
	In Tension	In Compression
Gray cast iron	1/10 U.T.S	70 Mpa
Carbon cast steel and alloy cast steel	The lesser of 1/5 U.T.S. or 1/3 Y.S.	The lesser of 1/5 U.T.S. or 1/3 Y.S.
Carbon or alloy steel forgings	1/3 Y.S.	1/3 Y.S.
Carbon or alloy steel plates for principal parts	1/3 Y.S.	1/3 Y.S.

U.T.S. = Ultimate Tensile Strength

Y.S. = Yield Strength

- ◆ Maximum stresses in shear shall not exceed 21 MPa in cast iron, nor 60% of the allowable stresses for other materials, except that the maximum shear stresses in the turbine / generator main shafts and shut-off valve stems shall not exceed 50 % of the allowable stress in tension.
- ◆ Thermally or hydraulically pre-stressed bolts such as coupling bolts, bolts for connecting of Butterfly valve body halves, bolts for pre-tensioning of Generator-stator metal sheets etc. are exempted from the limitations imposed and stresses up to 80 % of Y.S. are allowed in such cases.
- ◆ Parts subject to water pressure shall be designed to the applicable provisions of ASME Code and welding shall be as specified herein and in accordance with ASME Boiler and Pressure Vessel code Section 8, Division 2. These parts are the following:
  - Shut-off valve upstream and downstream connection pipes,
  - Shut-off valve housing and servomotor,
  - Spiral casing,
  - Guide vanes,
  - Pressure vessels.

#### ***Stresses in standard products***

Standard products are not subject to the above conditions i.e. will not be custom designed. Such products are for example:

- Drainage water pumps,
- Cooling water pumps,
- Air compressors,
- Fans, AHUs, Chillers,
- Other similar products.

#### 1.5.4 Steel Casting

Except otherwise specified herein, all steel castings shall conform to 'standard specification for Mild to Medium strength carbon steel casting' (A.S.T.M. Designation A27-46-T, grade 63-35, of the American Society for Testing Materials). Before proceeding with foundry work, The Bidder shall submit to the Owner, drawings of all important steel castings, showing thereon the location of tension and end test specimens. The Bidder shall notify the Owner in time to have an Inspector present at the foundry when casting have been cleaned and are ready for surface inspection and before any repairs are made and after the castings have been annealed and before they are shipped to machine shop. No repairs shall be made to castings without the knowledge and approval of Owner. Welding shall be performed only by properly qualified welders and accordance with the best welding practice. Cracks and other defects disclosed when the casting are cleaned or during machining operations shall be chipped to sound clean metal before any repairs are made. If the removal of metal to uncover the crack or defect reduces the stresses resisting cross section of the casting more than 50 % or to such an extent that the computed unit stress in the remaining metal is more than 50 % is excess of the following stress, the casting may, at the option of the Owner Inspector be rejected. Casting requiring welding repairs impairing the strength of the stress-resisting cross section, at any stage of the manufacture after the first annealing, shall be reannealed, unless otherwise permitted by the Owner. All thicknesses and or other dimensions of the casting shall not be less then called for on the drawings by an arnmount sufficient, in the opinion of the Owner, to impair by more than 10 % the strength of casting of the dimensions shown on the drawings and to exceed the stresses allowed under these specifications. Casting shall not be warped or otherwise distorted, nor shall their dimensions be oversize to such an extent as to interfere with the proper fit with other parts of the apparatus. The structure of the casting shall be homogeneous and free from excessive norunetallic inclusions. An excessive segregation of impurities or alloys at critical points in a casting will be cause for its rejection.

#### 1.5.5 Steel Plates

Steel plates for all the principal stress-carrying parts shall be fire-box quality grade B, conforming to the 'Standard specifications for Low Tensile Strength Carbon-Steel plates of Flange and Fire box Qualities' (ASTM Designation: 185-49 T) of the American Society for Testing Materials or other recognized standards, steel plates for generating housing cover plates and other moderately stressed parts shall be fire box quality grade A or B, conforming to the above mentioned A.S.T.M. Specifications or other recognized standards. The material selected shall be suitable for the required service.

Maximum stress values shall not exceed the allowable values as given in Particular Technical Specifications or in the relevant standards and regulations and agreed by the Engineer. However, the Contractor shall be responsible for an adequate design using lower working stresses it deems this necessary or desirable.

The dimensions of the parts, which are exposed to repetitive and alternating stresses as well as to impacts and vibrations, shall take into account the safety measures and appropriate allowable stresses.

#### **1.5.6 Seismic Loads**

The forces being caused by earthquake including hydraulic loads, which may occur additionally, shall be taken into account for the computations.

The project lies on the border of zone IV X- of Seismic Zoning map and the two zones correspond to seismic intensity VIII & IX respectively of modified Marcella Scale.

Stresses resulting after including these loads shall not exceed permissible stresses and following provisions, shall be made in the generator. Turbine and all switchyard equipment structure.

#### **1.5.7 Mechanical strength**

Generator, turbine, switchyard equipment and structure be designed to safely withstand earthquake acceleration force 0.3g both in the vertical and horizontal direction.

#### **1.5.8 Natural frequency**

Natural frequency of the machine be kept well away (higher) from the magnetic frequency of 100 Hz (twice the generator frequency). The natural frequency must be much away from multiple of runner blades passing frequency.

#### **1.5.9 Generator stator support and bearing brackets**

Generator stator and bearing brackets of turbine and generator be designed to safely withstand horizontal and vertical forces due to earthquake.

#### **1.5.10 Vibration detector**

Vibration detectors or eccentricity meters on turbines and generators should be provided for alarm and shut down.

#### **1.5.11 Mercury Contacts**

Anti vibration type mercury switch be used.

#### **1.5.12 Standardization of Works**

Every effort shall be made to standardize parts, instruments and devices to minimize costs of the Works and facilitate keeping stocks, maintenance, replacement, interchangeability, etc.

#### **1.5.13 Surface Finish**

Surfaces to be machine-finished shall be indicated on the shop drawings by symbols. Compliance with the specified surface shall be determined by the sense of feel and by visual inspection of the work compared to applicable "Standard Roughness Specimens", or with roughness feeler gauge instruments.

Where the finish is not indicated or specified, the type of finish shall be that type which is most suitable for the surface to which it applies and

shall be consistent with the class of fit required.

#### **1.5.14 Fits and Tolerances**

Fits and tolerances shall be given in accordance with ISO Standard. Tolerances on matching components shall be suitable for intended service and will ensure interchangeability. Fits shall be selected for the smooth functioning of the components for fairly long life.

#### **1.5.15 Materials**

In choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which equipment is to work. Tropical grade material should be used wherever possible. Material specifications, including grade or class shall be shown on drawings submitted to the Owner.

### **1.6 MANUFACTURING REQUIREMENTS**

#### **1.6.1 Workmanship**

All works shall be performed and completed in highly professional manner and shall follow the best modern practices in the design and manufacturing of the equipment. All parts shall be made accurately and shall not deviate from drawing and quality requirements. Wherever, in process inspection is required, due notice shall be given to inspection agency and the inspection shall not be bypassed. The Contractor shall arrange all measuring instruments, gauges, templates, fixtures and devices required for the purpose. All special gauges, instruments and devices deemed necessary for the maintenance of the equipment, shall be offered and included in scope of supply under this contract.

#### **1.6.2 Materials**

All materials used, shall be new and of first class quality free from rust, defects and imperfections. Inspection documents of all materials shall be reviewed and compiled before actual use. The Engineer shall review the inspection records of materials of major components. Materials of limited shelf life shall not be used after their expiry date.

### **1.6.3 WELDING AND HEAT TREATMENT**

#### **Welding**

All welding (except welding of thin plates or piping of small sizes) shall be performed by the electric-arc method and where practical, with process controlled automatic machines.

Butt welds can be welded from one side only, shall be provided with back strips on the whole length of the seam to be welded.

After being deposited, welds shall be cleaned of slag and shall show uniform sections, smoothness of weld metal, feathered edges without overlap, and no porosity and clinker. Visual inspection of the ends of welds shall indicate good fusion with the base metal.

Where weld metal is deposited in successive layers, each layer shall be thoroughly peened before the next layer is applied.

All welds transverse to the direction of flow shall be ground flush with the plates on the inside. Welds shall be ground flush on both the inside and the outside wherever dynamic stress occurs.

Particular care shall be taken in aligning and separating the edges of the members to be joined by butt-welding so that complete penetration and fusion at the bottom of the joint will be ensured. Where fillet welds are used, the members shall fit closely and shall be held together during welding.

The cut surfaces of plates requiring weld joints shall be free of all visible defects, such as laminations, surface defects caused by shearing or flame-cutting operations. The edges and surfaces to be welded shall be free of rust, mill scale, grease, oil, paint or any other foreign matter. Welding over painted surface shall be prohibited - all painting materials next to the joint to be welded shall be removed well beyond the heat-affected zone.

Where possible, welding shall be carried out in the workshop. Welding which has to be performed in the field shall be clearly indicated on drawings.

The Contractor shall maintain Weld Procedure Specifications (WPS) for the type of welds to be performed in shop. These WPS shall conform to the recommendations of material Contractors, electrode Contractors and approved standards. The WPS shall be got approved from Engineer. However, approval of the welding process shall not relieve the Contractor of his responsibility for correct welding, the use of correct electrodes and for minimizing distortion in the finished structure.

Additional copies of all records of all welding procedures, including preheating and stress relieving, chemical analysis and physical properties, shall be made available to the Engineer upon request.

### **Welding Qualifications**

For welding of principal stress carrying parts, the standard of welding procedures, welders and welding operators shall conform to standards equivalent to the requirements of the ASME Boiler and Pressure Vessel Code, Sections VIII and IX, or DIN 8560, DIN 8563, EN 287.

For welding of less important parts, the standards and qualifications shall conform either to the AWS Standard Qualification Procedure or equivalent standards.

All welders and welding operators assigned to the work shall have passed a performance qualification test. If more than one year has elapsed since the welder or welding operator passed his last test, then he shall again be tested. Welders' and welding operators' test certificates shall be submitted to the Engineer.

### **Quality and Procedure Control**

Quality control methods, e.g., radiography, ultrasonic crack detection, etc., shall be done in accordance with the appropriate manufacturing code. However, the

Bidder shall indicate clearly in the Technical Data Sheets the extent to which these methods shall be used.

All welded joints, which have to be tight, shall be inspected or tested by dye penetration tests.

All major welds carried out on parts under hydraulic pressure shall be at least 10 radio-graphically and 100% ultrasonic examined. All welds on the skin-plates shall be additional dye penetration tested as directed by the Engineer.

The Contractor shall indicate in the corresponding drawings the type of non-destructive testing to be carried out during manufacture and at Site.

### **Defects and Repairs**

Plates with laminations discovered after cutting shall be rejected unless the laminated portion is only local and can easily be repaired; such repairs shall require the consent of the Engineer.

Defects in welds, which are to be repaired, shall be chipped out to sound metal and the areas to be DP or ultrasonically tested to ensure that the defective material has been completely removed before repair of welding is carried out. Repairs shall be carried out in accordance with the relevant Standards and to the approval of the Engineer. The Contractor shall be fully responsible for the in-service performance of all welding work.

The Work shall be 100% inspected again by the method used first to determine such faulty work.

### **Heat Treatment**

Heat treatment shall be performed on all fabricated parts which are stressed during service and are to be finish machined as per the approved heat treatment / weld procedure.

Heat treatment of field erection welding seams shall be performed according to the specifications for the welding procedure for the corresponding parts, which shall be submitted to the Engineer for approval.

## **1.7 PROTECTION OF MACHINED SURFACES**

### **1.7.1 General**

Machine-finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins or bolts shall be oiled or greased and wrapped with moisture-resistant paper or protected by other approved means.

### **1.7.2 Corrosion Protection**

All ferrous metal work shall be provided with an effective painted or galvanized finish, applied in accordance with the best trade practice to protect from corrosion.

The Contractor's services shall cover the procurement of all materials,

and the preparation and application of the painting and other protective coats as specified. All costs of painting or galvanizing shall be included in the Tender Price.

The Contractor shall submit for the Engineer's approval full details of the preparation, type of materials, methods and sequences he proposes to use to comply with the requirements for the protection of the Works.

### **Painting**

#### **Surface Preparation**

All surfaces to be painted shall be thoroughly cleaned by suitable means before application of paint. After cleaning the surfaces shall be rinsed in a manner that no residues will remain.

For removing rust and mill scale on structural steel, piping and other steel surfaces, particularly parts which will be in contact with water, exposed to heavy condensation and humidity or subjected to high temperature shall be sandblasted. Parts, which cannot be sandblasted, shall be cleaned of rust by power tool cleaning to the highest degree possible.

The sandblasted clean surfaces shall receive a shop coat with a quick-drying highly pigmented 2-pack zinc-rich primer, unless otherwise specified.

Primed surfaces contaminated with oil or grease shall be de-greased in a manner not affecting the quality of the primer. 2-component coatings older than six (6) months shall be roughened prior to the application of the next coat.

#### **Application Procedure**

The most commonly used methods of application are painting by brush, roller, pressure and airless spraying equipment. Selection of the application method depends on the surface to be painted. The quality of the paint shall in no way be negatively influenced.

For all paints the surface temperature of the metal shall not be higher than +50°C during the painting. Concerning special paints, the requirements set by the paint manufacturer shall be followed. All painting shall be free of cracks and blisters and all runs shall be brushed out immediately. After application of the last coat the paint system shall be free of pores.

Parts, which are embedded in concrete, shall be painted with cement base paints.

### **COATING**

#### **General**

Unless otherwise specified, and insofar as possible, all of the Contractor's supply shall be shop painted according to the following specifications. Only touch-ups shall be done on site. The paint manufacturer's recommendations shall be followed for film thickness, drying time, application method moisture, temperature and other parameters. These recommendations shall be transmitted to Engineer for approval, before the start of the application of coating.

After painting, surfaces shall be protected from cold, moisture, dirt or new paint until they are completely dry.

For every planned field weld, an area 50 mm on either side of the weld shall not be painted. After the weld, the surface to be painted shall be considered a touch-up.

Unless otherwise specified, surface preparation shall be SSPC-SP6 "Commercial blast cleaning". Every surface preparation shall be inspected before painting and an inspection report shall be given to the Owner. SSPC Standards are published by the Society for Protective Coatings.

All surfaces destined to be embedded in concrete shall not be surface-prepared or painted.

There are no particular paint requirements for mass-produced standard components such as instruments, panels, cubicles, etc. However, exposed plain steel surfaces of these parts shall be supplied painted by the manufacturer, at the very least.

The protective coating shall be guaranteed with respect to materials and workmanship. This guarantee covers, among other things, the separation between the base and the coating.

Care shall be taken to protect workers against fumes and irritants, with the use of proper ventilation, masks, protective clothing, as specified in the respective MSDS instructions. The personnel assigned to the preparation of surfaces and application of paint shall be qualified for and experienced in this type of work, and be directed by an experienced supervisor.

Approximately 5% extra paint shall be provided to the Owner in sealed containers once the work is completed, for additional touch-ups at later times.

### 1.7.3 Requirements for Specific Components

- Piping:  
Carbon steel piping, including any interface with stainless steel, shall be painted with two coats of alkyd paint.
- Steel surfaces designed for permanent contact with water:  
Unless otherwise specified, two coats of polyamine epoxy paint shall be applied within four hours of SSPC-SP10 near white blast cleaning.
- Machined surfaces designed for contact (i.e. flanges or seal surfaces):  
No surface preparation and no paint shall be applied. However, surfaces shall be cleaned according to SSPC-SP1 "Solvent cleaning" and protected for shipping using an appropriate surface protector such as Cosmoline or Rustveto.
- Other steel surfaces, except for embedded surfaces:  
One coat of zinc rich primer and one coat of alkyd paint.

### 1.7.4 Touch-up Paint

Contractor shall touch-up all surfaces that have been burned, dented, welded, deeply scratched or have been damaged in any other way during site installation.

The surface preparation for the touch-ups shall be done according to SSPC-SP3 "Power Tool Cleaning". All touch-ups shall be done with the original paint system and thicknesses shall be as specified by the paint manufacturer.

The paint shall be inspected after any touch-ups and touched-up again if necessary

### 1.7.4 Colors

Unless otherwise specified, colors of the finishing coat shall be as below:

Turbine	:	Sky Blue
Generator	:	Sky Blue

Control panels	:	Grey (as per manufacturer's standard)
Oil components	:	Orange
Water piping	:	Sky Blue
Fire protection	:	Red
Compressed air	:	Yellow/Green

### Galvanising

Unless otherwise specified, all fasteners and steel structures including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works shall be hot-dip galvanized or electrolytically galvanized.

For galvanizing, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%.

The thickness of the zinc coat shall be:

For bolts and nuts of sizes above M36 approx. 60 micrometer and for sizes below M36, 25 micrometer.

- For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 50 micrometer
- For hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 100 micrometer.
- Cleaning: All material to be galvanized shall be cleaned carefully of rust, loose scale, dirt, oil, grease, and other foreign matters. Particular care shall be taken to clean slag from welded areas.
- Galvanising of hardware: Bolts, nuts, washers, locknuts and similar hardware shall be galvanised in accordance with the relevant standards.
- Straightening after galvanising: All plates and shapes, which have been warped by the galvanising process, shall be straightened by being re-rolled or pressed without injury to the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

### 1.8 MANUFACTURER'S NAMEPLATES

- Each important part to be delivered under this Contract shall be equipped with permanent nameplate in readily visible locations. The nameplates shall be protected during erection and especially during painting.
- The following data shall be shown in accordance with the relevant standards:
  - Manufacturer's name
  - Work's serial number and year of manufacture
  - Main design data.

As a general rule, standardised components, such as small or medium-sized electric motors, transformers, instruments, etc., may be delivered with the original manufacturer's standard nameplate.
- Items such as valves, which are subject to handling, shall be provided with an engraved chromium plated brass name plate or label with engraving filled with enamel.

- Nameplates or labels for outdoor equipment are to be of non-corrodible non-hygroscopic material with lettering of a contrasting colour. Labels for indoor equipments shall be engraved with black letters on white traffolyte.
- The wording of all labels shall be to the approval of the Engineer prior to the shipment of the plant or equipment.

## 1.8 TECHNICAL WORKS AND STEEL STRUCTURES

**General:** All mechanical Works and steel structures of any mechanical or lectrical installation shall comply with this General Technical Specification.

### 1.8.1 Bolts, Screws, Nuts, etc.

- All bolts, studs, screws, nuts, and washers shall be to the ISO metric system. Mild steel bolts and nuts shall be of the precision cold forged or hot forged type with machined faces parallel to one another.
- All parts, other than structural steel work, bolted together, shall be spot faced on the back to ensure that nuts and bolt heads bed down satisfactorily. Mild steel nuts and bolts shall be zinc or cadmium plated. Stainless steel bolts, nuts, washers and screws shall be used for holding renewable parts in water or when exposed to high humidity
- All bolts or studs which will be subject to high stress and/or temperature shall be of approved high tensile material with nuts of approved material. All bolts and studs larger than M60 shall be drilled for heaters or shall have an extension for pretensioning by hydraulic tools.
- Fitted bolts shall be a driving fit in the reamed holes they occupy, shall have the screwed portion of a diameter such that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.
- The Contractor shall supply the net quantities plus 5 percent of all permanent bolts, screws and other similar items and materials required for installation at the Site. Any such rivets, bolts, screws, etc., which are surplus after the installation of the Works has been completed shall become spare parts and shall be wrapped, marked and handed over to the Owner.

### 1.8.2 Seals

- Rubber Seals: Seals shall be designed and mounted in such a manner that they are adjustable, water tight and shall be readily removed and replaced. Seals shall be moulded type and not extruded.
- All adjusting screws and bolts for securing the seals and seal assembly in place shall be of stainless steel.
- Seals shall be made of synthetic rubber suitable for conditions at the Site and shall be of a material that has proven successful in similar applications. Joints shall be water/oil tight.

### 1.8.3 Drives

- All moving parts of machinery including shafts, couplings, collars,

projecting key heads, rope/belt-drives shall be completely guarded to provide full protection. All setscrews on revolving shafts shall be countersunk or suitably protected. All guards shall be arranged so that they can be removed without disturbing the main parts, which they protect.

- All bearings shall be mounted in dust-proof housings. Base of bearing supports shall be machined, and shall rest on machined-surfaces.

#### 1.7.4 Oils and Lubricants

Efficient means of lubrication, suitable for use under Site conditions, shall be provided for all moving parts.

- All different types of oils, lubricants, etc., shall be subject to the written approval of the Engineer.
- 
- Unless otherwise stated in the Particular Technical Specifications, the first oil or grease filling for bearings, pressure oil systems, transformers, etc., including the necessary quantity for flushing and for the first oil change shall be included in the Tender Price.
- 

#### 1.8.5 Piping, Fittings, Valves and Gates

##### General:

Unless otherwise stated, all piping shall be designed for a "nominal pressure" PN 10. All piping shall be tested with 1.5 the design/nominal pressure. All required piping shall be furnished complete with flanges, joints, expansion joints, gaskets, packing, valves, drains, vents, pipe suspensions, supports, etc.

- Flanged connections or joints shall be provided only as required for transport, installation or for reasons of dismantling for repair. Metric (DIN)-flanges shall be used throughout.
- Adequate clearance shall be given to parallel pipes to allow for easy maintenance without disturbing other lines. All overhead piping shall have a minimum clearance of 2.00 m from operating floors and platforms.
- Where required water piping shall be provided with anti-condensation insulation.

##### Pipes & Fittings Materials:

- Water, air admission and drain piping less than 25mm nominal bore shall be of heavy grade to IS-1239, Part-I or to schedule `STD' conforming to ANSI B36.10 or equivalent for steel pipe or copper as per relevant standards.
- Water, air admission and drain piping equal to or greater than 25 mm nominal bore shall be heavy grade to IS-1239, Part UIS-3589 or to schedule `STD' conforming to ANSI B36.10 or equivalent.
- Oil piping greater than 25 mm nominal bore shall be of seamless high quality steel pipe conforming to minimum API-SL GR.B/ ASTM

A106 or equivalent grade as per process requirement, whereas pipes less than 25mm bore shall be of stainless steel.

- Steel pipes of diameter 100 mm and above for a pressure of not more than PN 10 may be used in Welded type.
- The minimum steel pipe wall thickness shall be the "normal" or "standard" wall thickness as stated in the applicable standards.

### **Pipe Work Fabrication**

- Steel pipe work for water, air admission and drains smaller than 65 NB shall be Painted and joined by screwed fittings. After fitting, unprotected steel be wire brushed and painted with two coats of suitable paint. However, leak-free joint shall be ensured by the contractor.
- Steel pipe work for water, air admission and drains 65 NB and over shall be welded ends black pipe with painting after fabrication.
- Branches shall be made by welding or brazing. Flanged connections shall be made with approved jointing material, suitable for the duty.
- All valves, pumps, etc. shall be connected to the pipe work by sufficient flanges or spherically seated unions to allow their easy removal for servicing or replacement.
- No screwed or compression fittings shall be used within partitions, walls, or in inaccessible positions.
- Pipes shall be cut by saw or pipe cutters and all burrs removed by reaming, Gas cutting will be permitted only if the pipe ends are ground clean and to shape for welding.
- Pipes which pass through openings in walls, floors, etc. shall be clear of such openings. Any such holes or openings shall be cleanly and neatly cut or sleeved to a size sufficient to accommodate the pipe with reasonable clearance to allow for movement due to expansion.
- Sleeves, in concrete shall be either non-metallic, i.e. PVC or polyethylene, or of the same material as the pipe to pass through the sleeve.
- All pipes shall be supported/restrained/anchored in order to contain the forces/moments at the terminal point nozzles within permissible limits as well as not to cause any undue localized stress and deflection/sagging anywhere along the piping length. For the above purpose standard support attachments such as clamps, saddle plates, braces, angles/cleats, guides etc. and support components such as hangers, rods, turn buckles, spring boxes etc. shall be used by the contractor.

### **Painting**

- Un-galvanized steel piping shall be painted on the exterior to prevent rusting. The paint treatment shall be of the same system as used for the turbine exterior. Paint damaged during erection and commissioning shall be repaired prior to

Handing-Over.

### **Pressure Testing**

- Hydraulic piping shall be pressure tested after erection as site. The pressure shall be maintained without loss for one hour.

### **Protection for Transport and Storage**

- Oil piping shall have a protective coating applied to prevent corrosion occurring during transport and storage. The ends of the pipe lengths shall be plugged to prevent ingress of water.
- The lubricating oil piping shall be pressure tested after erection at a pressure 50% greater than maximum pump pressure. The pressure shall be maintained without loss for one hour.

### **Pipe work cleaning**

- Oil pipe work internal bores shall be chemically cleaned and passivated prior to use. Water, air and drain piping shall be blown through with high pressure air and flushed with water prior to use.

### **Valves & Gates**

- Generally, valves shall be leak-proof in either flow direction (except for non-return valves) when the nominal pressure is applied.
- All valves with design pressures higher than PN 10 and diameters larger than DN 100 shall be workshop-tested for tightness and soundness of materials.
- Valves shall close clockwise and be provided with position indicators/marks on hand wheel. The drive units of motor-driven valves shall also be provided with hand wheels for manual operation.
- To facilitate operation, large valves and gates shall be provided with bypass lines for pressure balancing, if required.
- Valves spindles and pins shall be of stainless steel, spindle nuts and bushes of bronze, the body of cast steel. No valve in cast iron body will be accepted.
- All pressure reduction valves; safety valves and similar components shall be workshop-tested and provided with a work certificate.

### **Pipe Supports and Hangers**

- All pipe work and accessories shall be mounted and supported in a safe and neat manner. All brackets, stays, frames, hangers and supports for carrying and staying the pipes, including their fasteners shall be included in the supply and completed by the Contractor at the Site. Pipes and fittings shall be supported at or near flanges wherever possible.

- All heavy valves and other mountings shall be supported independently of the pipes to which they connect, to the satisfaction of the Engineer.

#### 1.8.6 Castings

- All castings shall be free from blowholes, flaws, and cracks. All cast-iron shall be of close-grained quality approved by the Engineer.

#### 1.8.7 Mechanical Instruments

- All mechanical parts of instruments shall be suitably protected against shocks and vibrations, heat, humidity and splash water, etc.
- Pressure gauges shall be provided with a damping *liquid, e.g.,* glycerine, to compensate vibrations. Pressure gauges without damping means are not permitted, unless approved by the Engineer.

#### 1.8.8 Pumps

- Materials of the pumps shall be:
  - Casing: Cast steel.
  - Impeller : stainless steel
  - Shaft : stainless steel
  - Sleeves : stainless steel
  - Wear rings : bronze
  - Keys : stainless steel
- The impeller diameters shall be neither maximum nor minimum impeller size for the selected pump size.
- The pumps shall withstand corrosion and wear by abrasive matters within reasonable limits.
- Shafts sealed by packing glands shall be fitted with sleeves. Seals shall be exchangeable without extensive disassembly of the pump. Leakage water shall be directed to suitable drainage facilities.
- The size of the pump motor shall be 15 % higher than the maximum power required by the pump at any operation point
- For any pump, the overall pump-motor efficiency for the specified rated head and discharge shall not be less than 60%.

#### 1.8.9 Miscellaneous Metal work

- Except where otherwise indicated elsewhere in the Particular Technical Specifications, the Contractor shall supply the following:
  - All platforms, ladders, guards, handrails of tubular construction and hatch covers necessary for easy and safe access to Works
  - Safety guards at each point where normal access provision would permit personnel to come within reach of any moving equipment to be provided under the Contract.
- All covers for pipe, cable trenches and access hatches, required for completing the floors around and over the equipment supplied under the Contract will be supplied and installed. Unless otherwise approved, floor plates shall be of an angular pattern.

## **1.9 ELECTRICAL WORKS**

### **1.9.1 General**

- The electrical items of Works of any electrical or mechanical installation to be provided under this Contract according to the Particular Technical Specifications shall - if not stated otherwise therein-fulfill the requirements of this Section.
- All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.
- The Works shall be pre-assembled to the highest possible extent in the Contractor or Sub-Contractor's workshop, complete with all devices and wired up to common terminal blocks.
- The power supply and control cables shall be laid up to these common terminal blocks. The required control and protection devices, instruments, etc., within the different scopes of work shall be supplied and connected by the relevant Contractor.
- Unless otherwise agreed, ratings of main electrical Works (in feeds, bus-ties) as selected or proposed by the Contractor, whether originally specified or not, shall generally include a safety margin of 10% under consideration of the worst case to be met in service. Prior to approval of such basic characteristics, the Contractor shall submit all relevant information such as consumer lists, short circuit calculations, de-rating factors, etc.
- Short-circuit calculations shall be evaluated giving full evidence that every electrical component can withstand the maximum stresses under fault conditions, for fault levels and durations obtained under the worst conditions, e.g., upon failure of the corresponding main protection device and time delayed fault clearing by the backup protection device.
- All Works shall be suitable for the prevailing climatic conditions.
- The Contractor shall ensure that all the supplied Works is insensitive to any signals emitted by wireless communication equipment.

### **1.9.2 Clearances**

The layout of the Equipment on the site shall provide for ready access for operation and maintenance whilst the remaining sections of Equipment are alive. Working clearance provided between isolated Equipment and nearest live metal work shall be as per Indian Electricity rules & Standards.

### **1.9.3 Electrical Supplies For Auxiliary Equipment**

The electricity supplies available for auxiliary Equipment will be :

- 415 V, 3-phase 50Hz, 4-wire for power
- 220 V, single phase, 50 Hz for lighting, indication, and anti-condensation heaters.
- 220 V D.C. for essential indication, controls, protection, alarms and circuit breaker closing and tripping supplies.
- 48 V D.C for PLCC and 24 V D.C for SCADA System.

#### 1.9.4 Alternating Current Supply Practice

- All mains supplies shall be switched and fuse in accordance with the requirements stated in the appropriate Section. Double-pole switches shall be used to break single-phase A.C. mains supplies.
- For multi-phase supplies, each phase shall be switched simultaneously and the neutral should preferably not be switched. If it is switched, it shall be opened after and closed before the phase-lines.
- All mains circuits shall be protected only in the phase-lines by fuses of suitable rating or by other suitably protective devices. The neutral shall be connected by a removable link located near the protective devices.
- All mains transformers shall have an electrostatic screen which shall be earthed.
- Except where the prior approval of the Engineer is obtained, wires external to the equipment shall be coloured in accordance with the current IEC or relevant IS recommendation.

#### 1.9.5 Direct Current Supply Practice

- It shall be possible to remove/replace cards from / to electronic equipment without damage and without interfering with the operation of the rest of the equipment or system; if necessary consideration should be given to switching off the supplies locally to a card to prevent inadvertent interference to the equipment or system during removing/replacing a card.
- Application of battery or earth via a test lamp to any external interface point or test point shall not lead to any component damage.
- Power supply bus bars in cubicles shall be carefully routed and each bus bar shall be shrouded. It shall not be possible to inadvertently short bus bars either between themselves or to earth.

#### 1.9.6 Electric Motors

##### General

- All motors shall be of approved manufacture high starting torque and shall comply - as far as applicable - with ISI standard motor dimensions.
- The general construction shall be stiff and rigid; no light metal alloy casings will be accepted. All precautions shall be taken to avoid any type of corrosion.
- All motors shall be fitted with approved types of lifting hooks or eyebolts as suitable.
- AC motors shall have squirrel cage type rotors. Motor Voltages and Power Ratings
- The service voltages and corresponding power ratings for electric motors to be used in the Project shall be as follows:
- - Motors up to 100 kW  
Service voltage: 3-phase AC 415/240 V, 50 HZ  
Mode of starting : direct-on-line up

- Motors up to 0.75 kW
- Service voltage : single-phase AC 240 V,50 HZ
- Mode of starting : condenser

- Motors intended to work on the DC System
  - Service voltage: 220 V D.C.
  - Mode of starting: resistor

### Rating

- The rating of the motors shall be adequate to meet the requirements of its associated equipment. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine at its expected maximum power demand, shall be applied as follows:

<u>Power Demand of Driven Machine</u>	<u>Service Factor</u>
Up to 5 kW	1.2
More than 5 kW	1.1

- A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient over voltage of 130% of the nominal voltage shall as well be sustained.
- Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.
- D.C. motors shall be capable of operating continuously under rated output conditions at any voltage between 90% and 110% of the nominal voltage with a fixed brush setting for all loads. Unless otherwise approved, the speed drop between no-load and full-load shall not exceed 10% of no-load speed.

### Starting

- A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite bus bar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary bus bars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.
- The maximum starting currents (without any tolerance) shall not exceed the following values:
  - 5 times of rated current for L.V. motors rated 100 kW or above
  - 2 times of rated current for D.C. motors (by means of starting resistors)

- Generally, all motors shall be able to withstand five cold starts per hour, equally spaced. In addition, each M.V. motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each L.V. motor shall be capable of withstanding three successive starts under the same conditions or once every fifteen minutes without detrimental heating.
- Motors for frequent automatic starting shall have an adequate rating. In the motor list the Contractor shall state the frequency of starts permitted in compliance with the motor design.

#### **Insulation Class**

- The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials. It shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapours and for considerable fluctuations in temperature.

#### **Ventilation and Type of Enclosure**

- All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 141. Cable termination points shall be of class IP55.
- They shall have a closed internal cooling air circuit re-cooled by an external cooling air circuit drawn from the opposite side of the driving end.
- Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

#### **Bearings**

- As far as possible, the motors shall have sealed ball or roller bearings lubricated for life. All other motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and preventing over lubrication. Additionally, the bearings shall be fitted with: grease nipples permitting the use of a universal grease gun.
- Vertical motors shall have approved thrust bearings.

#### **Terminal Boxes and Earthing**

- The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables as specified in these General Technical Specifications and in the Particular Technical Specifications.
- The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.
- The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.
- A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation,

this shall be clearly indicated.

- For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

### **Noise-Level and Vibrations**

- Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).
- In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced.

### **Tests**

- Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

#### Workshop Tests:

- Measurement of winding resistances
- No-load and short-circuit measurements
- Measurement of starting current and torque - Efficiency measurement (type test) - Heat test run
- Dielectric test
- Measurement of insulating resistance

### **1.9.7 Starters and Contactors**

- Motor starters and contactors shall be equipped with short circuit protection and local disconnecting devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/240 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts.
- Starters and contactors shall comply with IEC 292.1 or NEMA IC 1 or relevant IS and be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Engineer. The enclosures shall be complete with locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards, etc as required by the duty of the starter or contactor.
- Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage, for a period of 5 minutes at a voltage 25 percent below nominal, at nominal frequency.
- Thermal type overload and phase failure relays shall be supplied with

starters for motors of 7.5 kW or greater. For motors of less than 7.5 kW, suitable rated 3-phase thermal overloads will be acceptable. Ammeters to read current in one phase shall be provided for motors above 7.5 kW.

- Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts for Owner's use.

#### **1.9.8 Moulded Case Circuit Breakers**

- All moulded case circuit breakers shall be of 2 or 3-pole type as required, having thermal time delay and instantaneous trips with "On-Trip-Off", indicating/operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The breakers shall comply with applicable section of IEC 15 7/1 or relevant Indian Standards.

#### **1.9.9 Control Relays**

- Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of 10A over a range of 6 to 600 V AC.

#### **1.9.10 Terminal Blocks**

- All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.
- Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.
- Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.
- Terminal blocks shall conform to the applicable standards. The smallest size to be used shall be designated for 2.5 Sq mm FRLS wire and not more than two conductors shall be connected under one terminal clamp.
- Terminal identification shall be provided corresponding to wire number of connected leads.

- Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with non inflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

#### 1.9.11 Equipment Wiring

- All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.
- Multi-conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilizing slip-on ferrules approved by the Engineer.
- Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.
- Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.
- All trip circuits shall employ markers having a red background.

#### 1.9.12 Cubicles And Control Panels

Cubicles and control panel enclosures shall be of sheet steel with minimum thickness of 2.5 mm, of rigid, self-supporting construction and supplied with channel bases.

- Cubicles shall be fitted with close fitting, gasketed, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.
- Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.
- The cubicles and panels shall be adequately ventilated, if required, by vents or louvers. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.
- Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.
- Unless stated otherwise, all cubicles and panels shall be provided

with a ground bus with 40mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm<sup>2</sup>.

- All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.
- The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.
- The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.
- Switched interior light and socket outlets shall be provided for all cubicles and control panels.
- All cubicles and control panels shall be provided with nameplates, identifying the purpose of the panel and all of its components.

#### **1.9.13 Earthing**

- Provision shall be made for earthing all equipment intended for connection in an A.C. mains supply. All structural metal work and metal chassis shall be connected to earth. Connection between circuits and metal work shall only be made for reasons of safety and/or reduction of interference. Where such connections are made, they shall not be used as normal current-carrying earth returns.
- Earthing conductors shall be at least equal in cross-sectional area to the supply conductors and shall be capable of carrying the fault current.

#### **1.9.14 Labels And Plates**

- Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.
- The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer for approval.
- Labels written in the Contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible.
- Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified. Cubicles and similar units shall also bear this

identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.

- All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list, etc.).
- Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

#### **1.9.15 Warning Labels**

- Warning labels shall be made of synthetic resin with letters engraved in the Contract and selected local language, where required in particular cases.
- For indoor circuit breakers, starters, etc., transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

#### **1.9.16 Labels For Cables**

- Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer, noncorrosive labels detailing identification number of the cable, voltage, and conductor size.
- The cable identification numbers shall comply with those of the cable list.
- All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

#### **1.9.17 Single-Line Diagrams**

- Each switchgear room shall be furnished with a copy of the final as-built single-line diagram detailing all electrical data and denominations, separate for each individual switchgear / distribution board / MCC, placed under glass and frame/wall mounted at an approved location.
- The same applies to the Station Single-Line Diagram one copy of which shall be arranged in the control room(s).

#### **1.9.18 Key System for Electric Boards**

- Key interlocked switches shall be provided with approved locks for locking in the neutral position. Similar locks shall be provided for

selector switches for locking the switches in any of the positions.

- The locks or padlocks shall be co-ordinated for the different applications and shall be supplied with three keys. The cabinet door keys shall be similar and shall be six (6) in number.

#### **1.10 INSTRUMENTATION AND CONTROL EQUIPMENT DESIGN CRITERIA**

- All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.
- The Works shall be pre-assembled to the highest extent in the Contractor's or SubContractor's workshop, e.g., shop welding of thermometer wells and other connections, wiring of boards, desks, etc., including internal wiring and installation of devices shall be carried out. Fragile instruments shall be removed for transportation to site.
- All components shall be suitable for continuous operation under site conditions.
- Materials for instrumentation and control equipment, including piping material, which are exposed to the measured media, shall be selected accordingly.
- All components shall be compatible with other electrical, electronic and mechanical Works.
- All instrumentation and control functions shall be shown on the piping and instrumentation diagrams. The symbols to be used shall be in accordance with ISO standard. The identification system (tag numbers) shall be in accordance with the Works identification system and is subject to approval by the Engineer. All measurements and alarms shall be listed in a measuring list of a standard form subject to Approval by the Engineer. For remote controls, a schedule of interlocks shall be provided. The features of automatic controls shall be shown in block diagrams.
- Shielded cables shall be provided for the control and supervisory equipment where required.

#### **Sizes of Indicators, Recorders, Etc.**

- The meters, instruments and recorders shall be of standard size, to be selected to guarantee unique appearance of switchgears, control panels, control desks, etc. The front glasses shall be of the anti-glare type. The scales shall be 90 degrees type for local control panels but must be 240 degrees type for control room instrumentation.

#### **Tests**

- The single components and pre-erected assemblies shall undergo functional and routine tests in the Contractor or Sub-Contractor's workshop. The ready mounted control and supervisory system shall

undergo functional tests on Site prior to commissioning of the power Works.

- Calibration tests shall be made on all-important pressure gauges and other instruments as required by the Engineer.

### **Measuring Systems**

- Electric measuring signals of 4-20 mA shall be transmitted to the control room for essential or regulating circuits. In this case the absence of live zero signal shall lead to a warning signal. Measuring signals for indicating purposes will be 4-20 mA.
- The components shall quickly respond to any changes of the measured magnitudes. Measuring ranges of indicators, transducers, etc. shall be selected in such a way that the rated value of the measured magnitude covers approx. 75% of the range.
- All local instruments shall, as far as practicable, be mounted vibration free to allow good reading. Wherever required, damping elements shall be used.
- Corresponding systems shall be grouped together in local panels.
- The binary sensors shall be fused separately and supplied with 24 V D.C.

#### **1.10.1 Temperature Measurement**

- Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. The temperature sensors shall be selected in such a way to minimise the number of different spare inserts.
- Resistance thermometers shall be used as far as possible and shall generally be of type Pt 100.
- The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring.

#### **1.10.2 Pressure Measurements**

- Pressure gauges shall be shock and vibration-proof (preferably by filling with glycerine) and shall be equipped with toothed wheels and toothed segments of the machined type. They shall completely be made of stainless steel.
- The error for pressure transmitters shall be limited to  $\pm 0.5\%$ .
- Each gauge, pressure switch and transmitter for absolute or differential pressure shall be equipped with a pressure gauge isolating valve including a test connection of the screwed type M20 x 1.7 mm so that such device can be removed without any disturbance of the plant operation.

- If the pressure is pulsating, the devices concerned shall be connected via flexible tubes or other pulse-absorbing means.
- The adjustment of the pointer shall be possible by means of an adjustment device without removing the pointer from its axle.
- All casings shall be dust and watertight and be made of stainless steel.

### 1.10.3 Level Measurements

The liquid level measurements in reservoirs and tanks with atmospheric pressure shall be made by means of displacement-type transmitters, float-disc-transmitters or capacitance measurement type. The errors shall not exceed  $\pm 1.0\%$  of the total measuring range. Level switches shall be of the externally mounted float or displacement operated type.

### 1.10.4 Electrical Measurements

- All Electrical instruments shall be of flush mounted design, dust and moisture-proof. A.C. ammeters and voltmeters shall have digital type system of not less than 1.7 accuracy class for connection to the secondary side of instrument transformers. D.C. measuring instruments shall have digital type systems of the same accuracy. The energy meters shall be digital /load analyzer type. Wattmeters/energy meters shall have electro-dynamic measuring mechanisms if fed by transmitters. Wattmeters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2 % accuracy class.
- All indicating instruments shall generally withstand without damage a continuous overload of 20% referred to the rated output value of the corresponding instrument transformers. Ammeters shall not be damaged by fault-currents within the rating and fault duration time of the associated switchgear via the primaries of their corresponding instrument transformers.
- All instruments and apparatus shall be capable of carrying their full load currents without undue heating. All instruments and apparatus shall be rear connected, and the enclosures shall be earthed. Means shall be provided for zero adjustment of instruments without dismantling.
- When more than one measured value is indicated on the same instrument, a measuring point selector switch shall be provided next to the instrument and shall be engraved with a legend specifying each selected measuring point.
- Scales shall be arranged in such a way that the normal working indication is between 50-75% of full scale reading permitting an accurate reading. CT connected Ammeters provided for indication of motor currents shall be provided with suppressed overload scales of 2 times full scale. The dials of such ammeters shall include a red mark to indicate the full load current of the motor.

- All instruments mounted on the same panel shall be of same style and appearance.
- All metering circuits shall be terminated in marked terminal blocks for remote metering purposes.

#### **1.10.5 Position Measurements**

Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and aux. supply voltage (if required) 48 V D.C.

#### **1.10.6 Limit Switches**

- Limit switches shall be mounted suitable for easy adjustment and for rigidly locking in position after being adjusted. They shall be of heavy-duty rating and have two changeover contacts suitable for 220 V D.C. operations.
- Switch fixings shall be positive and shall be unaffected by vibration. At the same time they should be capable of easy adjustment to suit changing parameters of the associated plant.
- Particular attention shall be paid to potentially harmful environmental conditions, including water, oil, dust, dirt, temperature variations and differential expansions.

#### **1.10.7 Contact Devices**

Contacts of level switches, pressure switches, temperature switches, limit switches, and of all other devices shall be of the snap action type (SPDT). Contact devices for interlocking systems shall be separate, i.e., contact devices serving commonly for interlocking and other purposes will not be accepted.

#### **1.10.8 Protection Systems**

- Electrical/Mechanical Protection and Interlocking Systems shall be provided for all works components and individual systems to ensure a safe and reliable operation and to limit harm and damage to personnel and works to an utmost extent.
- The primary functions of these facilities shall be to disconnect selectively faulty sections of the systems prior to influence or damage to other works and to maintain operative systems as far as possible.
- Moreover these devices shall facilitate the duty of the operation staff and prevent maloperation.

### **1.11 INSPECTIONS AND TESTS**

#### **1.11.1 General**

- Approval of assemblies, tests, inspections, related procedures etc. and acceptance of pertinent test and inspection certificates, or waiving of inspections or tests, shall in no way relieve the Contractor of his contractual obligations for finishing the Works in accordance with the provisions of the Specifications.

- Three (3) sets of all test records, test certificates, performance curves, tables etc. of all inspections and tests, whether or not attended by the Engineer shall be supplied after each inspection or test. After completion of all testing two. (2) sets of the above mentioned documents shall be supplied properly bound in books:
- All test certificates shall be endorsed with sufficient information for identification of the equipment and material to which the certificates refer.
- In addition, the following references shall be entered in the top right-hand corner:
  - Owner's name
  - Project title
  - Plant's (stage's) name
  - Number of Contractor's drawing
  - Date

#### **1.11.2 Workshop Inspections And Test**

- As far as practicable, quality of materials, workmanship and performance of all items of the Works to be furnished under this Contract shall be inspected at the places of manufacture.
- Where the Contractor desires to use stock material, not manufactured specifically for the Works, satisfactory evidence that such material conforms to the requirements of the Contract shall be submitted.
- Free and unrestricted access to the Contractor's factory and shops (including those of his Subcontractors) shall be granted to the Engineer also and upon reasonable notice by the Engineer if deemed necessary by the same for additional witnessing of assembly work or inspections and tests.

#### **1.12.3 Material Tests**

Unless otherwise specified, the quality of materials shall be verified generally by: -

- Chemical analysis
  - Mechanical tests (yield point, tensile strength, elongation, and notch impact.)
  - Welding tests (welding procedure, welding material, welding tensile strength, welding bend test, welding reversed bend test, etc.)
  - Non-destructive x-rays, ultrasonic, magnetic particle, liquid tests, penetration inspection, etc.).
  - Electrical tests (voltage, losses, tan delta, insulation, magnetic properties etc.)
- Certified mill test reports of plates will be acceptable when these comply with the requirement of specifications. Test specimen and samples for analysis shall be plainly marked to indicate the materials they represent.

- Castings and forgings shall be tested in the rough state in order to detect flaws in good time thus avoiding delays. Magnetic particle inspection of important castings shall cover the whole surface of the casting. After partial machining further tests can be conducted.
- Load tests on crane hooks, steel wire ropes, chains and other lifting devices, etc. shall be considered as material tests.

#### 1.11.4 Checking Of Dimensions

- The dimensions, especially clearances and fits, (ISO 286) which are essential for operation and efficiency shall be carefully checked in an approved manner, as for example:
  - run out and roundness tolerances of shafts, pistons, etc., to be measured on single parts,
  - fits and clearances of bearings, servomotor pistons, valves, guiding, distributing and actual actuating elements, etc.,
  - Accuracy, surface roughness and shape of sliding and guiding surfaces of seals, bearings, water passages in hydraulic machinery, valves, etc.,
  - Dimensions of couplings or connections for assembly with other deliveries from the Contractor, Sub-contractors or other contractors.

#### 1.11.5 Workshop Assembly

- In addition to the quality and production control tests, the following shop assembly work and tests shall be made to check measurements, fitting and functioning.
- Works to be furnished shall be shop assembled to a status sufficient to prove that the design and workmanship have been executed in accordance with the Specifications, that the delivery is complete, and that no work remains to be done at Site, which reasonably can or should be done in the shop.
- Where applicable, each item of the Works shall be assembled completely prior to painting.
- Field joints shall be temporarily connected. All parts shall be properly matched marked, identified and doweled where practicable, to facilitate correct and quick field assembly and alignment. Where necessary, suitable dowels shall be provided for insertion after field assembly and drilling. The holes for any fitted bolt shall be accurately reamed.
- During workshop assembly all instruments, control devices and piping shall be fitted. If the assembly shows defects in the design or manufacture or unforeseen difficulties in assembling and dismantling, these shall be eliminated. If required, design alterations or corrective measures can be executed provided that reliability of operation or interchangeability are not reduced and provided that the agreement of the Engineer has been

obtained.

- If the corrections cannot be carried out in accordance with the terms mentioned above, the components concerned will be rejected. The decision on possible subsequent corrections is reserved exclusively to the Engineer. Faulty parts or Works shall by no means be delivered. The assembled parts shall subsequently be subject to tests as per applicable standards or required by the Engineer.

#### **1.11.6 Pressure And Leakage Tests**

- All parts subject to internal or external pressure or containing any liquids or gases temporarily or permanently during operation shall be tested prior to painting.
- In addition to the Specifications, the applicable and approved standards and official regulations shall be observed. If any liquid is used for the test that may cause corrosion, all Works and piping shall be thoroughly cleaned immediately after the test.
- Leaks and defects can be repaired if permitted by the applicable standards and approved by the Engineer. If defects are found, the Engineer may reject the defective parts, or permit welding repairs with stress relieving, radiographic examination and additional pressure tests.

#### **1.11.7 Parts Exposed To Hydraulic Pressure**

- Unless otherwise specified or required, the following shall apply: the hydraulic pressure tests shall be carried out using the liquid to be used during operation or a liquid with less viscosity.
- The hydraulic test pressure shall be 1.7 times the maximum operating pressure and shall be maintained for a period of 30 minutes. Afterwards the test pressure shall be reduced to the operating pressure.

#### **1.11.8 Functional Tests**

Functional tests shall be defined as tests of the function of assemblies, sub-assemblies or parts of the Works under no load conditions. Functional tests shall be performed on all Works prior to the execution of operational tests.

#### **1.11.9 Operational Tests**

- As far as practicable operational test shall be carried out on all Works, simulating operating conditions.
- Parts to be delivered by sub-Contractors shall be tested either at the premises of the sub-Contractor or of the Contractor, as agreed by the Engineer.
- Testing of the electrical Works shall be performed in accordance with applicable Standards; they shall include but not be limited to tests of heating, loading, overloading, and losses.

- Operational tests of lifting equipment and other machinery shall include tests under nominal load and 125 % of nominal load unless otherwise specified.

#### **1.11.10 Electric Tests**

Electrical Works shall be tested in accordance with applicable Standards and agreed test programs and procedures.

#### **1.11.11 Type Tests**

Type tests for certain parts of the work or Works shall be carried out as specified or agreed between Contractor and Engineer.

### **1.11 ERECTION AND COMMISSIONING**

#### **1.12.1 Preparation and Installation**

- Prior to commencement of installation, the Contractor shall closely inspect the site and all the foundations and other structures on which parts of the plant supplied under this Contract will be installed; he shall check that the foundations conform to the installation drawings

#### **1.12.2 Reference Points**

- The Contractor shall employ a competent surveyor for setting-out of all datum lines including the constant checking and maintenance of the setting-out until the completion of his works.
- The Contractor shall provide all necessary pegs and centre lines and shall establish all such permanent markings and recovery marks as may be required by the Engineer for checking the Contractor's setting-out. The Contractor shall be responsible for rectifying, at his own cost, all work rejected by the Engineer due to errors in setting-out.
- The Contractor shall be responsible for the true and proper staking-out of the works and levels of reference given by the Engineer in writing, for the correctness of the positions, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection with this.
- The checking of any staking-out or of any line or level by the Engineer or the Engineer's Representative shall not in any way relieve the Contractor of his responsibility for its correctness.

#### **1.12.3 General Notes On Installation Work**

- All transportation and handling of the plant from the place of storage to the place of installation shall be carried out by the Contractor. He shall provide all hoisting equipment, staging and scaffolding, winches and wire ropes, slings, tackles and all other appliances and temporary materials.
- The Contractor shall comply with all applicable and approved safety regulations while carrying out the works on Site and with all reasonable requirements of the Engineer. This stipulation shall in no

way release the Contractor from any obligation concerning his liability for accidents and damages. He shall be responsible for adequate protection of persons, plant and materials against injuries and damages resulting from his operations.

- The Contractor shall be responsible that the installation of all plant is properly executed to the correct lines and levels and in accordance with the manufacturer's instructions and the Contract requirements.
- The alignment of the plant shall be done exactly; the tolerances indicated by the Manufacturers or in the drawings shall be kept.
- Setting of parts to be aligned shall be performed by means of fine measuring instruments. All erection clearances and settings shall be recorded. Copies : of these records shall be given to the Engineer. After alignment, the parts shall be held firmly in position by means of set pins, fitted bolts, etc.
- All parts to be embedded in concrete shall be set accurately in position and shall be supported rigidly to prevent displacement during the placing of concrete. Adjusting screws and bolts shall be drawn tight and secured adequately. Steel wedges shall be secured by welding. Wooden wedges shall not be used.
- The Contractor shall verify carefully the position of all parts to be embedded before concrete is poured. All important measurements and dimensions shall be recorded. Copies of these records shall be given to the Engineer for checking and approval before items are built-in to the Works.
- After concreting, the control measurements shall be verified again, indicated in the above-mentioned records and submitted to the Engineer.
- The Contractor shall provide all necessary anchors and braces to ensure the alignment and stability of the parts to be installed. All temporary anchors and bracings shall take care of all dead load, wind load, seismic and erection stresses, e.g., during concreting, and shall remain in place until they can be removed without endangering the stability of the plant. .
- If for installation purposes auxiliary structures have been attached to the plant, they shall be removed after completion of work and the surface restored to proper condition by grinding and repainting.
- Special care shall be taken not to damage surfaces of galvanised or specially treated plant during erection. Care shall be taken to prevent or remove any rust streaks or foreign matters deposited on galvanised or otherwise finished surfaces during storage or transport or after installation.

- Glass parts or other parts, which can easily be damaged, shall be provided with suitable protective sheaths or coverings during installation.
- Machined or bare metal surfaces, which are to receive no coat of paint, shall be protected during transportation, storage and erection by a suitable anti-corrosion film.
- All power tools preferably are operated pneumatically. They are to be handed over at the end of the installation work in good condition in accordance with the Engineer's instructions.
- After erection, the works shall be finally painted, in accordance with the painting specification, and any damaged paintwork shall be restored.
- The Contractor shall keep the site in clean condition during erection and commissioning time. On instruction of the Engineer he shall remove waste from the place of installation to the defined deposit site at his own cost.

### 1.13 PAINTING OF WORKS AT SITE

#### Painting Materials

- Coating materials shall be standard products of a paint manufacturer with proven experience in the field of corrosion protection of the type of Works to be supplied.
- Paint material shall be delivered in unopened original containers bearing the manufacturer's brand name and colour designation, storage directions and handling instructions. The entire paint material for a particular specified paint system shall be supplied by one manufacturer only; who shall guarantee the compatibility and quality of the paint material.

A complete list of the proposed paint material shall be submitted to the Engineer. For multicoated painting systems each coat shall have a different colour.

- With regard to materials, the Contractor shall submit full details including the source of the basic raw materials, volatile matter content, nature of solvent, number of components, type of coat, coverage, time interval between coats and number of coats, compatibility of each coat with the previous coat, toxic properties, physical properties, shelf life, resistance against chemical attack, resistance against ozone and UV-radiation, compatibility with drinking water standards, etc.
- He shall describe in detail the treatment he proposes to apply in order to give adequate protection during transport, site storage, building and concreting and subsequent erection.
- The Contractor shall submit to the Engineer for approval an overall colour scheme in accordance with the Particular All final coats shall be in the colours approved by the Engineer. On request of the Engineer,

painting samples for the different coats and colours shall be provided.

- All pigment, paints and primers shall be delivered to Site in sealed containers packed by the manufacturer. The manufacturer's instructions for preparation and application of all painting and protective coats shall be strictly observed. .

#### **Preparation of Paint Material**

Paint shall be delivered ready mixed wherever possible. Adding of diluting agents and mixing of two or multi-component systems shall be done in the field in accordance with the directions of the manufacturer. After mixing, the paint shall be poured into a clean container to ensure that no settled pigments are at the bottom.

#### **Application:**

The most commonly used methods of application are painting by brush, roller, pressure and airless spraying equipment. Selection of the application method depends on the surface to be painted. The quality of the paint shall in no way be negatively influenced. The manufacturer's directions shall govern the choice of application method. Inaccessible surfaces shall be painted prior to erection with prime and finish coats according to the specification. Areas inaccessible to spraying equipment shall be painted by brush. Corners and edges shall be pre-coated. Bolts, screws, studs, rivets etc. shall be painted as a whole with the complete paint system after erection.

- The primer shall be applied to an absolutely clean and dry surface only. Temperature and dry-out time shall be in accordance with the manufacturer's directions. Whenever possible the prime coat as well as one intermediate coat shall be applied in-doors at the Contractor's shop.
- During painting the air temperature shall be at least +5°C and the temperature of the items being painted must be at least 3°C above the dew point. During drying of the paint, the temperature shall not be below 0°C. For all paints the surface temperature of the metal shall not be higher than +50°C during the painting. Concerning special paints, the requirements set by the paint manufacturer shall be followed.
- Cleaning and painting work shall be interrupted outdoors and in non-conditioned rooms under the following conditions: rain, fog, dew, and polluting winds, sand and other dusts. Surface preparation and application of the first paint layer are parallel operations to be carried out within a maximum delay of 4 hours.
- All painting shall be free of cracks and blisters and all runs shall be brushed out immediately. After application of the last coat the paint system shall be free of pores. After erection of the equipment all damages to painted surfaces shall be repaired. Welds, rusty spots, slags, beads, flux deposits etc. shall be repaired and repainted. For touching up, the same materials shall be used as for the main painting work. Repaired finish coats shall be of the same appearance as the original coating.
- Remove electrical plates, surface hardware, fittings and fastenings before

starting painting operations. Carefully store, clean, and reinstall after completion of work.

#### **Repair of Primer and Finish Coats**

- For touching up, the same paint shall be used as for the original painting work. Repaired finish coats shall be of identical appearance with the original and no difference in the colour shall occur.

#### **Galvanised and Painted Structures**

- Surface Preparation: Thorough cleaning of the damaged surface i.e. removal of oil, grease, dust, etc.
- Repair of Coatings: Two coats of 2-component epoxy-resin micaceous iron oxide (mio) paint. Total film thickness min. 0.160 mm. The colour of the paint shall be the same as originally applied.

#### **Painted Structures**

- Repairs on painted structures shall be carried out as follows:
- Surface Preparation: Scraping, wire brushing or grinding to Grade ST 3 according to SIS 055 900-1967.
- Prime Coat: One coat of 2-component epoxy resin zinc-chromate primer. Dry film thickness minimum 0.050 mm.
- Parts, which are embedded in concrete, must not be protected against corrosion. However, transition zones of large steel pipes and of steel linings shall be painted over a length of 1 m within the concrete, all other concreted in steel surfaces over a length of 200 mm within the concrete.

#### **Quality Control of Painting**

- The minimum dry-film thickness prescribed in these Specifications shall be observed. Of each 100 m<sup>2</sup>, one area of 10 m<sup>2</sup> will be measured for dry-film thickness. No measured thickness shall be less than the specified thickness. Where the minimum thickness is not achieved, the coat shall be repaired to reach the specified minimum dry-film thickness.
- The dry-film thickness shall be measured by approved gauges to be arranged by Contractor.
- Upon completion of each coat, the painter shall make a detailed inspection of the painting finish and shall remove from adjoining work all spattering of paint material. He shall make good all damage that can be caused by such cleaning operations.
- A detailed inspection of all painting work shall likewise be made, and all abraded, stained, or otherwise disfigured portions shall be touched up satisfactorily or refinished as required to produce a first-class job throughout and to leave the entire work in a clean and acceptable condition.

#### 1.14 SITE INSPECTION AND TESTS

- During erection, commissioning and trial operation, the Contractor shall perform at suitable intervals all inspections and tests in the presence of the Engineer-In-Charge in order to prove the orderly execution of the works in accordance with the Contract.
- Unless otherwise specified, all costs for testing at site and of the works and charges associated with it shall be borne by the Contractor. This includes the measuring devices, properly calibrated, and any pertinent accessories, which shall be made available by the Contractor for the entire duration of the tests. The Contractor shall delegate his experts to perform the tests at site.
- The Engineer-In-Charge reserves the right to have checked at his own expenses the Contractor's instruments to be used or having been used for any tests by an independent, officially acknowledged institution.
- The Contractor's testing at Site shall be complete in every respect to prove the successful performance and operation of all the works and Works supplied and erected under the Contract.
- In case of disagreement between the Engineer-In-Charge and Contractor(s) on the test results, an independent expert shall be appointed by Owner to whom both parties shall agree. If no amicable settlement can be reached, the Arbitration Clause shall be applied.
- For the procedure of inspections and test at site, notice to the Engineer, reports, commissioning, trial runs and trial operation, and acceptance tests refer to General Conditions of Contract.

#### 1.15 COMMISSIONING TEST

- Commissioning acceptance tests shall be carried out, on all generating units to verify the rating characteristics of generating units and other equipment's in accordance to relevant standards. The complete field acceptance test reports shall be prepared by the Contractor and submitted to Owner for approval.
- The test run on generating units shall be carried out as per relevant provisions of IEC or Indian Standards.
- Before issuing the "Taking-Over Certificate", the revised copies of the Operation and Maintenance Manual shall be submitted together with the specified number of complete sets of drawings of the Works as completed. The Works shall not be considered complete for purposes of taking over under the terms of the General Conditions of the Contract until the above documents have been supplied by the Contractor.

### 1.16 TRIAL RUN & COMMERCIAL OPERATION

- Immediately upon completion of commissioning, the plant shall be kept on trial operation during which period all necessary adjustments shall be made while operating over the full load-range enabling the plant to be made ready for performance and guarantee tests. The duration of trial operation of the complete equipment shall be 72 hours continuous run.
- The trial operation shall be considered successful, provided that each item of the equipment can operate continuously at the specified operating characteristics, for the period of trial operation.
- For the period of trial operation, the time of operation with any load shall be counted. Minor interruptions not exceeding 4 (four) hour, at a time, caused during the continuous operation shall not affect the total duration of trial operation. However, if in the opinion of the Owner, the interruption is long, the trial operation shall be prolonged for the period of interruption.
- The trial operation report comprising of observations and recordings of various parameters to be measured in respect of the above trial operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during trial run, shall also include the dates of start and finish of the trial operations and shall be signed by the representatives of both the parties. The report shall have sheet, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. Based on the observations, necessary modifications, repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Owner to enable the latter to accord permission to carry out the performance and guarantee tests on the plant. However, minor defects, which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.
- During the trial run the Contractor shall make familiar the Owner's personnel with the equipment, the operation and maintenance of the Works and its auxiliaries to such extent that thereafter the duties can be assigned to the Owner's trained personnel.
- If any defects or irregularities affecting the safety or reliability of the Works should arise during the trial run, the trial run shall be interrupted and started again after such defects or irregularities have been corrected by the Contractor.
- After successful trial run, generating units shall be put for commercial operation under the supervision of Contractor for three months. During the three months of operation, Contractor shall be fully responsible for technical guidance to operating staff of the Owner.

### 1.17 ACCEPTANCE

- The taking-over testing of any part or section of the Permanent Works, which can operate as an independent unit, shall be performed as per the test procedure agreed upon between Engineer and Contractor.

- Immediately upon termination of any such testing of a part or section of the permanent Works a "Protocol of Acceptance" which shall be deemed to be the Test Certificate required by General Conditions of Contract shall be issued by the Engineer.
- This document shall be signed by an authorised representative of the Owner, the Engineer and the Contractor and shall form an integral part of the later "Taking Over Certificate".
- This "Protocol of Acceptance" shall state:
  - The date of testing
  - The quantity and type of Works concerned
  - Statement of all minor defects which have to be corrected by the contractor
  - Confirmation that the guaranteed data have been proven
- If any test for the verification of the guaranteed data could not be performed for operational reasons beyond the Contractor's responsibility, this part of the acceptance shall be stated in the "Protocol of Acceptance" and be postponed for a mutually agreed period.
- However, the tested part or section of permanent work shall continue to be operated by the Owner with the help of Contractor's personnel, till both Generating units have been tested and commissioned and trial run period of 10 days or that to be agreed with the Owner and the Contractor, has been completed in respect of last unit to be commissioned.

#### 1.18 LIST OF APPLICABLE STANDARDS

The design, manufacture and performance of equipment covered by this specification shall conform to the relevant Indian Standards and Codes. Where Indian Standards are not available they shall conform to relevant IEC and ANSI/IEEE Standards.

A.

S.No.	DESCRIPTION		INDIAN
1.	Electrical and instrumentation		
2.	Rotating electrical machines	IEC 34	IS:4722-1968
3.	Direct action indicating electrical measuring instruments	IEC 51	
4.	Paper-insulated metal-sheathed cables for rated voltages up to 18/30 kV	IEC 55	
5.	High voltage alternating current circuit breakers IEC 56	IS:2516-1980	
6.	Basic environmental testing procedures	IEC 68	

7.	Insulation co-ordination	IEC 71	
8.	Dimensions and output ratings for rotating electrical machines	IEC 72	
9.	Colours for indicator lights and push buttons	IEC 73	
10.	Power Transformers	IEC 76	IS:2026
11.	Classification of materials for the insulation of electrical machinery	IEC 85	
12.	Primary Batteries	IEC 86 -	
13.	Lead Acid Starter Batteries	IEC 95	
14.	lightening Arrestors recommended graphic symbols	IEC 99	
15.	Alternating current disconnectors (isolator) and earthing switches	IEC 129	
16.	Bushings for alternating voltages above 1000 V.	IEC 137	
17.	Degrees of protection for low voltage switch gear and control gear	IEC 144	
18.	Low voltage switchgear and control gear	IEC 157	
19.	Low voltage control gear tests on indoor and outdoor post insulators for voltages greater than 1000 V.	IEC 168	
20.	Current transformers	IEC 185	IS:2705
21.	Voltage transformers	IEC 186	IS:3156
22.	Low frequency cables and wires with P.V.C. insulation and PVC sheath	IEC 189	
23.	On-load tap changers	IEC 214	
24.	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V.	IEC 227	
25.	Conductors for insulated cables	IEC 228	
26.	Impulse tests on cables and their accessories	IEC 230	
27.	Electrical relays	IEC 255	IS:3231-1965
28.	Low voltage fuses calculation of the continuous current rating of cables (100% load factor)	IEC 287	
29.	Low voltage motor starter	IEC 292	
30.	Specification for new insulating oil for transformers and switchgear	IEC 296	

31.	AC metal-enclosed switchgear and control gear for rated voltages above 1 kV up to and including 72.5 kV	IEC 298	
32.	Standard colours for insulation for low frequency cables and wires	IEC 304	
33.	Guide to the calculation of resistance of plain and coated copper conductors of low-frequency cables and wires.	IEC 344	
34.	Loading Guide for oil immersed transformers	IEC 354	
35.	Marking of insulated conductors	IEC 391	
36.	Report on synthetic testing of high voltage alternating current breakers.	IEC 427	
37.	Factory-build assemblies of low voltage Switchgear and control. gear	IEC 439	
38.	Identification of insulated and bare conductors by Colours	IEC 446	
39.	Standard directions of movement for actuators	IEC 447	
40.	which control the operation of electrical apparatus		
41.	Methods off measurement of radio equipment used in their mobile services	IEC 489	
42.	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto 30 kV	IEC 502	
43.	Class 0.5, 1 and 2 alternating current Watt-hour Meter	IEC 521	
44.	Test methods for insulations and sheaths of electric cables and cords	IEC 540	

## B) TURBINES, GENERATORS AND ANCILLARY PLANT

1. International Code for Field Acceptance Test of Hydraulic Turbines Publication 41 (IEC -41)-1963.
2. The IEC publications 308 'International code for testing of speed governing systems for hydraulic turbines' shall be an integrated document of the governor specification.
3. Test code for Hydraulic Prime Movers, ASME Power Test Codes, ASME-New York 1949.
4. Electromechanical Equipment Guide for Sal Hydroelectric Installations (IEC-11161992-10)
5. International Code for Model Acceptance Tests of Hydraulic Turbines 193-1965-193A1972.

**C) CODE AND STANDARDS**

In complement to the standards specified in Section 01000. Generator Requirements, the particular following standards shall be applied;

1. Bolt calculation : VSM 14 332;
2. Vibrations : VDI 2 056;
3. Shaft coupling : ANSI B 49.1;
4. Shaft alignments : NEMA;
5. Rotating electrical machines; IEEC 30.4 to 31.11;
6. Test Procedure for Synchronous Machine; IEE 115

Referring to section 15010, the following subs or clauses shall be completed or amended or new clauses added as follows:

**INDIAN STANDARDS**

Sr.No.	IS:CODE	DESCRIPTION
1.	IS:4722-1968	Rotating electrical machines.
2.	IS:325-1978	Three phase induction motors
3.	IS:8789-19'18	Values of performance for three-phase induction motors
1.	IS:3156	Voltage transformers
5.	IS:L3156(Pt.I)-1978	General requirements
6.	IS:3156(Pt.II)-1978	Measuring voltage transformers
7.	IS:3156(Pt.III)-1978	Protective voltage transformers
8.	IS:3156(Pt.IV)-1978	Capacitor voltage transformers
9.	IS:2705	Current transformers
10.	IS:2705(Pt.I)-1981	General requirements
11.	IS:2705(Pt.II)-1981	Measuring current transformers
12.	I5:2705(Pt.III)-1981	Protective current transformer
13	IS:2704(Pt.N)-1981	Protective current transformers for special purpose applications
11.	IS:2026	Power transformers
15.	IS:2026(Pt.I)-1977	General
16.	IS:2026(Pt.II)-1977	Temperature-rise of Power transformers.
17.	IS:2026(Pt.ItI)-1981	insulation level-, and dielectric tests
18.	IS:2026(Pt.IV)-1977	Terminal markings, tappings and connection
19.	I5:335-1983	New insulating oils
20.	IS:3231-1965	Electrical relays for power system protections
21.	IS:3043-1966	Code of practice for earthing
22.	IS:1651-1979	Stationary cells and batteries lead-acid type with tubular positive plates)
23.	IS:2516-1980	Circuit-breakers

24	IS:2147-1980	Degree of protection provided by enclosures for low voltage switchgear and control gear
25.	IS:L1554(Pt.II)- 1976	For working voltages upto and including 1100 V
26.	IS:5613(Pt.USec.I) 1978	Lines upto and including 11 kV, section 1 Design.

647056/2022/PS-PEM-MAX



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

DOCUMENTS TO BE SUBMITTED ALONG WITH BID

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section III Date DEC'21

**SECTION-III****DOCUMENTS TO BE SUBMITTED ALONG WITH BID**



TITLE

206 MW SHAHPURKANDI HEP

DOUBLE GIRDER EOT CRANES ABOVE 100T

DOCUMENTS TO BE SUBMITTED ALONG WITH BID

SPECIFICATION NO. PE-TS-406-501-A501

REV 00

Section III Date DEC'21


Page 2 of 2

### 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) Electrical load list, duly signed and stamped
- c) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format given under Section-III
- d) Un priced copy of price format indicating quoted/ not applicable against each row/column
- e) Signed and stamped copy of Supply price percentage break-up (enclosed with section-IA)

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 WILL NOT BE CONSIDERED FOR BID EVALUATION.

	TITLE:	TECHNICAL SPECIFICATION	SPEC. NO.: PE TS 406 501 A501
	<b>DOUBLE GIRDER EOT CRANE ABOVE 100T COMPLIANCE CUM CONFIRMATION CERTIFICATE</b>		SECTION: III
		REV. NO. 0	DATE DEC 2021
		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', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- 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. 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

647056/2022/PS-PEM-MAX

	TITLE:	SPEC. NO.:	
	TECHNICAL SPECIFICATION	PE TS 406 501 A501	
	<b>DOUBLE GIRDER EOT CRANE ABOVE 100T COMPLIANCE CUM CONFIRMATION CERTIFICATE</b>	SECTION:	III
		REV. NO.	0      DATE    DEC 2021
SHEET		2      OF    2	
<p>BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.</p> <p>k) As built drawings shall be submitted as and when required during the project execution.</p> <p>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.</p>			





**647056/2022/PS-PEM-MAX**

9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of 10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.