

NHPC LTD.

**TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2**

**TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE
GIRDER EOT CRANE**

SPECIFICATION NO.: PE-TS-484-501-A001 Rev 0



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFICATION No: PE-TS-484-501-A001

SECTION

REV. 00

20-07-2021

SHEET : 1 OF 1

INDEX

SECTION	TITLE	PAGE NO.
I	SPECIFIC TECHNICAL REQUIREMENT	3
I	INTENT OF SPECIFICATION	4-5
IA	SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	6-11
IA	QUALITY ASSURANCE AND INSPECTION REQUIREMENT	12-65
IA	CUSTOMER SPECIFICATION – GENERAL TECHNICAL SPECIFICATION	66-130
IA	CUSTOMER SPECIFICATION – PARTICULAR TECHNICAL SPECIFICATION	131-203
IA	ANNEXURES	
IA	-ANNEXURE I: MAKES OF SUB VENDOR ITEMS	205-211
IA	-ANNEXURE II: LIST OF MANDATORY SPARE	212
IA	-ANNEXURE III: LIST OF TOOLS AND TACKLES	213
IA	-ANNEXURE IV: PAINTING SPECIFICATION	214
IA	-ANNEXURE V: DRAWING/ DOCUMENT SUBMISSION SCHEDULE	215-219
IA	-ANNEXURE VI: PACKING PROCEDURE	220-235
IA	-ANNEXURE VII: SUPPLY PRICE PERCENTAGE BREAKUP	236-237
IA	CRANE CLEARANCE DIAGRAM	239
IA	PROJECT DRAWINGS	241-242
IB	NOT USED	
IC	DATA SHEET	244-246
II	NOT USED	
III	DOCUMENTS TO BE SUBMITTED BY BIDDER	
III	LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID	248
III	PRE BID CLARIFICATION SCHEDULE	249
III	COMPLIANCE CUM CONFIRMATION CERTIFICATE	250-251

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENTS		SECTION I	
			REV. 00	20-07-2021

SECTION I SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA: Specific Technical Requirements (Mechanical)

SUB-SECTION IC: Data Sheet

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2 TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION No: PE-TS-484-501-A001	
		SECTION I	
		REV. 00	20-07-2021

1. SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising provision of labour, tools, plants, materials and performance of work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, preservation at site, installation, commissioning, performance testing, acceptance testing, training of Employer's personnel, handing over to employer after commissioning and guarantee for two years of EOT crane for MIV Cavern complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation .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. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2	SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE	SECTION I	
		REV. 00	20-07-2021
SPECIFIC TECHNICAL REQUIREMENTS			

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 Manufacturing Quality Plan for reference is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan's minimum requirement during manufacturing and testing. Further all checks and tests indicated in Quality Assurance Requirement as detailed in Customer's specification etc have to be followed.

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 (<https://pem.bhel.com/wrenchweb>).

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
			SECTION IA	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		REV. 00	20-07-2021
	SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)			
SECTION IA SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)				

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2	SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE	SECTION IA	
		REV. 00	20-07-2021
SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)			

1.0.0. SCOPE OF WORK (SUPPLY & SERVICES)

1.1.0. SCOPE OF SUPPLY

1.1.1. Equipment and services to be furnished by the bidder for the EOT CRANE with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified but required to make the EOT crane complete for efficient & reliable 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. One (1) number 90T/10T Double Girder Crane for MIV CAVERN shall include but not be limited to the following: -

a. Bridge girders with platform

b. End carriages with wheels

c. Crab (trolley)

d. Cross Travel & Long Travel drive arrangement.

e. Operator's cabin.

f. All electrical equipment including cables, junction box, VVVF drive, RRC, panels etc.

g. PVC insulated shrouded bus bar Copper conductor type DSL.

h. Rail complete including all accessories and end stopper.

i. Main Isolating switch/Changeover in enclosure at operating floor for incoming power supply from two boards.

j. Power cables from two nos. supply boards to the Main Isolating switch/Changeover. Electrical supply feeders 100A rating shall be provided by BHEL from SAB-1 & SAB-2 installed in control block at EL 242.0. Refer **"Section IA – Project Drawings"** of this specification

k. Slings and cradle for load testing at site.

l. Holding clamps against earthquake.

m. Earthing arrangement.

n. Fill of lubricant till commissioning of crane.

o. Painting of cranes and accessories.

p. One (1) no flexible power cable (Half the bay length + 25m) of suitable size as per load calculation for commissioning, testing & operation of EOT Crane till such time the DSL is charged.

q. Maintenance tools & Tackles.

r. Erection & Commissioning spares.

s. Mandatory Spares.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

1.1.4

Makes of Sub - Vendor items

Makes of bought out items detailed 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.

1.1.5

Mandatory Spares

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

1.1.6

Maintenance Tools and Tackles

Refer Annexure III, Section-IA of this specification.

1.1.7

PAINTING & COLOUR SCHEME

Refer Annexure IV, section-IA of this specification.

1.1.8

Erection and Commissioning spares

The Bidder shall also supply erection & commissioning spares along with the main equipment as per their 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. Oil and grease required for first filling along with ten (10%) percent excess quantity. The bidder shall deliver to the Owner all equipment complete with initial fill of fluids, grease or lubricants, in drums / containers. Bidder shall supply minimum following spares

i)	Oil seal for each gear box	1 Set
ii)	Indicating Lamps 1 no. of each type	1 Set
iii)	Push Button 1 no. of each type	1 Set
iv)	Aux. contactor 1 no. of each size	1 Set
v)	Limit switches- 1 no. of each type	1 Set
vi)	Any other spare/s, as per experience of bidder	

Note: a. Any spare, not quoted by bidder, but required during erection & commissioning shall be supplied by bidder without any additional cost to purchaser.

b. One set means 100% requirement of one crane.

1.1.9

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

1.1.10

Packing as per Annexure VI, forwarding and transportation to delivery address as per SCC.

1.2.0

Services to be provided by the bidder

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
1.2.1. Packing, forwarding and transportation to site. 1.2.2. Development of storage space including ward & watch of the equipment and handling at site. 1.2.3 Unloading, storage and handling at site. The Bidder shall provide means for all unloading and reloading for all consignments of plant; both during transport to Site and on the Site. Consignments shall be unloaded immediately on arrival at Site. The Bidder is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc. The following parts shall be stored inside enclosed warehouses: Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, electric motors and excitation equipment, instruments, welding material and equipment, all small parts and all parts of the crane which already have been finally painted. If large parts are stored in the open air, they shall be provided with weather resistant and fire & resistant covers. Electrical parts, which are not packed in heavy duty polyethylene foil and those so packed, but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation. All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity. All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers. 1.2.4 Arranging test load at site Arrangement of test load at site shall be under bidder's scope of work. Test load shall be in the form of rolled steel, plates, girder, angle , concrete blocks etc suitable for the cradle and slings being supplied at site. 1.2.5 Erection and Commissioning of EOT cranes and all accessories. 1.2.6 Demonstration / Load test at bidder's Works and at Site. 1.2.7 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. 1.2.8 Training to Customer's Operation & Maintenance staff (as applicable). 1.2.9 Any service mentioned in GCC & SCC as relevant to the package. 1.3.0. Exclusions Supply feeder. RCC Gantry girder. Storage & space for storage. Exclusion, if any, mentioned in GCC, SCC.				

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

2.0.0

Drawing and documents submission schedule along with number of prints.

Drawing and documents submission schedule along with number of prints / copies required for various drawing and documents are listed in Annexure –V, Section-I-A of this specification.

3.0.0

Deviations

If the offer submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the format of “Cost of withdrawal of deviation” attached in Sec 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.

4.0.0

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.

4.1.0

Testing at Works

Refer section IA: QUALITY ASSURANCE AND INSPECTION REQUIREMENT.

4.2.0

Testing at Site

4.2.1

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 under supervision of bidder’s representative.

i.

Deflection test of bridge girder at rated load.

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.

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

iv.

Brake test.

v.

Any other test as per IS-3177

Note: The test shall be carried out with actual panels, RRC, Master controller etc.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

5.0 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.

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

SECTION IA

QUALITY ASSURANCE AND INSPECTION REQUIREMENT

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IA	
			REV. 00	10-06-2021
SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)				

1.1.0. Inspection and Testing

Bidder shall submit Manufacturing Quality Plan (MQP) based on the guidelines given in the specification & MQP enclosed herein. Format shall be as agreed with Customer in line with **Customer's specification "QUALITY ASSURANCE AND TESTING SPECIFICATIONS (QTS) & MQAP"** Volume: III-D

1.1.1. Inspection and testing at Manufacturer's works

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

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

STAGE INSPECTION

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

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

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps
2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IA	
			REV. 00	10-06-2021
	SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)			

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.

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

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

FINAL INSPECTION OF CRANES- (TESTING OF CRANES AT SUPPLIER'S WORKS)

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

- a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
- b) Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.
- c) Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177
- d) All Other tests as per IS-3177.



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

10-06-2021

Procedure No. PEM (Q)/001

SHOP TEST PROCEDURE FOR GEAR BOX

1.0.0	Scope: Acceptance Norms for Crane Gear Boxes
1.1.0	This procedure lays down the Acceptance norms for the Gear boxes for EOT crane. This standard also covers vertical gear boxes. Reduction Gears shall be tested for reduction ratio, backlash & contact pattern. Gear Box shall also be subjected to No load run test to check for oil leakage, temp. rise, noise and vibration.
2.0.0	The following dimensions shall be checked:
2.1.0	i. Diameter and keyway dimensions of input and output shafts. ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box. iii. Centre distance between input and output shafts. iv. Centre Height. v. Distance between foundation holes with respect to center line of the output shaft and distance of foundation holes from center line of the gearbox. vi. Overall dimensions
3.0.0	Backlash
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	Area of Contact:
4.1.0	Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2) For final stage of Hoist gearing: h / H shall be more than 30% $(a - c) / b$ shall be more than 40% For all other gears: h / H shall be more than 40% $(a - c) / b$ shall be more than 50%
5.0.0	Running Test
5.1.0	1.1.1 The gear boxes shall be run under no-load condition at the rated speed for

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IA	
			REV. 00	10-06-2021
SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)				

	minimum four hours in each direction and the following are to be checked: i. All bolts at the joints remain tight ii. All gear mesh lines are getting enough lubrication iii. All bearings are getting enough lubrication iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour. v. Vibration: Maximum limit 125 microns (peak to peak) vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm. vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.
6.0.0	1.1.2 General
6.1.0	1.1.3 In addition to the above specific points, the following general points shall be ensured: i. Inspection pockets are provided as required. ii. Gear box casings are provided with at least two fit bolts/dowels at the parting line. iii. Dip sticks with minimum / maximum level markings are provided. iv. Drain plugs are provided at convenient locations preferably at vertical wall of the housing. v. Breathers are provided. vi. Lifting lugs or eye bolts are provided as required. vii. Wherever bearings have splash lubrication, oil retainers are provided. viii. Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint. ix. In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided. 1.1.4 Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

10-06-2021

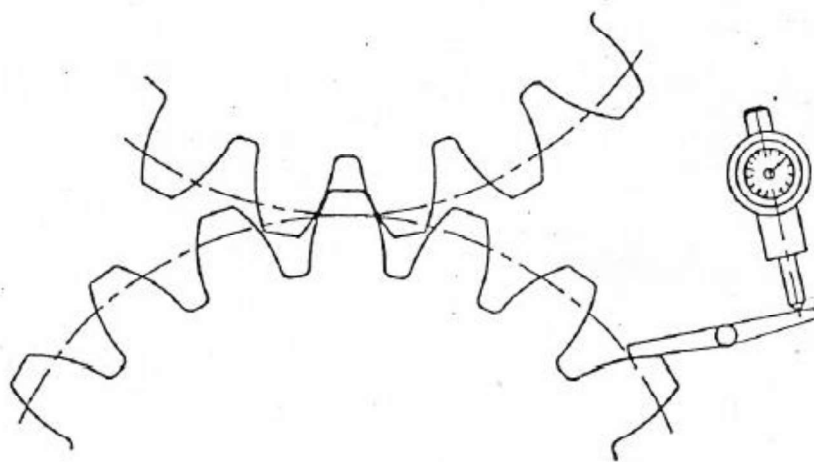


FIG.1 MEASUREMENT OF BACKLASH

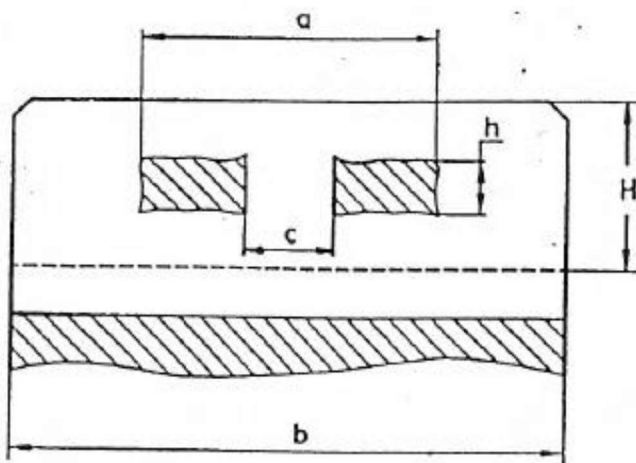


FIG.2 AREA OF CONTACT OF GEAR TEETH



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

10-06-2021

TABLE 1
BACKLASH AND 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



VOLUME-IIID

QUALITY ASSURANCE AND TESTING SPECIFICATIONS (QTS) & MQAP



QUALITY ASSURANCE AND TESTING SPECIFICATIONS (QTS)

373955/2021/PS-PEM-MAX**TEESTA HE PROJECT STAGE-VI**

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.

Note: Wherever "NHPC" is mentioned in the QTS/QAP(Model), the same may be substituted to read as "Employer"

Alfegh
GM(M)

✓

Alfegh
9.5.17

TEESTA HE PROJECT STAGE-VI

Quality Testing Specifications (QTS)

APKingle
GM(M)



QUALITY TEST SPECIFICATION (QTS)**INDEX**

Sl. No.	Equipments/ Particulars
1.	General Inspection & Testing Requirement
2.	Bus Duct
3.	GSU Transformers
4.	XLPE Cable
5.	245 kV GIS
6.	Outdoor Pot Yard Equipment
7.	DC System
8.	MV Switchgear
9.	LV Switchgear & Auxiliary Transformer
10.	Electric Overhead Travelling (EOT) Crane
11.	Grounding System
12.	Oil Handling System
13.	PLCC System

ବିନୟ
 କରମ (ଅଧ୍ୟକ୍ଷ)
 ୨୫.୫.୨୦୨୧
 ୨୫.୫.୨୦ (କି.)

QUALITY TEST SPECIFICATION (QTS) CLAUSES**1. GENERAL INSPECTIONS AND TESTING REQUIREMENT****1.1. General**

In addition to the provisions established in the Conditions of Contract regarding general procedure of inspections and tests, terms and definitions, and time schedules for inspections and tests the following stipulations shall apply:

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 soonest after performance of 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:

1. Employer's name
2. Project title
3. Plant's (stage's) name
4. Number of Contractor's drawing
5. Date

1.2 Manufacture and Supply

All material furnished shall be of tested quality and all work performed shall be subjected to rigid inspection as specified in relevant International or Indian Standards and no articles or material or supplies shall be dispatched until the dispatch instructions are issued by the Employer, which shall be issued only after all test's analysis and shop inspection have been completed or certified copies of reports or, results of tests and analysis have been accepted by the Employer. Duplicate copies of manufacturer tests certificate shall be submitted to the engineer in charge as soon as the tests are completed. In case test certificates are not available for any of materials, the same shall be tested if requested by the employer and only those materials, which fulfill the requirements of the specifications, shall be used.

AP Singh
G.M(M)

B. J. (M)

TEESTA HE PROJECT STAGE-VI

1.2.1 Steel Casting

Castings shall be sound and free from blowholes, porosities, shrinkage holes, cracks or any other defects. Surfaces of castings which do not undergo machining and which are exposed to view in the installation shall be dressed for good appearance and for painting. The location of existing defects shall be determined, and all defects, which impair the strength or utility of the casting, shall be removed to sound metal. The structure of the castings shall be homogeneous and free from excessive non-metallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a casting will be a cause for its rejection.

1.2.2 Welding

Members to be joined by welding may be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conditions. Edges shall be shaped according to DIN 8551. Design of welded joints and selection of weld filler metal shall be in accordance with approved standards and shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces to be welded shall be sound metal free of visible defects such as laminations or defects caused by cutting operation at least 30 mm back from the edge of the weld, and free from rust, oil, grease, and other foreign matter.

The qualification of welding procedures, welders, and welding operators for all welding, including weld repairs, shall conform to DIN 8560, DIN 8563, EN 287, or to the requirements of the ASME Boiler and Pressure Vessel Code Section VIII and IX. The Contractor shall perform qualification tests of his welders and welding operators and submit evidence of this to the Engineer in-charge.

Weld-fabricated pressure-containing parts shall be designed, fabricated, inspected and tested, unless otherwise specified, in accordance with approved standards and shall be stress relieved as a unit prior to final machining.

1.2.3 Workmanship**i) Electric Welding**

All welds shall be made continuous and watertight. The minimum size of fillet welds shall be 6 mm measured on the leg. All butt welds shall be full penetration welds welded from both sides.

Welds shall in general be treated so that they will display good appearance and a surface suitable for painting. Structural welds shall be ground and blended to avoid stress raisers. All welds, which require non-destructive examination, shall be dressed by chipping and grinding as required for good interpretation by the selected weld examination method.

All butt welds in the flanges and webs of beams and girders shall be radiographically inspected. The fillet welds between flanges and webs shall be tested by the magnetic particle method.

Handwritten signature
GM(M)

Handwritten signature

Handwritten signature
2.5.14

Handwritten signature

Handwritten signature

ii)

Machine work

All tolerances, allowances, and gauges for metal fits between plain (non-threaded) cylindrical parts shall be indicated. Sufficient machining stock shall be allowed on parts to be machined to ensure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished, and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. No machining shall be done on working surfaces of self-lubricating bushings or washers.

Finished Surfaces

All surfaces that are so indicated on the drawings or those that require machining for their intended function, or those that are usually machined according to good workshop practice shall be machined. Surface finish qualities shall be adequate for the intended use and shall be indicated on the Contractor's Drawings. Suitable measuring device such as Scatterometer or other acceptable measuring device will be used to determine compliance with specified surface.

Unfinished Surfaces

So far as practicable, all work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth, or machined, to secure proper alignment. If surfaces not designated as finished in the Contract Documents require machining to obtain the tolerances or straightness specified or needed for correct function, such machining shall be performed by the Contractor.

1.2.4 Dimensional Checks and Visual Inspection

Dimensional checks shall be performed on all major parts, components and partial assemblies, especially when close tolerances and fits are involved (tolerance of shafts, between stationary and moving parts, connecting dimensions for the assembly with other supplies, etc.). If the dimensional checks show discrepancies in measurement, which may affect the fit, assembly or dismantling of the respective part or component, the same have to be corrected correspondingly. Such correction or modification shall, however, in no way lead to sacrifices with respect to reliability of operation or inter-changeability, and shall be performed only after the agreement of the Engineer in-charge has been obtained. If the correction or modification cannot be carried out in accordance with the terms mentioned above, the part or component concerned may be subject to rejection. Faulty machine parts or equipment shall by no means be delivered.

Castings shall be inspected visually at the foundry after they are cleaned and while defects are being removed. Castings shall also be inspected after repairs and after heat treatment. Radiographic or other non-destructive tests will be required as specified under non-destructive testing and as directed by Engineer in-charge when granting permission to repair major defects. The Engineer in-charge reserves the right to require conducting non-destructive tests at the Contractor's expense to determine: the full extent of

Alfingh
GM(M)

[Signature]

[Signature]
व. ज. १५/१

[Signature] *[Signature]*

TEESTA IIE PROJECT STAGE-VI

defects; that area is properly prepared for welding that the repairs are satisfactory.

1.2.5 Impact and Bend Tests

Steel products for all principal turbine and shut-off valve parts shall be tested for impact resistance using the ISO V-notch specimen. Both longitudinal and transverse impact tests shall be performed on plate steel. Bend tests shall be performed on specimens of all major steel castings and forgings in accordance with the applicable DIN standards. The nil ductility transition temperature shall be the temperature at which the impact resistance is at the values specified above.

1.2.6. Non-Destructive Testing**1.2.6.1. Examination of Welds**

Unless otherwise indicated in these Contract Documents, non-destructive tests shall be in accordance with approved standards. Radiographic examination of welds shall be in accordance with the technique and acceptance standards of IIW (International Institute of Welding). The Contractor's Drawings shall indicate the type and extent of non-destructive examination as it applies to each component or weld.

Weld examination shall be by the ultrasonic, dye penetrant, or magnetic particle methods, supplemented by radiographic examination. Supplemental radiographic examination shall include examination of critical high-stressed areas where interpretation of other methods is unclear, or where the integrity of the weld is doubtful. The Employer shall have the right to request the Contractor to make random spot-check examination of welds, including radiographic examination, as part of his inspection of the equipment. The Contractor's detailed program for non-destructive examination of welds shall be submitted for review.

1.2.6.2. Examination of Casting

The turbine runner casting shall be given complete non-destructive examination including radiographic examination of the most critical areas. The Contractor shall submit Quality Sheets (Specification for inspection of steel casting for hydraulic machines), with his recommendation and specify special precautions to be taken for the casting of the turbine runner and other important casting components. The Quality Sheets submitted shall define the area and extent of the various non-destructive examinations to be performed on castings.

1.2.6.3 Examination of Forging

Shafts, stems and coupling bolts made of forgings shall be given complete ultrasonic examination and other applicable non-destructive test, to determine that they are sound. Non-destructive examination of other forgings shall be in accordance with accepted good practice to assure their soundness. The structure of forgings shall be homogeneous and free from excessive non-

APFingle
GIM(M)

1

21.11.21
21.11.21

21.11.21

21.11.21

373955/2021/PS-PEM-MAX

TEESTA HE PROJECT STAGE-VI

metallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a forging will be a cause for its rejection.

1.2.7. Pressure Tests

Unless specifically mentioned otherwise in the Contract Documents, equipment, vessels and tanks under internal pressure during service shall be subject to hydrostatic pressure testing. The test pressure shall be 1.5 times the maximum design pressure of the respective equipment, vessel or tank.

Unless otherwise specified, the test pressure shall be applied for a period of 1/2 hour without showing leaks or drop in pressure.

1.3 Workshop Inspections and Shop Tests

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.

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.

Should an agreed inspection not be carried out as proposed because of lack of preparation, obvious negligence or material and/or equipment being presented in a state, which does not corresponds to the proposed procedure or is clearly not acceptable such an inspection shall be repeated. The cost incurred by the Employer for repeated inspections shall be fully borne by the Contractor.

The Contractor shall state the plan of manufacture, testing and inspection of the various works in the contract, and the representative of engineer in-charge shall also be entitled to access to manufacturer's or, sub-contractor's work at any time during working hours for the purpose of inspecting the manufacture of equipment and materials.

All the required tests as per standard/specifications shall be carried out at Contractor's expenses. If any component of the equipment fails in the specified test, the same shall be replaced/ rectified and again offered for inspection.

Shop Tests specified in respective section shall be carried out in Employer's presence. The tests not specifically mentioned but recommended in the relevant standards for such equipment and/or good engineering practice shall also be carried out.

The factory test equipments and the test methods used shall conform to the recommendations of the relevant IEC Publications and shall be subject to approval of the Engineer in-charge.

1.3.1 Material Tests

At Singh
GM(M)

[Signature]

[Signature]
21.12.21
8.5.1.4

[Signature]

[Signature]

TEESTA HE PROJECT STAGE-VI

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

1. Chemical analysis
2. Mechanical tests (yield point, tensile strength, elongation, Transverse Contraction and notch impact.)
3. Welding tests (welding procedure, welding material, welding tensile strength, welding bend test, welding reversed bend test, etc.)
4. Non-destructive tests (X-rays, Ultrasonic, Magnetic Particle tests, Liquid Penetration inspection, etc.).
5. Electrical tests (voltage, losses, tan delta, insulation, magnetic properties etc.)

For the notched bar impact test, the impact value shall be obtained at plus (+) 20°C ambient temperature unless mentioned otherwise. The material tests shall be performed as per relevant ASTM unless approved otherwise.

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.

1.3.2 Checking of Dimensions

The dimensions, especially clearances and fits, which are essential for operation and efficiency shall be carefully checked in an approved manner, as for example:

1. Run out and roundness tolerances of shafts, pistons, etc., to be measured on single parts as well as (wherever possible) on the assembled components,
2. Fits and clearances of bearings, servomotor pistons, valves, guiding, distributing and actual actuating elements, etc.,
3. Accuracy, surface roughness and shape of sliding and guiding surfaces of seals, bearings, water passages in hydraulic machinery, valves, etc.,
4. Dimensions of couplings or connections for assembly with other deliveries from the Contractor, Sub-contractors or other contractors.

1.3.3 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.

Alsingh
GM(M)

[Signature]

[Signature]
व.प.सि.

[Signature]

373955/2021/PS-PEM-MAX

TEESTA IIE PROJECT STAGE-VI

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 match 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.

1.3.4 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. As far as practicable, these tests shall be done in the shop but can be repeated at site.

Parts exposed during operation to hydraulic pressure, to gas pressure or to any liquid without pressure, shall be treated distinctively.

As far as practicable and required, the influences of temperatures and temperature differences to which the part will be exposed during operation shall be considered in the performance of the tests.

1.3.4.1 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 1.5 times the maximum operating pressure (except for spiral distributor) and shall be maintained for a period of eight hours or longer if required by the applicable standards. Afterwards the test pressure shall be reduced to the operating pressure.

Handwritten signature: H. Singh
G.M(M)

Handwritten mark: L

Handwritten signature: [Signature]
9.5.17

TEESTA HE PROJECT STAGE-VI**1.3.4.2 Parts Exposed to Gas Pressure**

Parts which will be subjected to gas pressure during operation for example pressure tanks, pressure air tanks and others, shall be inspected and tested according to the official regulations with respect to design, construction, fittings, etc.

The pressure test shall be executed by applying the test pressure in accordance with the relevant standards and specifications.

1.3.4.3 Parts Exposed to Liquids without Overpressure

Parts which shall not be closed and which are exposed to only small pressures of any liquid during operation e.g., bearing housings, oil containers, etc.) Shall be subjected to a tightness test with a suitable liquid of low viscosity. The testing-period shall not be less than 8 hours, unless otherwise agreed.

1.3.5 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.

1.3.6 Operational Tests

As far as practicable operational tests shall be carried out on all Works, simulating operating conditions.

Parts to be delivered by sub suppliers shall be tested either at the premises of the sub supplier or of the Contractor, as agreed by the Engineer.

Before testing the Contractor shall submit a notice containing full information on the tests with detailed tables or graphs on the latest edition of the characteristic values of the Works to be tested and on the test facilities and equipment.

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, losses.

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

1.3.7 Electric Tests

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

1.3.8 Model Tests

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

1.4 Quality Control and Assurance

Handwritten signature: A.S. Singh
GM(M)

Handwritten signature: [Signature]
[Signature]

Handwritten signature: [Signature]

373955/2021/PS-PEM-MAX

TEESTA HE PROJECT STAGE-VI

To ensure quality during each stage of work, the Contractor shall establish a system defining quality assurance plan/procedures during various stages of work.

The Contractor shall maintain quality control during manufacturing of equipment as per the approved quality assurance plan. The model quality assurance plan for equipment / components for each section are given hereafter. Final quality assurance plan (QAP) for manufacturing shall be approved during detailed engineering.

The Bidder shall submit the detailed Quality Assurance Plan for the complete equipment/materials along with the bid for approval and acceptance by the Employer. This shall form integral part of the contract. The QAP shall include inspection and tests proposed to be conducted on raw material/ bought out items at the time of induction in the process of manufacturing and at final stage of assembly.

Based on the test certificate, inspection report dispatch clearance shall be issued by the employer. The materials/equipments/items shall only be dispatched after issue of material dispatch clearance certificate (MDCC).

Detail Model Quality Assurance Plan is attached here with of each and every equipments/ auxiliaries. These are to be strictly observed /followed by the Manufacturer / Contractor/ Sub – Vendor.

Inspections and tests shall be carried out by the Contractor as per approved QAP with due regard to stipulations in "Inspection and Tests" of "General Technical Specification" at various stages of manufacturing for assuring the full compliance of supply with the requirements of specification.

The Contractor shall follow approved site quality assurance plan and installation procedures. The Contractor shall maintain the quality records during site installation and commissioning which shall be produced to engineer in charge for approval at defined stages.

Inspection and tests shall be carried out at site by contractor during installation and commissioning as described in relevant clauses.

1.4.1 Type Tests

Type tests shall verify that all components of the equipment perform satisfactorily, both electrically and mechanically, at the rating assigned. All equipment proposed according to the specification shall be type tested at typical units in accordance with the relevant standards specified in respective sections.

The type tests for equipment, except wherever mentioned specifically as mandatory in respective section, may not be mandatory if similar typical units of equipment have been type tested and test certificate(s) for relevant tests are accepted by the Employer.

AP Singh
GM(M)

✓

Signature
Date

Signature

TEESTA HE PROJECT STAGE-VI

The Contractor shall prepare written documents, in a form agreed upon by the Contractor and the Employer, of all test certificates/ results and hand over these documents to the Employer in due time for review and acceptance as required.

All cost associated with the mandatory type tests shall be included in contract price. Also, the Contractor shall conduct the type test(s) at his own cost for which certificate(s) are not acceptable.

1.4.2 Routine Tests

Routine tests shall be conducted on various equipment/components as elaborated in respective section and/or approved quality assurance plan. (QAP).

1.4.3 Field 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 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 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.

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.

All field tests including tests during installation, pre-commissioning, commissioning, performance and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer. Procedure to be adopted for conducting these tests shall be submitted well in advance, before start of relevant testing, for approval of the Employer.

All test equipment and instruments shall be furnished by the Contractor and will remain the Contractor's property after the fulfilment of all field tests.

Handwritten signature
GM(M)

Handwritten mark

Handwritten signature
ক. প্র. শী

Handwritten signature

TEESTA HE PROJECT STAGE-VI

The Contractor shall prepare written test certificates in a form agreed upon by the Contractor and Employer of all tests results and hand them over to the Employer in due time.

1.4.3.1 Tests During Installation, Pre Commissioning And Commissioning

Immediately upon termination of commissioning of a part or section of the Permanent Works, which can operate as an independent unit a "Certificate of Suitability for Operation", shall be issued by the Engineer.

This document shall be signed by an authorised representative of the Employer, the Engineer and the Contractor.

This Certificate shall state:

1. The supplier of the Works concerned
2. The quantity and type of Works concerned
3. The conditions of commissioning
4. The names of the participants
5. The date of commencement of trial run
6. The list of minor defects, if any, which has to be corrected by the Contractor

During the trial run the Contractor shall make familiar the Employer's personnel with the equipment, the operation and maintenance of the Works and its auxiliaries to such an extent that thereafter the duties can be assigned to the Employer'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.

The tests during installation, pre-commissioning and commissioning shall be conducted at site in accordance with provision in respective sections and/or in applicable Indian/International testing standards for the system and system components. However, following generic tests shall be essentially performed on all installation/system:

- Visual inspection of the equipments/components
- Pressure test of all field installed piping at 1.5 times of the design pressure,
- Operational and functional tests of components, sub-assemblies, auxiliaries, piping system etc,
- Control logic field tests to prove control logic scheme for operation and interlocks of system components, including annunciation and shutdown scheme,
- Calibration Test - All instruments, gauges, sensors, switches, relays, and similar equipment shall be calibrated and adjusted after

Alfinghe
GM(M)

[Signature]

[Signature]
8-5-14

[Signature]

TEESTA HE PROJECT STAGE-VI

installation, wherever practical. Where not practical, the calibration and adjusting shall be done just prior to installation,

- Operational Tests For Protection - Field tests for verification of correct operation of protective relays shall be conducted,
- Dielectric and insulation resistance test, continuity test, starting current measurement of each motor,
- Any other checks/tests to ensure that requirements of the specifications are being met.

1.4.3.2 Performance Testing

If nothing unusual has been observed in load run and load rejection tests, the test service period of 72 hours shall follow. During this test service period, the unit must operate continuously at rated condition without any interruption except of those beyond the control of the Contractor. However, such interrupted period shall not be counted for in the test service period.

During this test service period, all the system/installations must perform satisfactorily.

The Contractor shall be responsible for the equipments during test service and also for the way it is operated. However, Employer will operate the equipment under the Contractor's guidance during test service period.

1.4.3.3 Field Acceptance Tests

The taking-over testing of any part or section of the Permanent Works which can operate as an independent unit, shall be performed in accordance with the standards and regulations laid down in the " General Conditions of contract, and 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 Employer, the Engineer and the Contractor and shall form an integral part of the later "Taking-Over Certificate".

This "Protocol of Acceptance" shall state:

1. The date of testing
2. The quantity and type of Works concerned
3. Statement of all minor defects and/or irregularities, which have to be corrected by the Contractor
4. Confirmation that the guaranteed data have been proven
5. Confirmation that all contractual documents have been submitted
6. Confirmation that the Employer's personnel have been familiarised with the Works and that they will be able to operate and maintain the Works.

HS Singh
GM(M)

✓

Signature
Date

9. LV Switchgear and Auxiliary Transformers

9.1 Type Test

The contractor is required to carry out all type tests as per relevant IEC/ International Standards on one apparatus of each type of similar rating and shall submit the reports to the Employer. The type test may not be mandatory if similar equipment has been type tested and test certificates for relevant tests are accepted by the Employer.

9.2 Shop Test

The UAT, SST & AT and 415V Switchgear shall be routine tested as per relevant IEC with latest amendments. Following shop tests shall be carried out by the manufacturer at their works:-

Test on UAT, SST & AT as per IEC: 60726 & IEC: 60076 are as follows:-

- Measurement of Winding Resistance.
- Measurement of Voltage Ratio/ Check of Polarity/Vector Relationship.
- Measurement of No Load Losses.
- Measurement of Magnetizing Current (before and after Dielectric Test).
- Measurement of Insulation Resistance and Polarization Index.
- Separate Source Voltage Withstand Test.
- Induced Over Voltage Withstand Test.
- Partial Discharge Test.
- Determination of sound level.
- Determination of transient voltage transfer characteristics.

Following Tests on 415V Cubicle assemblies as per relevant IEC:

- Visual & BOM Check
- Scheme Checking
- Insulation Resistance Test
- High Voltage Test
- Functional Test

The details of tests are given in Model Quality Assurance Plan of 415V Switchgear, Auxiliary & Station Service Transformer.

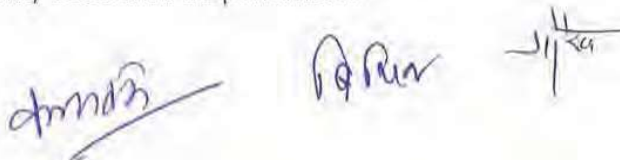
9.3 Field Test

All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least six (6) months before start of relevant testing, for approval of the Employer.

9.3.1 Tests during installation and pre commissioning

At least following inspections/ tests shall be performed:-



9.3.1 Transformers

- Correct functioning of the various protection systems.
- Inspection of the insulation to earth of the various parts of the transformers.
 - Phase order checking.
 - Measurement of the winding resistance.
 - Measurement of capacitance and $\tan\delta$.
 - Ratio test.
 - Measurement of the no load current at 415 V.
 - Measurement of impedance at low voltage.
 - Calibration and setting of WTI.
 - Transformer operation at no load for 24 hours (voltage, no load current, temperature measurement and noise),
 - Final IR values between windings and winding and earth,
 - Measurement of the magnetizing current at U_r ,
 - Checking of Neutral Earthing & Shorting of unused CTs.

9.3.2 415V Switchgear

- Functional and operational tests,
- Measurement of the insulating resistance of the different power and control circuits, including cables, instruments and apparatus, against earth,
- Adjustment of the protection equipment,
- Calibration of releases,
- Verification of component temperatures,
- Contact resistance measurement of circuit breaker,
- Verification of interlocks: ensure that interlocks are correctly installed and that access is prevented to live portions of the system when interlocks are in place and that access is permitted when interlocks are removed,
- Other test as suggested by the Contractor and/or the Employer at site

dmr

dmr *1/12/21*

10. ELECTRIC OVERHEAD TRAVELLING (EOT) CRANES**10.1 Type Test**

The contractor is required to carry out all type tests as per relevant Indian/ International Standards on one apparatus of each type of similar rating and shall submit the reports to the Employer. The type test may not be mandatory if similar equipment has been type tested and test certificate (s) for relevant tests are accepted by the Employer.

10.2 Shop Tests

The crane shall be shop assembled as completely as possible and then operated and load tested in the shop for adequacy of design and suitability for reliable, safe and proper operation. Following shop tests shall be carried out by the manufacturer at their works as per IS 3207-latest Version / International Standards :-

- Verification of dimensions,
- All electric hoist shall be tested as per hoist IS 3938/ national/ international Standards,
- Operation of brakes,
 - Full load and 25% overload test with trolley up to 1.5 meter on either side from Centre of the bridge shall be done at manufacturer's work on hoisting and Cross travel motions
- Tests to verify specified speeds under load conditions,
- Deflection Test - The deflection test shall be carried out with test load of 100% of rated load at rest and with the crab in central position.

The Details of the tests are given in Model Quality Assurance Plan of EOT Crane.

10.3 Field Tests

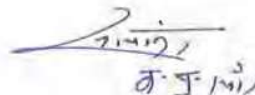
All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least six (6) months before start of relevant testing, for approval of the Employer.

10.3.1 Tests during installation and pre commissioning

These shall include the following:

- Operational and functional tests of components, sub-assemblies, auxiliaries i.e. lubrication etc.,



Handwritten signature and date: 21.11.21

TEESTA HE PROJECT STAGE-VI

- Control logic field tests to prove control logic scheme for operation and interlocks of system components and controls, including annunciation and shutdown scheme shall be done in so far as practical,
- Calibration test - All instruments, sensors, switches, relays etc. shall be calibrated and adjusted after installation, wherever practical,
- Operational tests for verification of correct operation of protective relays and safety devices shall be conducted,
- Operational tests for drives for verification of correct operation of each and every component of the drives,
- Operational tests of all the crane motors,
- Deflection Test - The deflection test shall be carried out with test load of 100 % of rated load at rest and with the crab in central position. The measurement shall not be taken on the first application of load. Datum line for measuring the deflection should be obtained by placing the crab on the extreme end of the crane span with smaller hook approach,
- Load tests at 100% and 125% of rated load on each crane,
- Verification of crane clearance and lifts,
- Incremental movement of hoists/travels,
- Tandem operation,
- Any other checks/tests to ensure that requirements of the specifications are being met.

After installation and prior to putting the equipment into operation at least the following tests shall be made:

- Test to demonstrate operational capabilities of the equipment along with its associated auxiliaries, control and drive system as per the intended requirements.

10.3.2 Commissioning Tests

The following tests shall necessarily be conducted:

- Insulation resistance test,
- Earthing Test of complete crane,
- Operational test - Operational test with/without rated load in all hoisting/ travelling motions to check for any misalignment, improper adjustments, overheating and other possible defects. This shall also include operational test for limit switches correctness of circuits, interlocks, operation of protective devices, brakes etc.

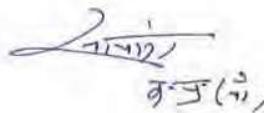
Handwritten signature:
 21-12-21
 05-10-21

10.3.3 Field Acceptance/Performance Testing

After commissioning of respective cranes, these shall remain in the Contractor's custody for erection activities till commissioning of last generating unit. The Contractor shall be responsible for proper operation and maintenance of EOT cranes during this period. The Contractor shall make good any damages and do the capital maintenance at the time of commissioning of last unit.

If nothing unusual has been observed after capital maintenance, the test service period of seven (7) days shall follow. During this test service period, the cranes must perform satisfactorily.

The Contractor shall be responsible for the equipment during test service and also for the way it is operated. However, Employer's personnel shall operate the equipment under the Contractor's guidance during test service period.



Handwritten signature and date: 21/12/21

11. Grounding System

11.1 Type Test

The contractor is required to carry out all type tests as per relevant IEC/ International Standards on one apparatus of each type of similar rating and shall submit the reports to the Employer. The type test may not be mandatory if similar equipment has been type tested and test certificate(s) for relevant tests are accepted by the Employer.

11.2 Shop Test

The all Grounding/ Earthing Materials shall be routine tested as per relevant IEC with latest amendments. Following tests shall be carried out by the manufacturers at their works:-

Test on Earthing Materials as per IEC

- Verification of Physical/mechanical& Chemical Properties
- Dimensional Check and Weight
- Surface finish Check
- Electrical Resistance Measurement
- Galvanization Test (if applicable)

The details of tests are given in Model Quality Assurance Plan of Grounding System.

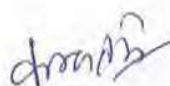
11.3 Field Test

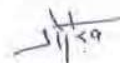
All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance test shall submitted well in advance, at least six(6) month before start of relevant testing, for approval by the Employer.

Following test shall be performed:

- Checking dimension, Laying of the of Earthing Materials,
- Checking of Ground Resistance and Touch Potential,
- Checking of complete Earthing Mats (continuity and resistance).







MODEL QUALITY ASSURANCE PLAN (MQAP)

MODEL QUALITY ASSURANCE PLAN (MQAP)**INDEX**

Sl. No.	Equipments/ Particulars
1.	General Inspection & Testing Requirement
2.	Bus Duct
3.	GSU Transformers
4.	XLPE Cable
5.	245 kV GIS
6.	Outdoor Pot Yard Equipment
7.	DC System
8.	MV Switchgear
9.	LV Switchgear & Auxiliary Transformer
10.	Electric Overhead Travelling (EOT) Crane
11.	Grounding System
12.	Oil Handling System
13.	PLCC System

ନିର୍ଦ୍ଦେଶ
 ମୁଖ୍ୟ (ମା.ସଂସ୍ଥା) - ୧/୧୧
 ୨୫.୫.୨୦୨୧ (ବି.)

1-MODEL QUALITY ASSURANCE PLAN (MQAP) FOR GENERAL TECHNICAL REQUIREMENTS

Special instructions: -

1. Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipments/ system/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
2. Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments / equipments during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Contractors /Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works for testing of equipments/materials.
4. One set of complete test certificates as per the requirement of QAP be made available to the NHPC for acceptance.
5. All the records, as per the requirement of QAP may be made available for review by the Inspecting Officer during inspection.
6. Field tests are to be carried out as per the requirements of the contract/purchase order.



Handwritten signature and date: 27.12.2017

QUALITY ASSURANCE PLAN (MODEL)

CLIENT: NHPC Ltd

VENDOR :

NAME OF EQUIPMENT: General Technical Requirements

NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	Raw Material & Bought Out Items								
2	In Process Stage								
3	Final inspection								

Note: a. In 'Inspection Agency/column figure 1.2.or 3 to be filled. 1- will indicate 'NHPC Ltd', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission, CHP - Customer Hold Point & JIR-Joint Inspection Report.

c. The firm shall obtain acceptance/clearance of finished product for further activities based on Test Certificates & Internal Report (IR)

d.Any additional test required as per the requirement of equipment in accordance with Contract Agreement/Relevant standard apart from QAP will be carried out by the firm without any additional financial implication.

e.This QAP does not absolve the Contractor/sub-contractor of his responsibility to supply the correct products, strictly in conformity to the specifications given in the purchase order/contract. The above Model QAP stipulates the bare minimum requirements which shall be complied by the contractor. The above QAP has been made presuming subletting of work shall be allowed in the tender. In case subletting of work is not allowed in the tender, then "3/2" shall be replaced by "2" under the column " Perform" except testing of material.

f. At the time of inspection the supplier shall arrange the requisite calibrated measuring instruments i.e micrometer, vernier caliper, pie tape, surface roughness tester, dial gauge etc. Material testing/ NDT shall be conducted from NABL Lab or NABL accreditation lab.

IMS/QAI/F-01

Rev-02 Effective date-05.01.16

Signature

NHPC LTD (QA&I DEPT.)

Signature & Seal

(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP) Page 14 of 22

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)

विक्रेता (VENDOR) :

एन आई टी/कय आदेश संदर्भ (NIT/P.O. REFERENCE) :

उपकरण का नाम (NAME OF EQUIPMENT) : CONDUCTOR

क्र.सं. (SR. No.)	मंडा/घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जाँच की प्रकृति NATURE OF CHECKS	जाँच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज़ / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन न	
A	Raw Material and Bought Out Items Electrolytic High Gr. Aluminium Rod. a) Chem. Composition b) Diameter c) Surface Finish d) Breaking Load Test e) Resistivity f) Elongation	Chemical Measurement Visual Mechanical Electrical Mechanical	100% -do- -do- -do- -do- -do-	Tech. Spec./Appd.drg./IS:5484 -do- -do- -do- -do- -do-	TC TC TC TC TC TC	3/2 3/2 3/2 3/2 3/2 3/2	- - - - - -	1 1 1 1 1 1	TC TC TC TC TC TC
B	In Process Inspection 1 Alum. Wire Drawing a) Dia of Die b) Dia of Wire c) Joint in Wire d) Surface Finish e) Breaking Load Test f) Resistance g) Measurement. Wrapping Test	Measurement -do- Visual Visual Mechanical Electrical Mechanical	1sample/ coil -do- -do- -do- -do- -do- -do-	Tech. Spec./Appd.drg. Tech. Spec./Appd.drg./IS:398 -do- -do- -do- -do- -do-	TC TC TC TC TC TC TC	3/2 3/2 3/2 3/2 3/2 3/2 3/2	- - - - - - -	1 1 1 1 1 1 1	TC TC TC TC TC TC TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC Ltd.', 2- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.

b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

IMS/QA/IF-01
Rev.-03 Effective date-09.01.19


जिपेन

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

Page 15 of 22

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)

विक्रेता (VENDOR) :

एन आई टीएच आदेश संदर्भ (NIT/P.O. REFERENCE) :

उपकरण का नाम (NAME OF EQUIPMENT) : CONDUCTOR

क्र.सं. (SR. No.)	सद/घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जाँच की प्रकृति NATURE OF CHECKS	जाँच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP.			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन न	
2	Testing of Stranded Steel	Measurement	Each wire/drum	Tech. Spec./Appd.drg./IS:398	TC	3/2	-	1	TC
a)	Dia of individual wire								
b)	Breaking Load	Mechanical	-do-	Tech. Specn./IS:1521& IS:398/76	TC	3/2	-	1	TC
c)	Torsion Test	-do-	-do-	-do-	TC	3/2	-	1	TC
d)	Elongation Test	-do-	-do-	-do-	TC	3/2	-	1	TC
e)	Wrapping Test	-do-	-do-	-do-	TC	3/2	-	1	TC
3	Galvanising Test								
a)	Wt. of Zinc Coating	Chemical	-do-	Tech. Spec./Appd.drg./IS:4826	TC	3/2	-	1	TC
b)	Uniformity of Zinc Coating (Dip Test)	-do-	-do-	Tech. Spec./Appd.drg./IS:2633	TC	3/2	-	1	TC
c)	Surface Finishing	Visual	-do-	-do-	TC	3/2	-	1	TC
d)	Purity of Zinc	Chemical	-do-	Tech. Spec./Appd.drg./IS:209	TC	3/2	-	1	TC
C	Final Inspection:								
1	Conductor	Measurement	Sample plan	Tech. Spec./Appd.drg./IS:398	JIR	3/2	1	-	CHP
a)	Over all Dia	Test	-do-	-do-	JIR	3/2	1	-	CHP
b)	Lay Direction	Test	-do-	-do-	JIR	3/2	1	-	CHP
c)	Lay ratio for Aluminium & Steel								

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC Ltd', 2- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.

b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature
NHPC (QA&I DEPT.)Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)IMS/QA/I/F-01
Rev.-03 Effective date-09.01.19

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

Page 16 of 22

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)
विक्रेता (VENDOR) :

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)

उपकरण का नाम (NAME OF EQUIPMENT) : CONDUCTOR

एन आई टी/प्र.ओ. रीफरेंस (NIT/P.O. REFERENCE) :

क्र.सं. (SR. No.)	माद/घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जाँच की प्रकृति NATURE OF CHECKS	जाँच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज़ / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
2	Aluminium Strand								
a)	Diameter	Measurement	Sample plan	Tech. Spec./Appd.drg./IS:398	JIR	3/2	1	-	CHP
b)	Breaking Load Test	Mechanical	-do-	-do-	JIR	3/2	1	-	CHP
c)	Resistance	Electrical	-do-	-do-	JIR	3/2	1	-	CHP
d)	Wrapping	Mechanical	-do-	-do-	JIR	3/2	1	-	CHP
3	Steel Strand								
a)	Diameter	Measurement	-do-	-do-	JIR	3/2	1	-	CHP
b)	Breaking Load Test	Mechanical	-do-	-do-	JIR	3/2	1	-	CHP
c)	Elongation	-do-	-do-	-do-	JIR	3/2	1	-	CHP
d)	Torsion	-do-	-do-	-do-	JIR	3/2	1	-	CHP
e)	Wrapping Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
f)	Wt. Of Zinc Coating	Chemical	-do-	Tech. Spec./IS:4826 & 6745	JIR	3/2	1	-	CHP
g)	Uniformity of Zinc Coating	Chemical	-do-	-do-	JIR	3/2	1	-	CHP
4	Conductor Drum								
	Dimension	Measurement	Sample plan	Tech. Spec./Appd.drg./IS:1778	TC	3/2	-	1	TC
D	Routine Test								
	All tests covered under Acceptance test	Measurement	100%	Tech. Spec./Appd.drg./IS:398	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC Ltd'. 2- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.

b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

IMS/QA/IF-01

Rev.-03 Effective date-09.01.19

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)


- 1/1/19

गुणवत्ता आश्वासन योजना (प्रास्य) QUALITY ASSURANCE PLAN (MODEL)

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)
 उपकरण का नाम (NAME OF EQUIPMENT) : ISOLATOR

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड (NHPC Ltd)
 विक्रेता (VENDOR) :
 एन आई टीएस आदेश संदर्भ (NIT/P.O. REFERENCE) :

Page 1

क्र. सं. (SR. No.)	मद/ घटक एवं विशेषता (ITEM/COMPONENTS & CHARACTERISTICS)	जांच की प्रकृति NATURE OF CHECKS	जांच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
A	RAW MATERIAL AND BOUGHT OUT ITEMS								
1	Reduction Gear Unit	Visual	100%	Tech. Spec./Appd.drg./IS Code	TC	2/3	-	1	TC
a)	Visual	Measurement	Sampling Plan	-do-	TC	2/3	-	1	TC
b)	Dimensional	Visual	-do-	-do-	TC	2/3	-	1	TC
c)	Operational	Chemical	-do-	-do-	TC	2/3	-	1	TC
d)	Chemical Analysis				TC	2/3	-	1	TC
2	Auxiliary Switch	Visual	100%	Tech. Spec./Appd.drg./ IS 9921 & IEC-129	TC	2/3	-	1	TC
a)	Visual	Visual	Sampling Plan	-do-	TC	2/3	-	1	TC
b)	I.R.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	H.V.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
d)	Mechanical Endurance Test	Mechanical	Sampling Plan	-do-	TC	2/3	-	1	TC
e)	Temp. Rise Test	Temperature	-do-	-do-	TC	2/3	-	1	TC
3	Interlock Coil	Visual	100%	Tech. Spec./Appd.drg./IS:3842	TC	2/3	-	1	TC
a)	Visual Inspection	Visual	Sampling Plan	-do-	TC	2/3	-	1	TC
b)	I.R. Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	H.V. Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
d)	Operational Check	Visual	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
 b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
 c. Test certificates shall be submitted at the time of final inspection.

IMS/QA/IF-01
 Rev.-03 Effective date-09.01.19

Signature
 NHPC (QA&I DEPT.)

Signature & Seal
 (VENDORS Q.C. DEPT. OR REPRESENTATIVE)




गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

Page 2

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड (NHPC Ltd)

विक्रेता (VENDOR) :

एन आई टी प्रोप्रायिटी आदेश संदर्भ (NIT/P.O. REFERENCE) :

उपकरण का नाम (NAME OF EQUIPMENT) : ISOLATOR

क्र.सं. (SR. No.)	मद/घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जांच की प्रकृति NATURE OF CHECKS	जांच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
4	Copper Strips (Fingers in female contact & earth switch fingers)	Visual Measurement Chemical	100% 100% Sampling plan	Tech. Spec./ IS:1897 -do- -do-	Log Sheet TC TC	2/3 2/3 2/3	- - -	1 1 1	TC TC TC
5	Copper Tube (Main blade arm, E.T.S. Grade as drawn condition)	Visual Measurement Chemical	100% 100% Sampling plan	Tech. Spec./ IS:2501&IS:191 -do- -do-	Log Sheet TC TC	2/3 2/3 2/3	- - -	1 1 1	TC TC TC
6	Springs	Visual Measurement Mechanical	100% Sampling plan -do-	Tech. Spec./IS:4454 & AISI:304 -do- -do-	Log Sheet TC TC	2/3 2/3 2/3	- - -	1 1 1	TC TC TC
7	Operating Mechanism	Visual Visual Electrical Electrical	100% -do- -do- -do-	Tech. Spec./IS:9921 -do- -do- -do-	Log Sheet TC TC TC	2/3 2/3 2/3	- - -	1 1 1	TC TC TC TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

IMS/QA/IF-01

Rev.-03 Effective date-09.01.19

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)




गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

Page 3

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड (NHPC Ltd)

विक्रेता (VENDOR) :

एन आई टी/एच आदेश संदर्भ (NIT/P.O. REFERENCE) :

उपकरण का नाम (NAME OF EQUIPMENT) : ISOLATOR

क्र. सं. (SR. No.)	मद/ घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जांच की प्रकृति NATURE OF CHECKS	जांच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज / स्वीकृति मानक REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
8	Motor All Routine Test	Electrical	-do-	Tech. Spec./IS:325	TC	2/3	-	1	TC
9	Motor Operating Mechanism	Measurement	100%	Tech. Spec./Appd. drg.	TC	2/3	-	1	TC
a)	Dimensional Checks	Visual	-do-	-do-	TC	2/3	-	1	TC
b)	Checks as per BOM	Visual	-do-	-do-	TC	2/3	-	1	TC
c)	Wiring Check	Mechanical	-do-	-do-	TC	2/3	-	1	TC
d)	Torque Measurement								
B.	IN PROCESS								
1	Silver Plating of Current carrying Paths	Measurement	Sampling plan	Tech. Spec./IS Code.	TC	2/3	-	1	TC
a)	Plating Thickness								
2	Galvanising of M.S. Material	Visual	100%	Tech. Spec./IS:2633 & IS:4759	Log Sheet	2/3	-	1	TC
a)	Visual	Chemical	Sampling plan	-do-	TC	2/3	-	1	TC
b)	Galvanising of M.S.								

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

Signature
NHPC (QA&I DEPT.)Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)IMS/QA/I/F-01
Rev-03 Effective date-09.01.19

Signature
Signature & Seal

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

Page 4

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड (NHPC Ltd)

विक्रेता (VENDOR) :

एन आई टी/कय आदेश संदर्भ (NIT/P.O. REFERENCE) :

उपकरण का नाम (NAME OF EQUIPMENT) : ISOLATOR

क्र. सं. (SR. No.)	मद/घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जांच की प्रकृति NATURE OF CHECKS	जांच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज /स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
3									
a)	Galvanising	Chemical	100%	Tech. Spec./IS Code	TC	2/3	-	1	TC
b)	Greasing of Bearings, Checking of Function & Rust Protection	Visual	-do-	-do-	TC	2/3	-	1	TC
C.									
	Final Inspection								
a)	Routine Tests Power Frequency Voltage Tests on Control and Auxiliary Circuit.	Electrical	Sampling plan as per standards	Tech. Spec./Appd Drg./IEC/IS Standards	JIR	2/3	1	-	CHP
b)	Measurement of Resistance of the Main Circuit.	-do-	-do-	-do-	JIR	2/3	1	-	CHP
c)	Mechanical Operating Tests.	Mechanical	-do-	-do-	JIR	2/3	1	-	CHP
d)	Dimensional Checks on Isolators.	Measurement	-do-	-do-	JIR	2/3	1	-	CHP
e)	Galvanisation Test	Chemical	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

IMS/QA/IF-01

Rev.-03 Effective date-09.01.19

Signature

NHPC (QA&I DEPT.)

Signature & Seal

(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

परियोजना (PROJECT) : टीस्टा-VI जल विद्युत परियोजना (TEESTA-VI HEP)

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)
विक्रेता (VENDOR) :

उपकरण का नाम (NAME OF EQUIPMENT) : INVERTER

एन आई टी/कच आदेश संदर्भ (NIT/P.O. REFERENCE) :

Page 13 of 14

क्र. सं. (SR. No.)	मद/ घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जाँच की प्रकृति NATURE OF CHECKS	जाँच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
A	RAW MATERIAL / BOUGHT OUT ITEMS								
1	Steel Sheet	Phyl/ Chem.	100%	Tech.Spec./Appd.drg. IS/IEC	TC	3/2	-	1	TC
2	Capacitor, contactor, CT, power/control transformer, choke, resistors, scanner, fan, panel meters, relays, single phase preventor, thyristor/diode module, IGBT, MCCB	Visual Electrical	-do- -do-	-do- -do-	TC TC	3/2 3/2	- -	1 1	TC TC
a)	Make, Type & Rating								
b)	Functional Check								
B	IN PROCESS INSPECTION								
1	Cubicles	Visual/ Measurment	-do-	-do-	TC	3/2	-	1	TC
2	Electrical Wiring								
	Routing of wires, Bunching, Labelling, Ferruling, Crimping, Soldering, Connection, Color coding	Visual	-do-	-do-	TC	3/2	-	1	TC
3	PCB Testing	Electrical	-do-	-do-	TC	3/2	-	1	TC
D	FINAL INSPECTION								
1	Bill of Material Check	Visual	100%	Tech.Spec./Appd.drg	JIR	3/2	1	-	CHP
2	Alarm & Indication Test (Auxiliary Device Test)	Electrical	-do-	Tech.Spec./Appd.drg/ IEC:60146	JIR	3/2	1	-	CHP
3	HV Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
4	Insulation Resistance Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
5	Light Load	-do-	-do-	-do-	JIR	3/2	1	-	CHP

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC Ltd.', 2- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.

b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

IMS/QAI/F-01

Rev.-03 Effective date-09.01.19

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)
विक्रेता (VENDOR) :

उपकरण का नाम (NAME OF EQUIPMENT) : INVERTER

एन आई टी/क्रय आदेश संदर्भ (NIT/P.O. REFERENCE) :

क्र. सं. (SR. No.)	मद/घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जाँच की प्रकृति NATURE OF CHECKS	जाँच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज़ / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
6	Voltage/Current Stability Test (Input line)	Electrical	100%	Tech.Spec./Appd.drg/IEC:60146	JIR	3/2	1	-	CHP
7	Regulation /Full Load Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
8	Overload Capability Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
9	Inverter/UPS Efficiency Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
10	Regulation, Ripple, Harmonic & Noise Measurement Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
11	Short Circuit Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
12	Output Overvoltage/ Undervoltage Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
13	AC Input Failure & Return Test (for Inverter)	-do-	-do-	-do-	JIR	3/2	1	-	CHP
14	DC Failure & Return Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
15	Synchronization Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
16	Parallel Redundant UPS Fault Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
17	Current Division in Parallel UPS	-do-	-do-	-do-	JIR	3/2	1	-	CHP
18	Unbalanced/Balanced Load Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
19	Transfer-Retransfer Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
20	Dynamic /Transient Response Test (overshoot/undershoot)	-do-	-do-	-do-	JIR	3/2	1	-	CHP
21	Manual bypass Switch Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
22	Heat Run Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
23	Measurement of Neutral to Ground Voltage	-do-	-do-	-do-	JIR	3/2	1	-	CHP
24	Protection Device Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
25	Restart Test	-do-	-do-	-do-	JIR	3/2	1	-	CHP
	Burn in Test	-do-	-do-	-do-	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC Ltd', 2- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.

b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

IMS/QA/IF-01

Rev.-03 Effective date-09.01.19

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

9.0 MODEL QUALITY ASSURANCE PLAN (QAP) FOR LV SWITCHGEAR SYSTEM AND TRANSFORMERS (UAT, SST & Distribution)

Special instructions: -

- 1) Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipment/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
- 2) Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments/equipment during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
- 3) Contractors/Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works for testing of equipment/materials.
- 4) One set of complete test certificates as per the requirement of QAP be made available to the Inspecting Officer at the time of inspection/testing.
- 5) All the records, as per the requirement of QAP are to be made available for review by the Inspecting Officer during inspection.
- 6) Field tests are to be carried out as per the requirements of the contract / purchase order.

Handwritten signature
Handwritten signature
Handwritten signature

गुणवत्ता आश्वासन योजना (मॉडल) QUALITY ASSURANCE PLAN (MODEL)

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (Teesta-VI HEP)
 उपकरण का नाम (NAME OF EQUIPMENT) : LV Switchgear System

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)
 विक्रेता (VENDOR) :
 एन आई टी/क्रय संदर्भ (NIT/P.O. REFERENCE) :

Page 2 of 13

क्र.सं. (SR. No.)	मद/घटक एवं विशेषता (ITEM/COMPONENTS & CHARACTERISTICS)	जांच की प्रकृति (NATURE OF CHECKS)	जांच की मात्रा (QUANTUM OF CHECKS)	संदर्भ दस्तावेज़ / स्वीकृति मानदंड / REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म (RECORD FORMAT)	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी (REMARKS)
						प्रदर्शन (Perform)	गवाह (Witness)	सत्यापन (Verify)	
A	Raw Material & Brought Out Items	Measurement Mechanical -do-	As per sampling plan -do- -do-	Tech. Spec./ Appd.drg./ IS:513 -do- -do-	TC	2/3	-	1	TC
2	Copper/ Copper Alloy Flats for Bus Bars & Links	Measurement Mechanical -do- -do- Chemical Electrical	-do- -do- -do- -do- -do- -do-	Tech. Spec./ Appd.drg./ IS:613 Tech. Spec./ Appd.drg./ IS:191 -do- Tech. Spec./ Appd.drg./ IS:1897 Tech. Spec./ Appd.drg./ IS:6160 Tech. Spec./ Appd.drg.	TC	2/3	-	1	TC
3	PVC Wire	Measurement Electrical Electrical Mechanical	-do- -do- -do- -do-	Tech. Spec./ Appd.drg./ IS:694 -do- -do- -do-	TC	2/3	-	1	TC
4	MCB / MCB	Visual Electrical -do-	100% -do- -do-	Tech. Spec./Appd.drg./IEC:60947 -do- -do-	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC Ltd.', 2- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.
 b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.
 c. Test certificates shall be submitted at the time of final inspection.

IMS/QAI/F-01

Rev.-03 Effective date-09.01.19

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

(Handwritten signatures and initials)

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (Teesta-VI HEP)
 उपकरण का नाम (NAME OF EQUIPMENT) : LV Switchgear System

Page 3 of 13
 ग्राहक (CLIENT) : एनएचपीसी लिमिटेड (NHPC Ltd)
 विक्रेता (VENDOR) :
 एन आई टी/एचय आदेश संदर्भ (NIT/P.O. REFERENCE) :

क्र. सं. (SR. No.)	मद/घटक एवं विशेषता (ITEM/COMPONENTS & CHARACTERISTICS)	जांच की प्रकृति (NATURE OF CHECKS)	जांच की मात्रा (QUANTUM OF CHECKS)	संदर्भ दस्तावेज / स्वीकृति मानदंड / REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म (RECORD FORMAT)	निरीक्षण एजेंसी INSP.			टिप्पणी (REMARKS)
						प्रदर्शन (Perform)	गवाह (Witness)	सत्यापन (Verify)	
5	Power & Auxiliary Contactor								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:2959	TC	2/3	-	1	TC
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	High Voltage test	-do-	-do-	-do-	TC	2/3	-	1	TC
6	Protective Relays								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./ Appd.drg./IS:8544	TC	2/3	-	1	TC
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	High Voltage test	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Routine Tests	-do-	-do-	-do-	TC	2/3	-	1	TC
7	Over Current, Earth Fault & Under Voltage Protection Equipment								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./Appd.drg./IEC:Code	TC	2/3	-	1	TC
b)	Operational Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	High Voltage test	-do-	-do-	-do-	TC	2/3	-	1	TC
8	Timers								
a)	Operation & Time limits	Electrical	100%	Tech. Spec./Appd.drg./IEC:Code	TC	2/3	-	1	TC
b)	High Voltage test	-do-	-do-	-do-	TC	2/3	-	1	TC
9	Electrical Meters (Voltmeter Ampere meter, Energy meter etc.)								
a)	Physical condition	Visual	100%	Tech. Spec./ Appd.drg./IS:1248	TC	2/3	-	1	TC
b)	Verification of Scale & Range.	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	IR and High Voltage Test	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Calibration Test	Verification	-do-	-do-	TC	2/3	-	1	TC
10	Space Heater								
a)	Make, Type & Rating	Visual	100%	Tech. Spec./Appd.drg./IS/IEC	TC	3/2	-	1	TC
b)	Functional, IR & HV Test	Electrical	-do-	-do-	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.
 b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.
 c. Test certificates shall be submitted at the time of final inspection.

IMS/QA/IF-01
 Rev.-03 Effective date-09.01.19

Signature
 NHPC (QA&I DEPT.)

Signature & Seal
 (VENDORS Q.C. DEPT. OR REPRESENTATIVE)




गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (Teesta-VI HEP)
 उपकरण का नाम (NAME OF EQUIPMENT) : LV Switchgear System

Page 4 of 13
 ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)
 विक्रेता (VENDOR) :
 एन आई टी/कय आदेश संदर्भ (NIT/P.O. REFERENCE) :

क्र.सं. (SR.)	मद/घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जांच की प्रकृति NATURE OF CHECKS	जांच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फॉर्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY		टिप्पणी REMARKS
						प्रदर्शन Perform	सत्यापन Verify	
11	Switches/ Control Switches							
a)	Make & Rating	Visual	100%	Tech.Spec./Appd.drg./IS:4064,6875	TC	2/3	1	TC
b)	Operation & Breakage	Test/Visual	-do-	-do-	TC	2/3	1	TC
c)	HV Test	Electrical	-do-	-do-	TC	2/3	1	TC
12	Current Transformer							
a)	Make, Type & Rating	Visual	100%	Tech.Spec./Appd.drg./IEC44,61869	TC	3/2	1	TC
b)	Routine Test	Test	-do-	-do-	TC	3/2	1	TC
13	Voltage Transformer							
a)	Make, Type & Rating	Visual	100%	Tech.Spec./Appd.drg./IEC:186 & 61869	TC	3/2	1	TC
b)	Routine Test	Test	-do-	-do-	TC	3/2	1	TC
14	ACB							
a)	Make, Type & Rating	Visual	100%	Tech.Spec./Appd.drg./IEC:60947	TC	3/2	1	TC
b)	Routine test	Electrical	-do-	-do-	TC	2/3	1	TC
B	Final Test on Switchgear/ Panels/ Boards							
1	Dimensions, Paint shade & thickness, Layout, Accessibility, Name plate Check	Measurement/ Visual	100%	Tech. Spec./Appd.Drg./ IEC:60439, 60529 & 61439	JIR	3/2	1	CHP
2	BOM Checking & Equipment Mounting	Visual	-do-	-do-	JIR	3/2	1	CHP
3	I.R Test (before & after HV Test)	Electrical	-do-	-do-	JIR	3/2	1	CHP
4	H.V. Test	-do-	-do-	-do-	JIR	3/2	1	CHP
5	Functional (Electrical & Mechanical) Test	Elect.Mech.	-do-	-do-	JIR	3/2	1	CHP
6	Wiring & Continuity Test	Electrical	-do-	-do-	JIR	3/2	1	CHP
7	Interlock & Scheme Checking	-do-	-do-	-do-	JIR	3/2	1	CHP
8	Earthing Circuit Check	-do-	-do-	-do-	JIR	3/2	1	CHP
9	Protective Relays	-do-	-do-	-do-	JIR	3/2	1	CHP
a)	Functional / Operational Tests	Electrical	100%	Tech.Spec./Appd.drg./IS:Code/ IEC:60255	JIR	3/2	1	CHP

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'Sub-Supplier'
 b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.
 c. Test certificates shall be submitted at the time of final inspection.

IMS/QAI/F-01

Rev.-03 Effective date-09.01.19

Signature

NHPC (QA&I DEPT.)

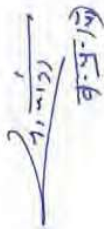
Signature & Seal

(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

10- MODEL QUALITY ASSURANCE PLAN (MQAP) FOR EOT CRANE

Special instructions: -

1. Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipments/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
2. Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments /equipments during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Contractors/Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works for testing of equipments/materials.
4. One set of complete test certificates as per the requirement of QAP be made available to the Inspecting Officer at the time of inspection/testing.
5. All the records, as per the requirement of QAP are to be made available for review by the Inspecting Officer during inspection.
6. Field tests are to be carried out as per the requirements of the contract / purchase order.



QUALITY ASSURANCE PLAN (MODEL)

PROJECT : TEESTA HE PROJECT STAGE-VI

CLIENT: NHPC LTD

VENDOR :

NAME OF EQUIPMENT:-EOT CRANE

NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY		REMARKS
						Perform	Witness	
1	Raw Material							
1.1	Structural Steel (Box Girder, End Trucks, Trolley, Rails etc.)			Appd. drawings/ Tech. specs./ Relevant Standard				
a)	Chemical Analysis	Chemical Test	Sample/Lot	-do-	TC	3/2	-	1 TC
b)	Mechanical Properties	Mechanical Test	Sample/Lot	-do-	TC	3/2	-	1 TC
c)	Visual and Dimension check	Visual /Measurement	100%	-do-	TC	3/2	-	1 TC
d)	Ultrasonic Test (only on plates above 19mm thick)	UT	100%	-do-	TC	3/2	-	1 TC
1.2	Cast/Forged Steel (Wheels, Shafts, Pins, Gears, Pinions, Brake Drum , Couplings, Hook etc.)							
a)	Chemical Analysis	Chemical Test	Sample/Lot	-do-	TC	3/2	-	1 TC
b)	Mechanical Properties	Mechanical Test	Sample/Lot	-do-	TC	3/2	-	1 TC
c)	Visual and Dimension check	Visual /Measurement	100%	-do-	TC	3/2	-	1 TC
d)	Ultrasonic Test (only on above 50mm thick/diameter)	UT	100%	-do-	TC	3/2	-	1 TC
1.3	Bought Out Items							
a)	Bushes, Bearings, Pulleys, Fasteners etc.	Material Properties	Sample/Lot	-do-	TC	3/2	-	1 TC
b)	Drive Motor, Gear Box, Plumber Block, EHT Brakes, EM Brakes, Wire Rope, Electrical Cables	Routine Test	100%	-do-	TC	3/2	-	1 TC

IMS/QA/F-01

Rev-02 Effective date-05.01.16

Signature

NHPC LTD (QA&I DEPT.)

Signature & Seal

(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

At Singh
GM(M)

At Singh
9-5-14

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : TEESTA HE PROJECT STAGE-VI

CLIENT: NHPC LTD

VENDOR :

NAME OF EQUIPMENT:- EOT CRANE

NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT			REMARKS
					Perform	Witness	Verify	
2	In Process Stage Inspection			Appd. drawings/ Tech. specs./ Relevant Standard				
2.1	Welder certification	Visual	100%	-do-	3/2	-	1	TC
2.2	NDT-Welding Fillet Welds	RT, UT, MPI, DPT (as applicable)	10%	-do-	3/2	-	1	TC
2.3	NDT-Butt Welds (Box Girder, Rope Drums and other full strength welds)		100%	-do-	3/2	-	1	TC
2.4	Post Weld Heat Treatment (Fabricated Rope Drums, Gear Box Housing, Forged Crane hooks)	Heat Treatment Chart	-do-	-do-	3/2	-	1	TC
2.5	Machining							
a)	Surface Finish (Rope drum shaft, Rope Drum grooves, Brake Drum)	Visual/M Measurement	-do-	-do-	3/2	-	1	TC
b)	Dimensions	Measurement	-do-	-do-	3/2	-	1	RR
2.6	Sub-Assembly Stage- Drive Mechanism, Hoist / Trolley arrangements, Brakes			-do-				
a)	Alignment/Layout	Visual/M Measurement	100%	-do-	3/2	-	1	RR
b)	Fitment and Clearance	Visual/M Measurement	-do-	-do-	3/2	-	1	RR
c)	Dimensional check	Visual/M Measurement	-do-	-do-	3/2	-	1	RR
d)	Running Performance (Drive Motors, Gear Boxes)-Noise level, Vibration, Temp. rise	Visual/M Measurement	-do-	-do-	3/2	-	1	TC
	Leakage Test - Gear Boxes							
e)	Crane Hook-Proof Load Test	Load Test	-do-	-do-	3/2	-	1	TC
f)	NDT-after Proof Load Test Butt Welds (Box Girder, Rope Drums and other full strength welds)	RT, UT, MPI, DPT (as applicable)	-do-	-do-	3/2	-	1	TC

IMS/QA/F-01

Rev-02 Effective date-05.01.16

Signature

NHPC LTD (QA&I DEPT.)

Signature & Seal

(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

Alfingh
GM(M)

[Signature]
9-5-17

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : TEESTA HE PROJECT STAGE-VI

CLIENT: NHPC LTD

VENDOR :

NAME OF EQUIPMENT:- EOT CRANE

NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY		REMARKS
						Perform	Witness	
3	Final inspection/Tests on assembled Crane at manufacturer's works/Site (As required)			Appd. drawings/ Tech. specs./ Relevant Standard				
3.1	Examination of Welding	Visual	-do-	-do-	TC	3/2	-	1 TC
3.2	Welding- NDT	RT, UT, MPI, DPT (as applicable)	10%	-do-	TC	3/2	-	1 TC
3.3	Dimensional check on assembled crane - bridge structure (Box girders, end trucks) hoisting trolley frame, travelling mechanism	Measurement	-do-	-do-	IR	3/2	-	1 RR
3.4	Crane Girder Camber	-do-	-do-	-do-	TC	3/2	-	1 TC
3.5	Deflection test at Full Load/Rated Load	-do-	-do-	-do-	JIR	3/2	1	- CHP
4	Operational/functional test							
4.1	Hoisting and LT & CT Speeds - without load	Measurement	-do-	-do-	JIR	3/2	1	- CHP
4.2	Hoisting and LT & CT Speeds at Rated load	Measurement	-do-	-do-	JIR	3/2	1	- CHP
4.3	Hoisting and LT & CT travel test at 125% of rated load	Measurement	100%	-do-	JIR	3/2	1	- CHP
4.4	Function of brakes for trolley and hoistings	Visual/Measurement	-do-	-do-	JIR	3/2	1	- CHP
4.5	Amperage at no load and full load for all motors	-do-	-do-	-do-	JIR	3/2	1	- CHP
4.6	Creeping speed/ Jog movement with rated load(VVVF Drive)	-do-	-do-	-do-	JIR	3/2	1	- CHP
4.7	Radio control tests of speed control of bridge travel, trolley travel & hoist motion, control of master contactor, indication and alarm (if applicable)	-do-	-do-	-do-	JIR	3/2	1	- CHP
4.8	Pendant control test (if applicable)	-do-	-do-	-do-	JIR	3/2	1	- CHP

IMS/QA/F-01

Rev-02 Effective date-05.01.16

Signature

NHPC LTD (QA& DEPT.)

Signature & Seal

(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : TEESTA HE PROJECT STAGE-VI

CLIENT: NHPC LTD

VENDOR :

NAME OF EQUIPMENT:- EOT CRANE

NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY		REMARKS
						Perform	Witness	
5	Control Panel							
5.1	Resistors, Capacitors, Limit Switches, Master Controllers, Thyresters, VVVF Modules, Transformers, Circuit Breakers, Switches etc.	Electrical Test	-do-	-do-	TC	3/2	-	1 TC
5.2	Verification of scheme, make and rating of components	Visual	-do-	-do-	JIR	3/2	1	CHP
5.3	Cubicle Dimensions	Measurement	-do-	-do-	JIR	3/2	1	CHP
5.4	Functional check including HV and IR tests	Visual/Test	-do-	-do-	JIR	3/2	1	CHP
5.5	Sequence of operation and interlock tests	Visual/Test	-do-	-do-	JIR	3/2	1	CHP
5.6	Single phase protection, over current protection, thermal over load, under voltage protection etc as per approved scheme.	Visual/Test	-do-	-do-	JIR	3/2	1	CHP
6	Sand blasting & Painting	Visual / Measurement	-do-	-do-	TC	3/2	-	1 TC

Note: a. In 'Inspection Agency' column figure 1,2, or 3 to be filled. 1- will indicate 'NHPC Ltd', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission, CHP - Customer Hold Point & JIR-Joint Inspection Report.

c. The firm shall obtain acceptance/clearance of finished product for further activities based on Test Certificates & Internal Report (IR)

d. Any additional test required as per the requirement of equipment in accordance with Contract Agreement/Relevant standard apart from QAP will be carried out by the firm without any additional financial implication.

e. This QAP does not absolve the Contractor/sub-contractor of his responsibility to supply the correct products, strictly in conformity to the specifications given in the purchase order/contract. The above Model QAP stipulates the bare minimum requirements which shall be complied by the contractor. The above QAP has been made presuming subletting of work shall be allowed in the tender. In case subletting of work is not allowed in the tender, then "3/2" shall be replaced by "2" under the column "Perform" except testing of material.

f. At the time of inspection the supplier shall arrange the requisite calibrated measuring instruments i.e. micrometer, vernier caliper, pie tape, surface roughness tester, dial gauge etc. Material testing/NDT shall be conducted from NABL Lab or NABL accreditation lab.

IMS/QA/F-01

Rev-02 Effective date-05.01.16

Signature

NHPC LTD (QA&I DEPT.)

Signature & Seal

(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

Handwritten signature: Atul Singh
Handwritten signature: GM (AT)

Handwritten signature: Atul Singh
Handwritten signature: 3.5.14/1

11.0 MODEL QUALITY ASSURANCE PLAN (QAP) FOR GROUNDINGSYSTEM

Special instructions: -

1. Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipment/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
2. Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments/ equipment during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Contractors/Manufacturers/Sub-suppliers has to make on their own all arrangements for testing facilities at their works for testing of equipment/materials.
4. One set of complete test certificates as per the requirement of QAP be made available to the Inspecting Officer at the time of inspection/testing.
5. All the records, as per the requirement of QAP are to be made available for review by the Inspecting Officer during inspection.
6. Field tests are to be carried out as per the requirements of the contract / purchase order.

dmv's
QAP
Jita

गुणवत्ता आश्वासन योजना (प्रारूप) QUALITY ASSURANCE PLAN (MODEL)

Page 2 of 2

परियोजना (PROJECT) : तीस्ता-VI जल विद्युत परियोजना (TEESTA-VI HEP)

ग्राहक (CLIENT) : एनएचपीसी लिमिटेड(NHPC Ltd)

विक्रेता (VENDOR) :

एन आई टी/क्रय आदेश संदर्भ (NIT/P.O. REFERENCE) :

उपकरण का नाम (NAME OF EQUIPMENT) : GROUNDING SYSTEM

क्र. सं. (SR. No.)	मद/ घटक एवं विशेषता (ITEM /COMPONENTS & CHARACTERISTICS)	जाँच की प्रकृति NATURE OF CHECKS	जाँच की मात्रा QUANTUM OF CHECKS	संदर्भ दस्तावेज / स्वीकृति मानदंड REFERENCE DOCUMENTS / ACCEPTANCE NORMS	रिकॉर्ड फार्म RECORD FORMAT	निरीक्षण एजेंसी INSP. AGENCY			टिप्पणी REMARKS
						प्रदर्शन Perform	गवाह Witness	सत्यापन Verify	
1	Raw Material/ Bought Out Item								
a)	MS Flats / Rods								
i)	Physical/mechanical Properties	Physical	-do-	Tech. Spec./Appd.Drg./IS/IEEE	TC	3/2	-	1	TC
ii)	Chemical Composition	Chemical	-do-	-do-	TC	3/2	-	1	TC
iii)	Dimensional check	Measurement	-do-	-do-	TC	3/2	-	1	TC
b)	Flexible Braided Copper								
Connectors/ Rod/ Wire									
i)	Physical Properties	Physical	Sampling	Tech. Spec./Appd.Drg./IS/IEEE	TC	3/2	-	1	TC
ii)	Chemical Composition & Purity	Chemical	-do-	-do-	TC	3/2	-	1	TC
iii)	Dimensional check	Measurement	-do-	-do-	TC	3/2	-	1	TC
c)	Clamps, Sheaths & Terminals								
i)	Physical Properties	Physical	Sampling	Tech. Spec./Appd.Drg./IS/IEEE	TC	3/2	-	1	TC
ii)	Chemical Composition	Chemical	-do-	-do-	TC	3/2	-	1	TC
iii)	Dimensional check	Measurement	-do-	-do-	TC	3/2	-	1	TC
2	Final Inspection								
i)	Surface finish	Visual	100%	Tech. Spec./Appd.Drg./IS/IEEE	TC	3/2	-	1	TC
ii)	Dimensional Check & Weight	Measurement	-do-	-do-	TC	3/2	-	1	TC
iii)	Electrical Resistance of Material	Electrical	Sampling	-do-	TC	3/2	-	1	TC
iv)	Test of Galvanization (if applicable)	Test	-do-	-do-	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'Supplier' & 3- will indicate 'Sub-Supplier'.

b. In 'Record Format & Remarks' column following abbreviations shall be used - JIR - Joint Inspection Report, T.C. - Test Certificate & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

IMS/QAI/F-01

Rev.-03 Effective date-09.01.19


 दिनेश कुमार शर्मा
 उप. प्रब. (कै.)
 17/09/19

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

SUB-SECTION IA
CUSTOMER'S SPECIFICATION
(GENERAL TECHNICAL SPECIFICATION (GTS))



VOLUME-IIIA

GENERAL TECHNICAL SPECIFICATIONS (GTS)



CONTENTS

1	<u>GENERAL REQUIREMENTS.....</u>	<u>1-1</u>
1.1	GENERAL	1-1
1.2	SCOPE OF WORK.....	1-1
1.3	STANDARDS	1-1
1.4	UNITS OF MEASUREMENTS.....	1-3
1.5	WORKS IDENTIFICATION SYSTEM.....	1-3
1.6	TIME SCHEDULE	1-3
2	<u>TECHNICAL DOCUMENTS</u>	<u>2-1</u>
2.1	GENERAL	2-1
2.2	DRAWINGS	2-2
2.3	DIAGRAMS	2-3
2.4	DESIGN CALCULATIONS	2-6
2.5	INSTALLATION AND COMMISSIONING PROCEDURES.....	2-6
2.6	OPERATION AND MAINTENANCE MANUALS	2-7
2.7	PROGRESS REPORTS DURING DESIGN AND MANUFACTURING	2-9
2.8	PROGRESS REPORTS DURING INSTALLATION AT SITE	2-10
3	<u>SPARE PARTS AND TOOLS</u>	<u>3-1</u>
3.1	SPARE PARTS	3-1
3.2	TOOLS AND APPLIANCES.....	3-1
4	<u>DESIGN AND MANUFACTURE</u>	<u>4-1</u>
4.1	GENERAL	4-1
4.2	DESIGN AND CONSTRUCTION REQUIREMENTS.....	4-1
4.3	ALLOWABLE STRESS.....	4-2
4.4	DESIGN CRITERIA	4-2
4.5	STANDARDISATION OF WORKS	4-2
4.6	NOISE.....	4-3
4.7	SAFETY.....	4-3
4.8	IDENTIFICATION PLATES	4-5
4.9	COLOUR CODING FOR ELECTRICAL CONNECTIONS.....	4-5
4.10	WORKMANSHIP	4-6
4.11	METAL WORK.....	4-8
5	<u>MECHANICAL WORKS AND STEEL STRUCTURES</u>	<u>5-1</u>
5.1	GENERAL	5-1
5.2	MATERIALS	5-1
5.3	BOLTS, SCREWS, NUTS, ETC.....	5-1
5.4	CORROSION RESISTANT BOLTS AND NUTS	5-2
5.5	DRIVES AND GEARS.....	5-2
5.6	LUBRICATION, LUBRICANTS, FUEL.....	5-2
5.7	PIPING, FITTINGS, VALVES AND HEAT EXCHANGERS	5-3
5.8	MECHANICAL INSTRUMENTS	5-6



5.9	PUMPS.....	5-7
6	<u>ELECTRICAL WORKS</u>	<u>6-1</u>
6.1	GENERAL	6-1
6.2	STANDARDS	6-1
6.3	COLOUR CODE	6-1
6.4	ELECTRIC MOTORS.....	6-2
6.5	CUBICLES AND PANELS	6-6
6.6	CABLES	6-10
6.7	LABELS AND PLATES	6-10
6.8	KEY SYSTEM FOR ELECTRIC BOARDS	6-12
7	<u>INSTRUMENTATION AND CONTROL EQUIPMENT</u>	<u>7-1</u>
7.1	GENERAL	7-1
7.2	DESIGN CRITERIA	7-1
7.3	MEASURING SYSTEMS	7-1
7.4	PROTECTION SYSTEMS	7-5
7.5	TRANSMITTER RACKS AND PIPING	7-5
8	<u>TRANSPORT AND INSTALLATION.....</u>	<u>8-1</u>
8.1	GENERAL	8-1
8.2	PACKING	8-1
8.3	MARKING	8-2
8.4	TRANSPORT AND STORAGE	8-2
8.5	PREPARATION AND INSTALLATION.....	8-3
8.6	REFERENCE POINTS	8-3
8.7	GENERAL NOTES ON INSTALLATION WORK.....	8-4
8.8	CIVIL SITE WORK.....	8-5
ANNEX-1	<u>.....</u>	<u>1</u>
ANNEX 2	<u>.....</u>	<u>7</u>



1 GENERAL REQUIREMENTS

1.1 General

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, manufacturing and testing shall conform to the latest applicable standards.

In addition, the Contractor shall abide 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 in-Charge.

The particular technical specifications shall take precedence over the general technical specifications in case of any contradiction. Clause number cross-references refer to the volume in which they occur unless stated otherwise.

1.2 Scope of Work

The scope of work in this Contract covered by the Electrical-Mechanical Works General Technical Specification is established in the Particular Technical Specifications. In addition to this, the Contractor shall prepare the detailed design, construction and installation drawings as well as calculations, material specifications, operating and maintenance instructions, etc., for the works as stipulated in the 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 at the port of arrival, intermediate storage, protection of the Works from the effects of the weather, cleaning, drying, storage at site and preservation related works, 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. The period provided for testing and commissioning is established in the Special Conditions.

The Contractor shall supply the O&M Instruction Manuals in a number and at a time as stated in the GCC and SCC.

1.3 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



TEESTA H.E.PROJECT, STAGE-VI

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 current at the time of issue of Tender Documents, together with any Amendments issued to that date.

If requested by the Engineer in-Charge 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:

1.3.1 Standards for General Application

- | | | |
|-------|------|--|
| i) | ISO | International Standards Organisation |
| ii) | IEC | International Electro technical Commission |
| iii) | IEEE | Institute of Electrical and Electronic Engineers |
| iv) | IS | Indian Standards |
| v) | AISI | American Iron and Steel Institute |
| vi) | ANSI | American National Standards Institute |
| vii) | ASME | American Society of Mechanical Engineers |
| viii) | ASTM | American Society for Testing and Materials |
| ix) | AWS | American Welding Society |
| x) | BS | British Standards |
| xi) | IIW | International Institute of Welding |
| xii) | AWS | American National Standard |

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

1.3.2 Material Standards

Materials shall be new and of first-class quality, suitable for the purpose, free from defects and imperfections, and the classifications and grades in conformance with the latest issue of the respective relevant standard. Material to other standards may be used if approval by the Engineer in-Charge has been obtained. Material specifications, including grade or class data, shall be shown on the appropriate detail drawings submitted for review.

If using stock material not specifically prepared for the works under this Contract, the Contractor shall submit evidence that the material complies with approved standards and that the material is adequate for the intended use.

The Contractor shall indicate in the Technical Data Schedules, the materials and applicable standards for all major parts of the supply.



The materials shall be carefully selected for the intended purpose and due consideration of the site conditions and the tropical environment. Higher-grade material shall be used where ordinary material is insufficient.

1.3.3 Electrical Standards

The following basic standards for electrical works or any other approved standard shall be applied:

- i) IS (Indian Standards)
- ii) Standards issued by IEC (International Electro technical Commission)
- iii) IEEE (Institute of Electrical and Electronic Engineers)

For specific standards see the Particular Technical Specifications.

1.4 Units of Measurements

The international SI-system of units shall be used for documents, calculations, correspondence, drawings, etc., relevant to the Tender and the subsequent Contract.

1.5 Works Identification System

An approved, uniform Works identification system shall be applied for all mechanical, electrical and Instrumentation and Control (I&C) Works to be agreed upon during detailed design.

1.6 Time Schedule

According to the relevant articles in the General and Special Conditions of Contract, the progress of the work shall conform to the basic Programme of Work on which the Contract is based. The "Programme" to be submitted shall include the following information

- i) Design work
- ii) Shop work
- iii) Testing and inspection of works
- iv) Transport to the Site
- v) Storage at site
- vi) Preparations at the Site
- vii) Interdependence with work of other Contractors
- viii) Erection and commissioning
- ix) Acceptance testing
- x) Handing over
- xi) Removal of erection equipment and clearing of the Site



TEESTA H.E.PROJECT, STAGE-VI

2 TECHNICAL DOCUMENTS

2.1 General

This Chapter specifies the general scope and gives a definition of the documents which, together with those listed in the Particular Specifications, shall be delivered by the Contractor to the Engineer in-Charge within the periods, and in a number and quality as specified in the General and Special Conditions as per indicative list under Annex-2.

The Engineer in-Charge 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 shall be submitted in accordance with the agreed programme so that any comment and change requested by the Engineer in-Charge can be taken into account before starting of the manufacture in the workshop and/or erection or installation at the Site.

If the Contractor fails to submit such documents, then the later execution of changes requested by the Engineer in-Charge and the resulting additional cost and/or delays shall be the Contractor's responsibility. The Contractor shall not be absolved of his responsibility and guarantee even after drawings and computations have been approved by the Engineer in-Charge.

On drawings, catalogue sheets or pamphlets of standard Works submitted to the Engineer in-Charge, the applicable types, paragraphs, data, etc. shall either be marked distinctively or the non-applicable parts shall be crossed out. Documents not marked in such a manner will not be accepted and approved by the Engineer in-Charge.

If required for proper understanding of the documents, additional descriptions/explanations shall be given on these documents or on separate sheets. All symbols, marks, abbreviations, etc., appearing on any document shall clearly be explained by a legend on the same document or on an attached sheet.

Each device appearing on any document (drawing, diagram, list, etc.) shall clearly be designated. The abbreviation mark used for an individual device shall be identical throughout the complete documentation so as to avoid confusion. All documents shall have a uniform title-block and agreed by the Engineer in-Charge. Beginning with the very first submittal to the Engineer in-Charge, 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 in-Charge.

Contractor shall submit all approved documents/ drawings (pdf and Autocad) in CD/ pen drive on monthly basis in addition to what is stated anywhere in the document.



2.2 Drawings

2.2.1 Loading Drawings

For all larger pieces of Works which, due to their dimensions and/or weight and transport limitations, will require special means for their transportation, the Contractor shall submit binding loading drawings indicating dimensions, weights, etc., of the respective pieces of Works and the necessary trailer for its transportation to the site.

2.2.2 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, these shall include openings, sleeves, slopes and the arrangement of any supporting structure, i.e. base-frames or other steel constructions for permanent fixing or erection purpose.

If conduits are to be installed in the foundations, the relevant information such as diameter, length, and purpose shall be indicated on the drawings.

2.2.3 Arrangement Drawings

All arrangement drawings shall be drawn to scale. The General Arrangement Drawings shall show the physical arrangement of Works/ equipment/ assemblies in relation to each other and to agreed co-ordinates and boundaries.

The Arrangement or Layout Drawings of electrical and instrumentation and control equipment shall indicate the location of all apparatus wherever used, i.e. in or on machines, control boards, switchboards, cubicles, control desks and panels, etc. The apparatus shall be denominated with the same standardised abbreviations as used in all other documents.

2.2.4 Outline Drawings

The Outline Drawing shall show all elements and the main dimensions of individual components where necessary in plan view, cross-section, side and top views. If reasonably possible such dimensions can be shown on Arrangement Drawings.

2.2.5 Civil Work Guide Drawings

Civil work Guide drawings shall be drawn to scale. The drawings shall include all civil interfacing details like dimensional details of all openings, cut-outs, insert plates, foundations, trenches, trench cover, rail embedment and floor loading etc. These drawings shall be complete in all respect for working as a reference for preparation of civil construction drawings. Wherever all such information/details are not possible to be



TEESTA H.E.PROJECT, STAGE-VI

included in the drawing of any area, civil work guide drawing shall include all such references of other drawings.

2.2.6 Design Drawings

The Design Drawings shall include outline drawings, assembly manufacturing drawings of components, erection drawings, piping diagrams and piping arrangement drawings, etc., showing the dimensions including fitting tolerances, surface finish, design and data of all constructions, apparatus and Works to be furnished under this Contract.

The drawings shall - where applicable - substantially conform to the Tender Drawings and shall show:

- i) Details of manufacturing of major single work pieces specially manufactured for this Contract.
- ii) Assembly of the Works in plan and elevation with main dimensions
- iii) Sub-assembly of the principal components of the Works with overall dimensions, adjustment and clearance tolerances, numbers of corresponding detail drawings
- iv) Sub-assemblies in which the Contractor proposes to ship the Works
- v) All necessary details of the parts connecting to the Works supplied by others
- vi) Location and sizes of auxiliary connections for oil, grease, water, air, electrical power etc.
- vii) Location and size of the instruments and accessories provided
- viii) Methods of lubrication and sealing
- ix) Instructions for heat treatment, pressure tests, surface preparation and anti-corrosive protection
- x) Full details of parts for which adjustment is provided or which are subject to wear
- xi) Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

2.2.7 Installation Drawings

The construction, mechanical, electrical and I & C Installation Drawings shall provide detailed information on the disposition of the various items of a system.

2.3 Diagrams

For electrical diagrams general reference is made to IEC 113-1.

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



2.3.1 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.

When recommendable, a Block Text Diagram may be prepared, consisting essentially of explanatory texts enclosed in outlines which are linked by lines showing the functional relationships that exist between the various parts of an installation, Works or circuit.

2.3.2 Logic Diagrams

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

2.3.3 Schematic/ Single-Line Diagrams

This is a simplified diagram of the essential Works and their interconnections. Each circuit shall be represented by a single line only. It shall contain all required technical information of the Works represented.

Single-line diagrams of individual main components and switchboards shall additionally show the control, indicating, measuring, metering, protection, automatic and other auxiliary devices separated for each individual installation site and location as applicable

Furthermore, the applied recommended setting of adjustable devices (protection and control elements, time relays, etc.) shall be indicated.

2.3.4 Electrical Circuit Diagrams

The Circuit Diagrams shall show the power circuits in all the phases with the main apparatus as well as the pilot circuits (measuring and control circuits). It shall show in full the functioning of part or all installations, Works or circuits with all required technical information.

The control part shall be subdivided into separately drawn "current paths", each showing all its components regardless of their actual physical location. The individual circuits are to be drawn in a straight-line sequence, avoiding line crossings. The current paths (to be designated by numbers) shall be drawn starting from two horizontal lines, which represent the control voltage source. All devices belonging to the Works or forming part of the Works or control devices shall appear between these two lines.

Contact developments of the installed switches, contactors, relays and other apparatus which appear in the diagram shall be shown below the



TEESTA H.E.PROJECT, STAGE-VI

respective contactor coil, indicating by means of numbers and, if not on the same, also the page No., the current path in which the corresponding contact has been used.

Interconnections to other circuit diagrams shall be clearly marked by means of dotted line separations and the corresponding functional designation.

The power circuit portion of the installation shall be drawn at the left side of the drawing.

Circuit diagrams shall also contain all terminals and their correct designations. Terminals grouped together to terminal blocks of switchboards, distributors, etc. shall be shown on the circuit diagrams in one fictitious horizontal line surrounded by demarcation lines. If, for any reason, the current paths of circuit diagrams must be separated, the corresponding counter terminal has to be indicated by all means.

The representation of electrical Works and control circuits shall not be terminated at the limits of the scope of supply, but has to be extended beyond this limit by all switchgear, protective, measuring and monitoring equipment required for full comprehension of the whole circuit. All terminals and functions of Works to be supplied by others shall be taken over as well.

Standard Circuit Diagrams are patterns of circuit diagrams which have been standardised with regard to scope, arrangement, representation and allocation of Works with the aim of simplification and easy surveillance of electrical circuitry.

2.3.5 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

- i) Cable designation
- ii) Type of cable
- iii) Number and cross-section of conductors
- iv) Assignment of conductors
- v) Number of spare conductors
- vi) Approx. length of cable and its destination.

2.3.6 Protection Co-ordination Diagrams

These diagrams shall show in a graphical manner separately for each power supply circuit:



- i) A simplified single-line diagram of the circuit with technical data of all instrument transformers and relays
- ii) Co-ordinated tripping curves of related protection devices

2.3.7 Emergency Shutdown Diagram

This diagram shall show the sequential steps and interdependencies during emergency closure.

2.4 Design Calculations

In addition to the drawings or whenever the contractual documents do so require, the Contractor shall submit to the Engineer in-Charge 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, sample calculations, definition of variables and constants, explanation of abbreviations etc., will not be accepted.

2.5 Installation and Commissioning Procedures

2.5.1 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 in-Charge/employer to plan and supervise the Works at site, if required.

2.5.2 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.

2.5.3 Commissioning Procedures

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



TEESTA H.E.PROJECT, STAGE-VI

2.5.4 Commissioning Test

Commissioning and acceptance tests shall be carried out, on all equipment in accordance to relevant standards. The complete field acceptance test reports shall be prepared by the Contractor and submitted to employer for approval. Close coordination with contractor of Package – EM-I shall be required as actual commissioning of generating units is in the scope of EM-I package.

2.6 Operation and Maintenance Manuals

2.6.1 Contents

The Operation and Maintenance Manuals shall be provided in five (5) hard bound copies along with DVD or any permanent storage device (eight sets), and shall contain the following information in sufficient detail to enable the Employer to maintain, dismantle, reassemble, adjust and operate the Works with all its items of Works and installations:

- 1) Table of Contents
- 2) List of Illustrations
- 3) Introduction

The Introduction shall contain:

- a) A brief general description of the Works items
- b) A brief description of the use of the Works items
- c) Definitions of technical terms used in subsequent graphs of the instruction book
- d) A complete list of all items used in accordance with the Works Components Identification System.

4) 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.

5) Operating Principles and Characteristics

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

6) Operating Instructions

The instructions shall be accurate and easy to understand, and shall contain the sequence of individual manipulations required for operation. The information shall be presented in such a manner that the contents of this paragraph can be used for instructing personnel in the operation of the Works. 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.

7) Testing and Adjustment



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

8) Maintenance Instructions

This section is divided into six paragraphs:

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

The maintenance instructions shall include a tabular (or in other approved form) summary of the required activities sorted according to

- a) Daily
- b) Weekly
- c) Monthly
- d) Quarterly
- e) Yearly
- f) (Or other) cycles as applicable.

This document shall provide the maintenance engineer with brief and yet fully comprehensive information including all references to the applicable, detailed service and maintenance instructions.

- ii) Repair and adjustment, describing the inspections, fitting and dismantling of parts, fault tracing as well as repair and adjustment procedures.
- iii) 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.
- iv) Tool lists, containing all necessary data for identification of tools to be delivered under the present Contract.
- v) As-built drawings

2.6.2 Operation and Maintenance Manual Drawings

Each kind of drawing aforementioned shall have a uniform size. The final size of drawings for the Operation and Maintenance Manual shall be decided by the Engineer in-Charge. 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. All figures, statements and data valid for sizes and types not delivered must be crossed out.



2.6.3 Revisions and Supplements

The completeness of the manuals shall be checked during installation, testing, commissioning and trial operation jointly by the Contractor and Engineer in-Charge.

If it becomes evident during the installation, commissioning trial operation and defects liability period of the Works that the Operation and Maintenance Manuals are inadequate or incorrect, the Contractor shall supply immediately the necessary supplements and corrections. This shall be handled in the following manner:

A) Deletions:

One sheet of errata, printed on pink paper, shall be issued indicating the pages and date of issue of those pages, which are to be deleted, and are no longer valid.

B) Corrections, Revisions, Replacements:

New sheet (s) shall be issued to replace the wrong pages. Whenever a new sheet is added to the instruction manuals, this sheet shall be given the new date of issue and a revision symbol, and an indication "Substituted for ..." and a marking of the corrected/revised items.

C) Insertions, Supplements:

Insertions or supplements shall be accompanied by a new respective "Table of Contents" page, where the latter shall be handled as described above under replacements.

The revisions and supplements requested by the Engineer in-Charge shall be made by the Contractor at the Site as far as possible and shall be submitted in each case to the Engineer in-Charge for checking and revision as stated above.

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.

2.7 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 in-Charge, detailing the progress of the work during the preceding period. The report shall contain (but not be limited to) the following information:

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



TEESTA H.E. PROJECT, STAGE-VI

- iii) The percentages of each main work activity completed during the reported quarter with reference versus the scheduled programme. Appropriate comments shall explain any differences.
- iv) A list of all activities of scheduled and actual progress during the reporting period including actual starting dates versus scheduled starting dates and actual completion dates versus scheduled completion dates for each activity. Appropriate remarks shall explain any differences, and also methods/actions prepared to be taken for making up the deficiencies in actual design and manufacturing process.
- v) 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.

2.8 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 in-Charge, detailing the progress of the work during the preceding month. The report shall contain (but not be limited to) the following information:

- i) A general description of the Works performed during the reporting period on each main activity, and includes any notable problems, which were encountered.
- ii) The total overall percentages of erection works completed, with reference to the CPM programme. Appropriate comments shall explain any differences.
- iii) The percentages of each main work activity completed during the reported month with reference versus the scheduled programme. Appropriate comments shall explain any differences.
- iv) A list of all activities of scheduled and actual progress during the reporting period including actual starting dates versus scheduled starting dates and actual completion dates versus scheduled completion dates for each activity. Appropriate remarks shall explain any differences.
- v) 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.
- vi) A list of local manpower (by trade classification) employed during the reporting period.
- vii) A list of expatriate personnel (by position) employed during the reporting period.
- viii) A list of the Contractor's Equipment and materials presently located at the Site. Also a list of equipment and materials, which



TEESTA H.E.PROJECT, STAGE-VI

arrived at Port of entry and is in the process of being cleared through customs.

- ix) Progress photographs of significant events. The Engineer in-Charge may direct the inclusion of specific photographs if deemed necessary.
- x) Main items of temporary facilities constructed during the reporting period.
- xi) A statement detailing the status of progress on the overall programme and how to regain any lost time or setbacks, which may have occurred.
- xii) A list of inoperable temporary equipment, and the estimated date when the repair will be completed.
- xiii) A statement about labour relations & an explanation of an actual or potential problems
- xiv) A listing of each accident at the site involving the hospitalization and/or death of any person
- xv) A listing of the amount & date of any payments received during the reporting period & the amount of any monthly invoice, which has been submitted but not yet paid.
- xvi) A list of claims (if any) submitted during the reporting period including the claimed cost & extension of time.
- xvii) A statement concerning potential problems and recommendations on how they could be resolved.



3 SPARE PARTS AND TOOLS

3.1 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. Before issue of the Taking-Over Certificate the spare parts shall be checked at the Site by the Contractor in presence of the Engineer in-Charge/Employer.

Acceptance of any spare parts will not take place before the Contractor has submitted the complete final detailed list of all spare parts and tools.

All spare parts shall be protected against corrosion and shall be marked with identification labels in the English Language. The identification shall be in accordance with the agreed Works Identification System.

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

3.1.1 Specified Spare Parts

The required specified spare parts are listed separately in the Particular Technical Specifications. The price for listed spare parts shall be quoted item-wise separately for each section in the Price schedule. The total price of spares shall be included in the Total Tender Price.

3.1.2 Recommended Spare Parts

If any additional spare parts are recommended by the Contractor beyond the spare parts listed in specified spares, these shall be stated in quantity and description separately for each item along with their prices.

Orders for recommended spare parts shall be optional to purchase by the Employer for a period of five (5) years after the date of the completion of the project.

3.2 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, the tools 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 tools, wrenches, etc. shall be unused. Customary tools for erection shall be of the forged and polished chrome-vanadium type. Use of special tools and devices for erection shall be allowed, but shall be approved by the Engineer in-Charge in each case. Special tools and devices shall be provided with means for ready identification.



All lifting devices and slings to be used at site shall be tested at works and test certificate shall be supplied to the Engineer in-Charge.

Suitable hardwood or steel boards arranged for wall mounting as well as tool carts and/or toolboxes shall be included in the delivery. An itemised list and description of all provided tools, auxiliary devices, storage equipment, etc. shall be included in the Tender. Acceptance of any tool or device shall not take place before the Contractor has submitted the complete final detailed List of Tools and Appliances.

Ropes, slings etc. shall be handed over in new condition. The Employer shall be entitled to take over from the Contractor the entire erection tools, appliances, instruments at mutually agreed conditions.



4 DESIGN AND MANUFACTURE

4.1 General

Design, manufacture and construction requirements shall generally be as described below besides complying with the specific requirements elaborated in particular technical specification

4.2 Design and Construction Requirements

The following directions, information and technical requirements for layout, design and manufacture shall be observed as far as they are applicable to the Works to be offered. The technical requirements of the General Technical Specifications are valid for all parts of the Works except where they are modified by additional and/or special requirements, specified in the Particular Technical Specifications.

Whenever a Contractor 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.

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

The parts of the Works shall be designed and arranged so that they can be easily inspected, cleaned, erected and dismantled without involving large scale dismantling of other parts of the Works. They shall be designed, and manufactured in accordance with the latest recognised rules of workmanship and modern engineering practice.

The regulations, standards and guidelines listed in these Specifications shall be observed in the design, calculation and manufacture of the Works.

All parts of the Works shall be suitable in every respect for continuous operation at maximum output efficiency under the climatic conditions and operating conditions prevailing at the Site.

Special attention shall be given to Works, parts of which are delivered by different manufacturers. Problems arising in this connection shall be solved by the Contractor and be defined in writing.

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

Manufacturers shall take appropriate measure to prevent the ingress of dust into any Works (such as bearings, relays, control and measuring equipment, etc.), which may be endangered thereby.

Suitable lifting eyes and backing-out bolts shall be provided where required or where they will be useful for erection and dismantling.



All design details and layout matters shall be discussed in periodic meetings with the Engineer in-Charge. The first design meeting between the contractor and the Engineer in-Charge shall take place within 60 days after the date of signing of the contract or placement of the order. Further design meetings shall take place as agreed between the participants until the design work is completed.

4.3 Allowable Stress

The layout of the parts of items of works shall fundamentally consider the most severe conditions to which they will be subjected during testing and operation.

If different stress values are given in the General / Particular Technical Specifications or in the relevant standards and regulations, then the more stringent values shall be applicable.

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 approved in practice.

4.4 Design Criteria

The plant equipment shall be designed for the worst possible combination of the following loading conditions as applicable:

- i) All static and dynamic hydraulic loads,
- ii) All loads due to dead weight and frictional forces,
- iii) Seismic or wind loads, and
- iv) Other loads.

4.4.1 Seismic Conditions

The project area lies in seismic zone IV of India which corresponds to the highest seismically active area in India.

Stresses resulting after including these loads shall not exceed permissible stresses.

4.5 Standardisation of Works

Every effort shall be made to standardise parts and minimise costs of the Works throughout the Works in order to facilitate keeping stocks, maintenance, replacement, interchangeability, etc.

The Engineer in-Charge, therefore, reserves the right to request the different contractors to use uniform types or makes of works & materials. The contractor shall not be entitled to claim extra payment due to this request. This request shall especially be applicable to small mechanical and electrical works such as:

- i) Valves
- ii) Thermometers



TEESTA H.E. PROJECT, STAGE-VI

- iii) Pressure gauges
- iv) Flow meters
- v) Water level gauges
- vi) Terminals & terminal racks
- vii) Indicating instruments & meters
- viii) Auxiliary relays
- ix) Contractors, fuses
- x) Motor protection switches
- xi) Control devices
- xii) Lights, bulbs, plugs, sockets
- xiii) Limit switches
- xiv) Level switches

The types or makes to be used shall be decided later by the Engineer in-Charge. All instrument scales shall be written in the ruling language of the contract and in the international SI- System of units.

4.6 Noise

The noise level caused by the installed Works shall not exceed the following values if not otherwise stated in the Particular Technical Specifications:

- i) Machine hall, workshops, etc. max. 85 dB (A) at any place 1 m distant from operating equipment.
- ii) Offices, control rooms, max. 55 dB (A) rooms, canteens, etc.

The noise level definition and measurement shall be in accordance with ISO. The values stated shall be adhered to taking a normal civil construction into account.

4.7 Safety

4.7.1 Safety of personnel

Where specific standards are not mentioned by the Employer, all equipment and services provided under this contract shall abide by international standards commonly accepted in the hydroelectric utility industry for safety of personnel whether involved with operation or maintenance. All operations and routine maintenance interventions shall be completely safe and designed to be carried out under normal conditions of access and while the equipment is operating.

4.7.2 Safety of operation

All equipment and services provided under this contract shall abide by commonly accepted standards for safety of operation.



The overall design shall comprise a substantial degree of conservatism, especially with respect to the selection of the design parameters and of the components critical to the safety and reliability of the operation.

4.7.3 Handling provision

Lifting lugs, brackets, eyes, and other items required for attaching lifting devices shall be provided on all the major components of the equipment weighing more than 24 kg for safe handling. All slings and lifting devices required for attachment to the components and assemblies and to a crane hook for safe handling during erection and later disassembly shall be furnished.

4.7.4 Availability and reliability

The Contractor shall design each equipment, system or subsystem to provide a high level of availability and reliability.

The "Electrical & Mechanical Works" shall be designed, constructed and integrated using components and systems which have been proven in other plants of similar application and have shown low failure rates in such applications.

4.7.5 Interchange-ability

The Contractor shall optimise the various systems and subsystems to minimize the number of different components and associated spare parts. Equipment fulfilling the same or similar functions at various locations shall whenever possible use the same material.

Homologous parts shall be interchangeable without needing any adjustment.

All equipment, parts and elements of mass production shall be standardized. These pieces of equipment, parts and elements shall include but not be limited to the following: motors, pumps, flanges, bolts, nuts and threads, valves, gauges and detectors, electrical instruments and measuring devices, flow meters, terminal and terminal boxes, primary, secondary and auxiliary relays, contactors, fuses and switches, lamps, bulbs sockets push buttons, lubricants, control modules, I/O modules, etc.

Where the equipment supplied under this Contract comprises identical pieces of equipment each of their corresponding removable parts shall be fully compatible and interchangeable for use in the other, without adjustment to the remaining parts.

The Contractor shall coordinate the supply of his sub-contractors to achieve a great degree of standardization throughout the "Electrical & Mechanical Works" and the stock of spare parts.



4.8 Identification Plates

4.8.1 General

Each important part to be delivered under this Contract shall be equipped with permanent identification plates in readily visible locations. Whether a part shall be considered as important in this respect shall be decided by the Engineer in-Charge.

The identification plates shall be protected during erection and especially during painting. Damaged or illegible identification plates shall be replaced by new ones. The identification plates of non-corroding, non-disintegrating material (except manufacturer's nameplates of small standardised components) shall be inscribed in the Contractual language.

The inscription shall be printed, stencilled, or hand-written, but in any case, waterproof, oil-proof and wear-resistant. Works (machines, transformers, etc.) nameplates shall be either of the enamelled type or be of stainless steel covered after stamping with a transparent paint. Wording, size and material of all labels and plates shall be subject to the Engineer in-Charge's approval.

4.8.2 Manufacturer's Nameplates

The following data shall be shown in accordance with the relevant standards:

- i) Manufacturer's name and address
- ii) Work's serial number and date of manufacture
- iii) 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 manufacturer's standard nameplate.

The design of the Manufacturer's nameplates for the main components such as gates, cranes, valves, hoists, servomotors, pumps etc., shall be submitted for the Engineer in-Charge's approval sufficiently in advance.

4.8.3 Functional Plates / Instruction Plates

Each part appearing under a certain symbol or number in functional diagrams, piping diagrams, in the Operation and Maintenance Instructions, etc., shall be equipped with a plate showing the same symbol or number.

4.9 Colour Coding For Electrical Connections

Live parts of electrical connections shall be colour coded as follows:

Conductor Designation	Coding Alphanumeric	Symbol	Colour
a.c. network 3	Phase 1	R	Red



phase	Phase 2	Y	Yellow
	Phase 3	B	Blue
	Neutral	N	Black
a.c. single phase	Phase	P	Red
	Neutral	N	Black
	Earth	E	Green-yellow
D.C. Network	Positive	a	Red
	Negative	b	Black

4.10 Workmanship

4.10.1 Finished Surfaces

Where the finish is not indicated or specified, the type of finish shall be most suitable for the surface to which it applies and shall be consistent with the class of fit required. Surfaces to be machine-finished shall be indicated on the shop drawings by symbols.

4.10.2 Unfinished Surfaces

Unfinished surfaces shall be true to the lines and dimensions shown on the drawings and shall be chipped or ground free of all projections and rough spots.

4.10.3 Protection of Machined Surfaces

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.

4.10.4 Painting Systems

Annex-1 "Painting Schedule", indicates painting guidelines and materials considered suitable for the various parts of the Works. Painting in respect of standard items shall be acceptable as per manufacturer practice.

4.10.4.1 Painting Materials

The Contractor shall provide a complete, reliable coating system. 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.

The Contractor shall submit for the Engineer in-Charge'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 of the repainted surface shall be in accordance to the relevant standard and shall be detailed by the Contractor for Engineer in-Charge's acceptance.

4.10.4.2 Galvanising

Unless otherwise specified, all structural steel including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works, as well as bolts and nuts associated with galvanised parts shall be hot-dip galvanised, electrolytically galvanised or sherardized, as may be appropriate to the particular case.

A) Material:

For galvanising, 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:

- i) For bolts and nuts, approx. 60 micrometer
- ii) For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 70 micrometer

B) Galvanising of hardware:

Bolts, nuts, washers, locknuts and similar hardware shall be galvanised in accordance with the relevant standards. Excess spelter shall be removed by centrifugal spinning.

C) Straightening after galvanising:

All plates and shapes, which have been warped by the galvanising process, shall be straightened by being re-rolled or pressed. The material shall not be hammered or otherwise straightened in a manner that will injure the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

D) Repair of galvanising:

Material on which galvanising has been damaged shall be re-dipped unless the damage is local and can be repaired by soldering or by applying a galvanising repair compound; in this case, the compound shall be applied in accordance with the manufacturer's instructions.

Soldering shall be done with a soldering iron using 50/50% solder (tin and lead). Surplus flux or acid shall be washed off promptly and the work shall be performed so as not to damage the adjacent coating or the metal itself. Any member on which the galvanised coating becomes damaged after having been dipped twice shall be rejected.

4.10.4.3 Painting Guarantee

The guarantee period for all painting shall be 2 years, starting from the issue of the "Taking-Over Certificate". This painting guarantee period shall



be effective regardless of any other guarantee periods for the project or parts of the project, or any "Defects Liability Certificate", issued prior to the elapse of the painting guarantee period.

At the end of the painting guarantee period the anti-corrosive protection of the painted or galvanised surfaces shall not have a degree of rusting higher than RE 1 (one) on the European scale of degree of rusting for anti-corrosive paints, (the corrosion committee of the Royal Swedish Academy of Engineering Sciences, Stockholm).

4.11 Metal Work

4.11.1 Embedded Metal Work

The contractor shall supply & install all anchors, fasteners, embedded metal work, piping, & sleeves associated with & required for the equipment to be installed under this contract, except if otherwise mentioned in the specifications.

As far as practicable, the supports shall be of consistent design throughout. Attachments to concrete shall wherever practicable be by means of embedded inserts.

The Contractor shall be responsible for the determination and details of all loads and forces exerted by his equipment and transferred to the foundation.

The Contractor shall show the location and full details of all embedded components on his drawings and shall be responsible for the completeness and accuracy of his drawings and the information supplied to others.

Any steel work which is to be built into the concrete foundations shall not be painted or coated unless otherwise approved or specified.

4.11.2 Miscellaneous Metalwork

Except where otherwise indicated elsewhere in the Particular Technical Specifications, the Contractor shall fabricate and supply the following:

Walkway, platform, handrails, trench covers etc shall be provided for convenient and safe access to all operating equipment.

The minimum thickness of chequered plate shall be 8mm.

Curbing for dismantling hatches in main floors will be provided by the civil contractor



5 MECHANICAL WORKS AND STEEL STRUCTURES

5.1 General

All mechanical Works and steel structures of any mechanical or electrical installation shall comply with this General Technical Specification and the requirements of the Particular Technical Specification.

The Works shall be of an approved, reliable design providing the highest possible degree of uniformity and interchangeability.

All Works shall be pre-assembled in the manufacturer's premises to an utmost extent.

5.2 Materials

Materials shall be new and of high-grade quality, suitable for the purpose, free from defects and imperfections, and of the classifications and grade meeting specification requirement and shall be subjected to acceptance by the Employer. Material specifications, including grade or class shall be shown on the appropriate Contractor's detail drawings submitted for review.

All materials or parts used in the equipment shall be tested in conformity with the standards accepted by the Employer.

Certified Material Test Report for the materials of major/important components and/or materials for special application shall be furnished to the Employer as soon as possible after the tests are performed. Each test certificate shall identify the components for which the materials are used and shall contain all information necessary to verify compliance with the contract.

5.3 Bolts, Screws, Nuts, etc.

All bolts, studs, screws, nuts, and washers shall be to the ISO standard (metric system) except other standards will be considered for specific applications. The extent to which other standards are proposed shall be indicated by the Contractor.

Where mild steel bolts and nuts are used, they shall be of the precision cold forged washer faced type if commercially available in the size required. Alternatively, approved hot forged bolts and nuts, machined so that the undersides of bolt head and nut are faced and parallel to one another when assembled, may be used. In the latter case, a suitable fillet shall be machined between the bolt head and shank. 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. Bolts machined from bar stock shall not be used without approval of the Engineer in-Charge. All bolting material shall be adequately treated against corrosion before dispatch from the workshop. Mild steel nuts and bolts shall be zinc or cadmium plated. Stainless steel bolts, nuts washers and screws shall



TEESTA H.E.PROJECT, STAGE-VI

be used in water or when exposed to high humidity, for holding renewable parts and parts made of stainless steel.

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.

Washers shall be provided under bolt heads and nuts unless otherwise approved by the Engineer in-Charge. All ferrous nuts and bolts on Works items where dismantling may be required during the life of the Works shall have their threads coated with an approved anti-seize compound. When in position, all bolts or studs shall project through the corresponding nuts by at least one thread, but this projection shall not exceed three threads, unless more length is required for adjustment. All nuts and set screws shall be securely fastened, to prevent loosening due to vibrations, using spring washers, lock nuts, split pins, self-locking inserts or 'Loctite' as appropriate for the purpose and material used.

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 Employer.

5.4 Corrosion resistant bolts and nuts

Corrosion resistant steel or bronze shall be used for bolts and nuts when either or both are subjected to frequent adjustment or frequent removal, such as adjusting bolts for packing glands on removable screens or strainers, on adjustable bearings, rubber seal holders, etc. Bolts on manholes shall be of high-strength stainless steel. Protective measures against electrolyte corrosion shall be foreseen where necessary.

5.5 Drives and Gears

Gears shall be designed so that all stresses are within allowable limits when the maximum loads are being handled. On request of the Engineer in-Charge, the manufacturer shall submit the calculation of the gears.

Where practicable gear wheels shall be forced fit on the shaft and in addition, shall be keyed adequately to prevent any relative motion between the wheel and shaft. Couplings and collars shall be the shrouded or protected-type, free from projections of any kind. All bearings shall be mounted in dust-proof housings. Base of bearing supports shall be machined, and shall rest on machined-surfaces.

5.6 Lubrication, Lubricants, Fuel

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

The contamination of the air, water and soil by lubricants and fuel shall by all means be avoided by applying of an appropriate design and layout of



the Works in conformity with the latest recognised standards for modern engineering practice.

The number of different lubricants, transformer oils, oils for pressure systems, etc., used in the items of Works throughout the Works shall be limited to a minimum in order to facilitate keeping stocks and maintenance.

The Employer reserves the right to request the use of certain types of lubricants, oils, etc. The Contractor shall not be entitled to claim extra payment for this request. All different types of oils, lubricants, etc., shall be subject to the written approval of the Engineer in-Charge.

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.

5.7 Piping, Fittings, Valves and Heat Exchangers

5.7.1 General

Unless otherwise stated, all piping fitting, valves shall be designed for at least 1.5 times of the working pressure but minimum for "nominal pressure" PN 16 and tested with 1.5 times of the design pressure.

5.7.2 Valves

Generally, valves shall be leak-proof in either flow direction (except for non-return valves) when the design pressure is applied.

All valves with design pressures higher than PN 16 and diameters larger than DN 100 shall be workshop-tested to relevant IS for tightness and soundness of materials.

Valves shall close clockwise and be provided with position indicators and padlock kit. The drive units of motor-driven valves shall also be provided with hand wheels for manual operation. The hand wheel shall be operable under all conditions and shall be independent of the motor drive. Further, it shall not be rigidly coupled to the motor drive and shall not compulsory turn when the motor is energised.

To facilitate operation, large valves and gates shall be provided with by-pass lines for pressure balancing, if required.

All valves shall be readily accessible for both operation and maintenance, and where necessary for ease of operation the spindles shall be extended and an approved form of pedestal hand-wheel provided at convenient operating floor level.

Shut-off valves shall be suitable for opening and closing against full unbalanced pressure, including closure against free discharge. If necessary, bypasses are to be provided to meet these requirements.

Material of valve body and other parts shall be as mentioned below for all type of valves:



Part name	Valve size	Application	Material/ Grade	Standard/
Valve body	DN 50 and below	Water	Stainless steel (ASTM A276 Type 316/ ASTM A182 Gr. F 316 or better)	
Valve body	Above DN 50	Water	Cast/ Forged steel (ASTM A216 Gr. WCB/ ASTM A105 or better)	
Valve body	All	Air and oil	Stainless steel (ASTM A276 Type 316 or better)	
Valve spindle/ shaft & pins	All	Water, air & oil	Stainless steel (AISI 410 or better)	
Disc/ ball/ Wedge	All	Water, air & oil	Stainless steel (ASTM A 351 Gr. CF8 or better)	
Gland seal/ seat	All	Air and oil	PTFE	
Seat/ body lining	DN 200 and Above	Water	PTFE	
	Below DN 200	Water	PTFE/ EPDM(Peroxide cured)	

Unless otherwise specified in Particular Technical Specification, valve type used in water, oil and air application shall be as per below:

1) Water application

- i) All the valves connected to penstock (such as penstock / spiral case drain valve or any valve for cooling water or fire fighting system tapping) shall be heavy duty forged gate type. The same shall be capable of open under 100% unbalance condition.
- ii) Penstock drain valve, fire fighting system tapping and other tapings from penstock shall also have guard valves.
- iii) All valves connected to tail race and draft tube shall be heavy duty gate valves.
- iv) All valves for flow regulation shall preferably be heavy duty globe type.
- v) All valves which are to be frequently opened and closed shall be heavy duty gate valves.
- vi) All valves used in ejector system, fire fighting system shall necessarily be heavy duty gate valves.
- vii) Generally, all valves upto DN80 shall be heavy duty gate valves (except in flow regulation).

2) Oil application



- i) Generally, all valves shall be heavy duty ball/ gate/ needle/ globe type made of stainless steel.
 - ii) All valves for flow regulation shall preferably be heavy duty globe type.
- 3) Air application
- i) All valves shall be heavy duty ball type made of stainless steel.
- Use of butterfly valves shall be avoided and if need be, the same should only be used in water outlet circuit, where pressure is less. All butterfly valves shall preferably be Resilient Seated and no part of valve body or stem shall expose to media. Heavy duty gear operator units with hand wheel shall be provided for butterfly valves size DN200 and above. Butterfly valves shall comprise of following :
- a) Heavy duty non corrosive bronze/ acetal copolymer bushing.
 - b) Heavy duty sealing with self adjusting double U- cup seal for positive sealing in both directions.
 - c) Machined and hand polished disc edges.
 - d) Valve body lining shall preferably be integrally moulded and bonded.

All pressure reduction valves; safety valves and similar components shall be workshop-tested and provided with a work certificate 2.3 to DIN 50049.

5.7.3 Piping and Fittings

All required piping shall be furnished complete with flanges, joints, expansion joints, gaskets, packing, valves, drains, vents, pipe suspensions, supports, etc.

Metric flanges shall be used throughout. Welded flanges shall be weld-neck or slip-on flanges. The raised face shall be machined. Joints between stainless and normal steel flanges shall be of the insulated type.

If the piping crosses over joints of civil structures of different settlement, the piping shall be provided with flexible joints to allow for vertical, horizontal, and angular deviations.

Piping installation shall be sloped to prevent trapping of air bubbles. Where required suitable venting system shall be provided.

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 with vapour proof cover.

Piping shall be of heavy duty class carbon steel confirming to ASTM A53/ ASTM A106 or equivalent IS as per Employers approval confirming to the requirement. Pipe sizes < 100 mm and all sizes of oil pressure pipes shall be seamless type. The minimum pipe wall thickness shall be the normal or standard wall thickness as stated in the applicable standards.



Bends and flanges shall preferably be of the forged type below DN 200. Mitered/Fabricated bends and flanges shall be allowed for larger sizes.

All piping shall be acid-treated to guarantee clean surfaces, completely free from welding residues. This treatment shall be applied to workshop and site manufactured piping. The entire piping arrangement shall be subjected to the pressure test in section at the site.

Oil pipes shall generally not be embedded in concrete. Oil pipes crossing civil structures shall be routed through sleeves embedded in the concrete. All oil piping shall be hydrostatically tested at a pressure 100 % greater than the maximum working pressure. As far as possible, oil pipes shall be prefabricated in the Contractor's workshop. They shall be welded except at terminal points and as necessary for erection and future dismantling.

5.7.4 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.

Supports and hangers shall be designed and arranged so that any pipe can be withdrawn without disturbing the others.

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

The Contractor shall supply drawings showing the location of each major anchor and support and the weight to be carried by that support.

5.7.5 Heat Exchangers

Specification of the material of the heat exchanger shall be:

Item Description	Tubular type	Plate Type
Material for Cooling tube / plate	Cupro-nickel (90:10)	Stainless Steel (316L or better)
Thickness of cooling tube / plate	Generating unit : 1.0mm or more Other : 0.5mm or more	0.6mm or more
Frame / body	Mild/cast steel	Mild/cast steel

5.8 Mechanical Instruments

All mechanical parts of instruments shall be suitably protected against shocks and vibrations, heat, humidity and splash water, etc.



Pressures 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 in-Charge.

5.9 Pumps

Materials of the Impeller, Shaft and Sleeves of the pumps shall be stainless steel. The pump casing for horizontal centrifugal and submersible pumps shall be cast steel and ductile/ improved cast iron respectively.

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. Leakage water shall be directed to suitable drainage facilities.

Each pump shall be fitted with:

- i) Check valve at the discharge side
- ii) Air and drain valve
- iii) Pressure gauge & pressure / flow switch.

The size of the pump motor shall be at least 10 % higher than the maximum power required by the pump at any operation point

For non-submersible type, pumps and motors shall be mounted on common frames, while in case of submersible type, the same shall be contained in the common casing and designed as a package unit with incorporated suction strainer and check-valve.

The motors of submersible pumps operating in potable water shall not be filled with oil or other media detrimental to potable water.



6 ELECTRICAL WORKS

6.1 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-fulfil 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 (infeeds, 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 back-up protection device.

All Works shall be suitable for the prevailing climatic conditions.

Outdoor installations needing protections shall be protected against solar radiation by means of adequate covers, where required.

The Contractor shall ensure that all the supplied Works is insensitive to any signals emitted by wireless communication equipment.

6.2 Standards

The design, manufacture and testing of all Works and installations shall strictly comply with the latest edition of the relevant IEC publications.

6.3 Colour Code

In general, the colour code for electrical Works shall be as described in the Particular Technical Specifications.

The manufacturer's painting systems shall be used to the maximum possible extent, but shall by all means be subject to the approval of the



Engineer in-Charge. Final coats of paint shall be matching adjacent installations, where required.

6.4 Electric Motors

6.4.1 General

All motors shall be of approved manufacture and shall comply with the requirements of this Chapter. Motors of the same type and size shall be fully interchangeable and shall comply - as far as applicable - to IEC 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.

6.4.2 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:

A) Motors up to 100 kW

1	Service voltage	3-phase a.c. 415/240 V, 50 HZ
2	Mode of starting	direct-on-line up to 50 kW above 50 kW with suitable starters

B) Motors up to 0.75 kW

1	Service voltage	single-phase a.c. 240 V, 50 HZ
2	Mode of starting	Condenser

C) Motors intended to work on the D.C. System

1	Service voltage	220 V D.C.
2	Mode of starting	Resistor

6.4.3 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:

Sl. No.	Power Demand of Driven Machine	Service Factor
1	Up to 5 kW	1.2
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.

6.4.4 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 busbar 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 busbars, 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: -

- i) 5 times of rated current for L.V. motors rated 100 kW or above
- ii) 2 times of rated current for D.C. motors (by means of starting resistors)

Generally, all motors shall be able to withstand three 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 twenty 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.

6.4.5 Windings and 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.



The stator winding shall be suitably braced to withstand the forces due to direct-on-line starting and transfer conditions as mentioned before. The winding envelopment and tails shall be non-hygroscopic. The stator winding shall withstand the maximum fault current for the period determined by the associated protective devices.

The rotor winding (if applicable) shall be designed to give trouble-free continuous service including repeated direct-on-line starting. The rotor shall be subjected to a 120% over speed test for 2 minutes without showing any winding dislocation.

6.4.6 Ventilation and Type of Enclosure

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. 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.

Where motors are installed outdoors, a weatherproof design shall be chosen. L.V. motors of IEC size 132 and above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods. Such A.C. heater shall be suitably fixed inside the motor casing; the leads shall be led to a separate L.V. terminal box.

Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields.

Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

6.4.7 Brushgear and Commutators

Brushgear for D.C. motors shall be designed to ensure constant brush pressure. Carbon brushes shall be provided which stand at least 6 months of operation without replacement. Each brush shall be independently adjustable but should not require adjustment throughout its life. A design of brushgear which permits the brush holder to touch the commutator as the brushes wear or which passes current through the pressure fingers will not be accepted.

A sufficient number of brushes, not less than two per pole, shall be fitted to ensure that vibrations do not affect the commutation.

The minimum safe wearing margin of commutators shall not be less than 20 (twenty) per cent of the total thickness of the commutator bars and the minimum safe diameter shall be clearly marked on it.

6.4.8 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.

Terminal boxes shall be totally enclosed and designed to prevent the ingress of moisture and dust. All joints shall be flanged with gaskets of neoprene or similar material. For motors above 1 kW, the terminal box shall be sealed from the internal air circuit of the motor.

Depending on the size, the terminal box of L.V. motors shall be fitted either with an approved cable sealing-end or with a gland plate drilled as required and provided with suitable fittings for cable fixing and sealing. Such openings shall be temporarily plugged or sealed during transportation.

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.

The cable termination philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field-mounted group. JB'S at strategic locations (where large concentration of signals are available, e.g. switchgear) is done. Termination / Junction boxes shall have either maxi- terminal or cage clamp type terminals

6.4.9 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.

A) Workshop Tests:

- i) Measurement of winding resistances
- ii) No-load and short-circuit measurements
- iii) Measurement of starting current and torque
- iv) Efficiency measurement (type test)
- v) Heat test run
- vi) Dielectric test
- vii) Measurement of insulating resistance
- viii) Over speed test

**B) Site Tests:**

- i) Measurement of insulation resistance
- ii) Measurement of motor vibrations
- iii) Measurement of starting time.

6.5 Cubicles and Panels

All control cubicles/panels, switch gear panels and other cubicle/panel enclosures shall be UL/Lloyds register of shipping/VDE approved and would be of cold rolled sheet steel. Cubicles/panels shall have full modularity along X-Y-Z axis made out of folded profile based structure with reference to the requirement of combinability of the panels which shall be finalized during detailed design with respect to the layout. Such structure shall be made by a sheet of not less than 1.5 mm. However, doors can be extracted through a sheet of 2mm which could be of rigid construction and the sides where no instruments/MCB/relay is to be installed can be provided with a cover sheet of not less than 1.5mm which shall be approved during detailed design based upon the construction of panel. Further top and bottom of the panels should not be less than 2mm. The structural frame shall have provision at a regular interval to facilitate retrofitting components without need of drilling holes.

In case of junction boxes, small starter panels and muslin kiosks shall be made out from a single sheet of thickness not less than 2mm which should have minimum weld interface except weld seal at the enclosing envelope. Door specification however, remain the same as of cubicles/panels having specific PU seal with reference to the IP class mentioned in the specification either under GTS or PTS.

Cubicles shall be fitted with close fitting, hinged, lift-off doors capable of being opened through minimum 120 deg. The doors shall be provided with door handles with integral lock and master key. The doors shall have PU seal for perfect sealing and longer life.

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. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer in-Charge. Mounting of protection relays directly on front door of the relay panel shall not be acceptable.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. 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 x 5mm or higher (as per requirement) 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 120mm².

The standard phase arrangement when facing the front of the motor control centres and switchboard shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipment involving 3 phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require cutting away of adjacent framework.

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 in-Charge. The interior of all cubicles and panels shall have a matt white finish preferably.

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.

6.5.1 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 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 in-Charge. 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.

6.5.2 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 157/1 or equivalent standards.

6.5.3 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.

6.5.4 Pilot devices

Pilot devices such as selector switches, push-button starters and thermostats shall be of heavy duty type and, where mounted outdoors, shall be housed in weather proof enclosures specially designed for the environment.

All electrical contacts for control, alarm and shutdown shall have a thermal current rating of not less than 10 A at 220 V DC.

6.5.5 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 be disconnecting link type for CT, PT and incoming supplies AC/DC & for balance fixed link type conforming to the applicable standards. The smallest size to be used shall be designated for 2.5-sq. mm 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.

6.5.6 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.

Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly trunked inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipment.

Multiconductor 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, utilising slip-on ferrules approved by the Engineer in-Charge.

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.

Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only.

6.5.7 Alarm contacts

Where applicable, all alarm contacts shall be of galvanically isolated type and provide inputs to the following devices.

- i) Local annunciator
- ii) Station annunciator
- iii) Supervisory control and sequence of events / fault recorder system.



All alarm contacts shall be changeover type. Where required, relays shall be provided as contact multiplier.

6.6 Cables

The General Cable Specification shall include the calculation of the derating factors for the individual modes of installation at applicable ambient temperatures and grouping of cables, and furthermore, for each cross section:

- i) The rated current carrying capacity
- ii) The max. Short-circuit capacity
- iii) The voltage drop
- iv) Type, insulation serving, armouring and sheathing of cable
- v) Type, description and catalogue/pamphlet of cable termination.

Separate specification(s) shall be prepared for cable trays, conduits, supporting structures and other accessories.

6.7 Labels and Plates

6.7.1 General

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 in-Charge for approval.

Where applicable, designations in the selected local language shall appear above or to the right of the designation in the Contract language. The translations into and writings in the local language shall be submitted for approval.

6.7.2 Equipment Labels and Instruction Plates

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. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in engineering documents.

Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified by its Works identification number. 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 / stainless steel with black engraved inscriptions, arranged at the top section of the units.



TEESTA H.E.PROJECT, STAGE-VI

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.

6.7.3 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.

Details are stated in the Particular Technical Specifications or will be fixed at a later date.

6.7.4 Labels for Conduits, etc.

The material shall be non-corrosive and the description be done with 4 mm high letters/figures.

6.7.5 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 in-Charge, non-corrosive 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.

6.7.6 Rating Plates

Works (hoists, machines, transformers, etc.) rating plates and other technical data/informative plates shall either be of the enamelled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

6.7.7 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).



6.8 Key System for Electric Boards

Key interlocked switches shall be provided with 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. A key cabinet at the end of each board (distribution board, MCC, control cubicles, etc.) shall be provided for storing the keys of that board. All keys shall have six master keys to open any lock or padlock supplied. Each key shall have one identification label fixed above the key-hanging hook inside the cabinet.

The cabinet door keys shall be similar and shall be six (6) in number.



7 INSTRUMENTATION AND CONTROL EQUIPMENT

7.1 General

All instrumentation and control equipment shall be of internationally reputed make having proven performance and acceptability in the field.

7.2 Design Criteria

7.2.1 General

Chapter 6, "Electrical Works", shall be considered for I & C equipment as far as applicable. Special reference is made to cabling, wiring and labelling.

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 Sub-Contractor'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 is 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 in-Charge. All measurements and alarms shall be listed in a measuring list of a standard form subject to Approval by the Engineer in-Charge. 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.

7.3 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.

All local indicating instruments and test connections shall be included in the respective Works as integrated parts. The scope of local indicating instruments and test connections shall enable the operator to properly survey the Works, and shall also allow to adequately carrying out all acceptance and other tests.

The binary sensors shall be fused separately and supplied with 24 V D.C.

7.3.1 Temperature Measurements

All wells for capillary type thermometers, resistance temperature sensors and thermocouples shall be of the weld-in type. Wells for thermometers and temperature sensors of the screw-in type shall be restricted to measuring points for lubrication oil, and to such measuring points where welding is not suitable, e.g., at cast-iron parts. Shop-welded thermometer wells shall be covered by screw caps for protection during transportation and erection.

Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. Thermometer arrangements shall be such that the connection heads do not become warmer than 80 °C, and the measuring inserts are easily exchangeable.

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. Double resistance thermometers (with two resistors in one insert) should be avoided.

The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring. In all other cases, thermocouples or resistance thermometers and electric contact modules (monitors) shall be used. Glass thermometers or similar will not be accepted as contact thermometers.

7.3.2 Pressure Measurements

- 1) Pressure gauges shall be shock and vibration-proof (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.
- 2) Higher than rated pressure shall not deteriorate the pressure gauge or affect its calibration. The pressure gauges shall be equipped with a radial-connecting stud, to allow the mounting on a gauge holder.



- 3) The accuracy for the pressure gauges and pressure switches shall not be less than $\pm 0.5\%$ FSR. The error for pressure transmitters shall be limited to $\pm 0.5\%$.
- 4) Pressure gauges and transmitters for inflammable liquids shall have filled systems and the filling liquid shall be separated from the inflammable liquid by means of adequate isolating membranes.
- 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 1.5 mm so that such device can be removed without any disturbance of the plant operation.
- 6) Pressure gauges and transmitters for pressures of 10 bar and above shall not be directly mounted on the pressure tapping point. They shall be mounted apart from the tapping point on gauge holders or gauge boards. Whenever possible, pressure gauges and transmitters shall be group wise combined on racks or consoles.
- 7) Pressure gauges for high pressures shall be equipped with a relieve valve for safety reasons in case of leaks (with a rubber reverse flow check).
- 8) In case of flowing substances, the measuring point shall be selected in locations of undisturbed flow.
- 9) If the pressure is pulsating, the devices concerned shall be connected via flexible tubes or other pulse-absorbing means.
- 10) In general, all pressure gauges, transmitters and pressure contacts shall easily be accessible for maintenance and supervision.
- 11) The scales shall have preferably a diameter of 150 mm with black letters and figures on a white ground. The calibration shall be in "bar".
- 12) The adjustment of the pointer shall be possible by means of an adjustment device without removing the pointer from its axle.
- 13) The high and low-pressure connections of differential pressure gauges shall be marked accordingly.
- 14) All casings shall be dust and watertight made of stainless steel having preferably IP 67 protection class and be provided with toughened glass.

7.3.3 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 1.5 accuracy class for connection to the secondary side of instrument transformers. D.C. measuring instruments shall have digital type systems of the same accuracy. Watt meters/energy meters shall have electro-dynamic measuring mechanisms if fed by transmitters. Watt meters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2 % accuracy class or better.



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.

All voltage circuits to instruments shall be protected by MCB's in the unearthed phases of the circuit, installed as close as practicable to the instrument transformer terminals, or, where instruments are direct-connected, as close as practicable to the main connection. All power factor indicators shall have the star point of their current coils brought out to a separate terminal which shall be connected to the star point of the current transformer secondary windings.

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.

All instruments shall be of the flush mounting type and shall be fitted with non-reflecting glass and shall comply in every respect with the requirements of IEC Publication 51.

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.

Instrument scales shall be submitted for approval by the Engineer in-Charge. All instruments mounted on the same panel shall be of same style and appearance.

Transmitter connected ammeters (for example those in mosaic-type control desks) shall have 90 degrees or 240 degrees circular scales calibrated 0-120 %. The rated motor current shall correspond to 100% scale indication.

All metering circuits shall be terminated in marked terminal blocks for remote metering purposes.

7.3.4 Position Measurements

- 1) Position transmitters of the potentiometer type will not be accepted. Inductive or capacitive type shall be provided.
- 2) Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and aux. supply



voltage (if required) 220 or 48 V D.C. The "potentiometer-type" position measuring principle is not permitted.

7.3.5 Limit Switches

Limit switches shall be provided for each electrically operated gate, valve or gantry to automatically stop the motor at both ends of travel. Additional switches shall be provided where necessary for control, interlocks and indication.

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. Where switches operate through linkages, precautions shall be taken to eliminate variations of settings and incorrect operations resulting from wear or tolerances.

7.3.6 Contact Devices

Contacts of level switches, pressure switches, temperature switches, limit switches, and of all other devices shall be of the snapaction 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.

7.4 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 mal-operation.

7.5 Transmitter Racks and Piping

Wherever practicable, transmitters for flow, pressure, etc., shall be installed in readily accessible positions in the proximity of the measuring point, free from vibration and protected against damage, moisture, dust, corrosive air, and great temperature changes.



The transmitters shall be grouped and assembled as far as practicable on local transmitter racks or in cubicles with glass or plexi-front.

The connecting lines between the primary elements and the transmitters shall be installed to falls in order to ensure that no air pockets or water locks are created.



8 TRANSPORT AND INSTALLATION

8.1 General

Shipping, loading, transportation, unloading, storage, erection and test running shall be performed by the Contractor.

From the time of manufacturing until commissioning all parts of the plant shall be protected and insured at the Contractor's expense against damage of any kind. Parts, which are damaged during transport, storage, erection or trial operation, shall be replaced at the Contractor's expense.

The Contractor shall provide the Engineer in-Charge with complete packing lists of each performed shipment.

8.2 Packing

The contractor shall prepare all plant, devices & materials for shipment to protect them from damage in transit & shall be responsible for make good all damages due to improper preparations, loading or shipment.

After the workshop assembly & prior to dismantling for shipment to the site, all items shall be carefully marked to facilitate site erection. Wherever applicable, these markings shall be punched or painted so they are clearly visible.

Dismantling shall be done into convenient sections, so that the weights & sizes are suitable for transport to site & for handling on the site under the special conditions of the project.

All individual pieces shall be marked with the correct designation shown on the Contractor's detailed drawings and other documents (packing lists, spare part lists, in Operating and Maintenance Instructions, etc.).

Marking shall be done preferably by punching the marks into the metal before painting, galvanising, etc., and shall be clearly legible after painting, galvanising etc. In labelling, the Contractor shall endeavour to use as few designations as possible and each part of identical size and detail shall have the same designation, regardless of its final position in the plant.

All parts shall be suitably protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc.

All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in biodegradable packing material. Where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.

The material used for shipment of material frame at manufacturer's works withstanding the above shall be preferably environment friendly. Biodegradable packing shall be used to the extent possible.

The Engineer in-Charge reserves the right to inspect & approve the packing before the items are dispatched but the contractor shall be



entirely responsible for ensuring that the packing is suitable for transit & such inspection will not exonerate the contractor from any loss or damage due to faulty packing.

8.3 Marking

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked with following information on at least two sides:

- i) Consignee
- ii) Contract No.
- iii) Country of Origin
- iv) Port of entry
- v) Item number (if applicable)
- vi) Package number, in sequence and quantity per package
- vii) Description of Works
- viii) Net and gross weight, volume

8.4 Transport and Storage

The Contractor shall inform himself fully as to all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Contractor shall also be responsible for obtaining from the Indian railway or highway authorities any permit that may be required for the transport of loads exceeding the normal gauges.

The Contractor shall provide means for all unloading and reloading for all consignments of plant; both during transport to Site and on the Site. Consignments shall be unloaded immediately on arrival at Site. The Contractor is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc.

All parts of the plant shall be brought, as far as possible, to their final place of erection. The Contractor shall construct their own storage facilities at site.

The warehouses shall be weatherproof, with good ventilation and solid floors. The floors of the warehouses and storage areas shall be designed to carry the loads imposed on them by the stored parts. The following parts shall be stored inside enclosed warehouses:

Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, electric motors, instruments, welding material and equipment, all small parts and all parts of the plant which already have been finally painted.

If large parts are stored in the open air, they shall be provided with weather resistant and fire-resistant covers. Electrical parts, which are not packed suitably and those so packed, but whose packing has been



damaged shall be kept in suitable places from the moment of storage to the moment of installation.

All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity.

All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers. Dehumidifiers shall be installed in store/enclosed area as per direction of Engineer-in-charge.

8.5 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.

The result of this check shall be reported to the Engineer in-Charge in due time to allow any errors to be corrected before the commencement of erection. All parts of the plant shall be cleaned carefully of all contamination such as dust, sand, rust, mill scale and other dirt prior to installation.

8.6 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, profiled templates and centre lines and shall establish all such permanent markings and recovery marks as may be required by the Engineer in-Charge for checking the Contractor's setting-out. The Contractor shall be responsible for rectifying, at his own cost, all work rejected by the Engineer in-Charge due to errors in setting-out.

All bench marks, notch marks, pegs and signals on the surface, alignment pins and the like put in by the Engineer in-Charge for the purpose of checking the Contractor's work or as permanent survey marks will be under the care of the Contractor during the period of the Contract. He shall, at his own expense, take all proper and reasonable care and precautions to preserve and maintain them in their true position where such marks are within or adjacent to his work area. In the event of their being disturbed or obliterated by any cause whatsoever, they may, if so determined by the Employer, be replaced by the Engineer in-Charge at the Contractor's expense.

The Contractor shall be responsible for the true and proper staking-out of the works and levels of reference given by the Engineer in-Charge 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 in-Charge or the Engineer in-Charge's Representative shall not in any way relieve the Contractor of his responsibility for its correctness.

8.7 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 erection staging and scaffolding shall be provided with coverings and barriers and shall guarantee safe working conditions.

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 in-Charge. 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 plant or parts to be installed shall not be overstressed during the process of installation.

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 in-Charge. 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 in-Charge 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 in-Charge.

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.

Welding, torch-cutting and drilling work on the plant to be erected shall only be carried out with the approval of the Engineer in-Charge only for modification if any.

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 be operated pneumatically. They are to be handed over at the end of the installation work in good condition in accordance with the Engineer in-Charge'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 in-Charge he shall remove waste from the place of installation to the defined deposit site at his own cost.

8.8 Civil Site Work

The following works shall be carried out as part of the civil works contract and is not included within the scope of work covered by the equipment specifications.

- i) All concrete work, including reinforcement and form-work, and all grouting required for filling in, around and under the various parts of the works to be embedded in concrete.
- ii) All necessary excavation and backfilling / concreting required for installing the plant in its final position, unless otherwise stated in the Particular Technical Specifications.
- iii) Building in of all required parts into the first stage concrete. The readiness of such parts shall be communicated to the Engineer in-Charge and they shall be delivered in due time by the Contractor unless otherwise specified or agreed in the Contract.
- iv) Providing and grouting the blackouts for all anchoring and foundation bolts needed to support and fix the plant in its final position.



- v) All protective measures, e.g., pumping, etc., to keep the various parts of the plant and the erection site free from water during the time of erection.
- vi) Provision of cable and pipe ducts, trenches, block-outs, drilling for grounding system etc., in accordance with the drawings supplied by the Contractor and supervised by the Contractor.
- vii) Adequate safety covers and protective measures against injury or damage to the Contractor's employees and equipment and to the works due to any operations of the civil contractor.
- viii) Embedded plates and hooks in different floors, ceiling, walls etc.

The Contractor shall level and adjust all parts of the equipment on the foundations and after each item is set up and the Engineer in-Charge's approval obtained, grouting or concreting will be carried out by other contractors and verified by the Contractor. The Contractor shall be responsible for ensuring that such work is carried out to his satisfaction and that level and adjustments made by him are not disturbed by the grouting operation. The Contractor shall be responsible for ensuring that the positions, levels and dimensions of the Works are correct according to the drawings notwithstanding that he may have been assisted by the Engineer in-Charge in setting out the said position, levels and dimensions

**Volume IIIA****ANNEX-1****PAINTING SYSTEM**



PAINTING SYSTEM

Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
A	Un-machined internal surfaces of indoor ferrous parts in water contact such as draft tube cone, bottom ring, discharge ring, spiral case, head cover, main inlet valves including other wetted internal ferrous surfaces of turbine.	Sa 2 1/2 - 3	Prime Coat: 1 x zinc dust primer, 2-component Base: epoxy resin	1 x 50	
			Intermediate Coat: 1 x coal tar epoxy, 2-components	1 x 125	The colours of intermediate and finish coats shall be black - brown - black
			Finish Coat : 1 x coal tar epoxy, 2-components	1 x 125	
			Total	300	



PAINTING SYSTEM

Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
B	External surfaces of Cranes, Lifting Beams, Fixed Hoist, and other similar Drive Supports	Sa 2 1/2 - 3	Prime Coat: 1 x zinc dust primer, 2-component Base: epoxy resin	1 x 50	The pure metallic zinc shall be at least 92% of the polymerized film
			Intermediate Coat: 2 x micaceous iron oxide paint, 2-component Base : epoxy resin	2 x 80	This paint system is for temperatures up to 60°C
			Finish Coat : 1 x micaceous iron oxide paint, coloured, 2-component Base : epoxy resin	1 x 80	
			Total	290	



PAINTING SYSTEM

Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
C	Un-machined external surfaces of indoor ferrous parts which are directly exposed to air such as draft tube cone, bottom ring, discharge ring, head cover, bearing supports & housing, pit liner, regulating ring, servomotors, accumulator, main inlet valves, connection pipes, oil/ air tanks, lower & upper bracket, stator frame, including other similar items.	Sa 2 1/2 - 3	Prime coat : 1 x zinc dust primer, 2-component Base: epoxy resin	1 x 50	The pure metallic zinc shall be at least 92% of the polymerized film
			Intermediate Coat: 2 x micaceous iron oxide paint, 2-component Base : epoxy resin	2 x 75	This paint system is for temperatures up to 120°C
			Finish Coat : 1 x topcoat, 2-component Base : epoxy resin	1 x 50	
			Total	250	



PAINTING SYSTEM

Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
D	Control panels / cubicles, switch gear panels and other panels / cubicles except marshalling kiosks etc.	Sa 2 1/2 - 3 and de-grease before painting or any other equivalent process.	Prime coat : All enclosures, frames, bottom cover etc., should be dip coat primed or zinc plated and passivated for corrosion resistance or equivalent.	20-25	Finally to be approved at design stage
			Finish Coat; Texture powder coating or equivalent as per approved colour code on interior and exterior surface	> 70	Finally to be approved at design stage
			Total	> 95	



PAINTING SYSTEM

Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
E	Interior surfaces of oil and air tanks such as bearing oil tank, accumulator, sump tank, air tank and other similar items	Sa 2 1/2 – 3	Prime coat : 1 x epoxy iron oxide or equivalent Finish Coat : 1 x polyurethane or equivalent	*	* To be decided during detailed engineering

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

SUB-SECTION IA
CUSTOMER'S SPECIFICATION
(PARTICULAR TECHNICAL SPECIFICATION (PTS))



VOLUME-III B

PARTICULAR TECHNICAL SPECIFICATIONS (PTS)



TEESTA H.E.PROJECT, STAGE-VI

1 GENERAL TECHNICAL REQUIREMENTS

1.1 Introduction

Particular Technical Specifications (PTS) elaborated in various sections specify the detailed technical requirements for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, site storage and preservation, installation, commissioning, performance testing, acceptance testing, training of Employer's personnel, handing over to employer and guarantee for two years of the Electrical & Mechanical works covered under this contract. The quality assurance and testing requirements for each section are specified separately in "Quality assurance and Testing Specifications (QTS)".

This section provides the general technical requirements applicable to all sections hereafter specifying the detailed technical specifications for respective equipment/ system forming E&M installation of the project.

1.1.1 Clustering of E&M Works

The complete Electro-Mechanical works have been clustered into eight Packages described as below:

A) Package-EM-I

~~The Package-EM-I shall comprise of complete works as detailed in respective sections of the specification as per following:~~

- ~~• Design, supply of only the balance/damaged items of main TG items (7 sub packages) already supplied by GE i.e. Turbine, Generator, MIV, Governing System, Excitation System, Control & Monitoring System, Protection System and erection, testing and commissioning of these 7 sub packages.~~
- ~~• Design, supply, erection, testing & commissioning of all Power and Control Cables including Cable Trays etc.~~
- ~~• Design, supply, erection, testing and commissioning of Cooling water system.~~
- ~~• Preparation of all layout, interfacing and erection drawings of complete E&M Packages (EM-I to VI & VIII) in coordination with other Contractors.~~
- ~~• Overall commissioning of complete E&M Packages (EM-I to VI & VIII).~~

B) Package-EM-II

The Package-EM-II shall comprise of complete works as detailed in respective sections of the specification as per following:

- ~~• Design, supply, erection, testing and commissioning of Generator transformer, GIS, XLPE Cables, Pothead Yard Equipment, 220 V DC System, PLCC, 415 Voltage AC system, including UAT and SST, 11 KV System and Earthing of Pothead Yard, GIS Cavern, MIV Cavern and balance earth mat in Power House.~~
- Design, supply, erection, testing and commissioning of GIS EOT Crane and MIV cavern EOT Crane.



TEESTA H.E.PROJECT, STAGE-VI

- ~~Design, supply, erection, testing and commissioning of Bus duct.~~
- ~~Design, supply, testing and commissioning of Transformer Oil Filtration Plant.~~

C) ~~Package-EM-III~~

~~The Package-EM-III shall comprise of complete works of design, supply, erection, testing and commissioning of Fire Fighting System as detailed in the specification of respective packages.~~

D) ~~Package-EM-IV~~

~~The Package-EM-IV shall comprise of complete works of design, supply, erection, testing and commissioning of DG system as detailed in the specification of respective packages.~~

E) ~~Package-EM-V~~

~~The Package-EM-V shall comprise of complete works of design, supply, erection, testing and commissioning of HVAC system as detailed in the specification of respective packages.~~

F) ~~Package-EM-VI~~

~~The Package-EM-VI shall comprise of complete works of design, supply, erection, testing and commissioning of Illumination system as detailed in the specification of respective packages.~~

G) ~~Package-EM-VII~~

~~The Package-EM-VII shall comprise of complete works of design, supply, erection, testing and commissioning of Transmission system as detailed in the specification of respective packages.~~

H) ~~Package-EM-VIII~~

~~The Package-EM-VIII shall comprise of complete works of design, supply, erection, testing and commissioning of mechanical BOPs like Drainage & Dewatering System and Compressed Air System as detailed in the specification of respective packages.~~

1.1.2 Completeness of system / equipment / item

The work to be carried out as per the scope defined in respective sections shall be all in accordance with the requirements, conditions, appendices etc. given in Technical Specifications (GTS, PTS, TDS, QTS and Contract Drawings) together with those stated in General Conditions of Contract (GCC) and Special Condition of Contract (SCC).

It is not the intent to specify herein all aspects of design and construction; nevertheless, the equipment and installation/works shall conform in all aspects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Employer, who will interpret the meaning of the specification and drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable Indian / International standards mentioned elsewhere in this specification.



TEESTA H.E.PROJECT, STAGE-VI

Any such system/equipment/items, which are not explicitly mentioned in specification but are functionally necessary/advisable as per best national/international practices for smooth operation of powerhouse, shall be deemed to be included in the scope of work and the Contractor shall provide the same without any extra cost to employer.

1.1.3 Priority of documents

The documents forming the Technical Specifications are to be taken as mutually explanatory of one another. If there is an ambiguity or discrepancy in the documents, the Employer shall issue necessary clarification or instruction to the Contractor and the priority of the documents shall be as follows:

- i) Particular Technical Specification,
- ii) Guaranteed Technical Particulars in Technical Data Sheets,
- iii) General Technical Specification,

In case of dispute in interpretation, Employer's interpretation shall be final and binding.

1.1.4 Co-ordination and Interfacing

1.1.4.1 With sub-contractors/ manufacturers /vendors

The Contractor shall ensure the functional and physical compatibility of supply at each physical interface among various sub-contractors/ manufacturers/vendors in order to ensure efficient, reliable and safe operation of the whole system/scheme.

The limits of the supply and the definition of interface indicated by any sub-contractor shall in no way release the Contractor from his obligation to fulfil the scope defined in specifications.

The Contractor shall ensure co-ordination among various sub-contractors, to verify the continuity and the coherence between their scopes and shall be accountable to the Employer for fulfilment of the scope defined in the specifications. The Contractor shall also resolve all interfacing requirements among various sub-contractors for execution of the work as per scope of contract.

Grounding system

The scope of earthing system shall be as per detailed specification of respective section of EM-II contract. The mobilization/ commencement for grounding system works along with partial supply needs to be taken up within two months from LOA.

1.1.4.2 With other E&M Contractors

It will be obligatory for the Contractor of this package to extend full co-operation in regard to providing interfacing inputs/ data/ details/ drawings etc in proper format within the requisite time frame as desired by the Contractor(s) of Packages - EM-I, EM-III, EM-IV, EM-V, EM-VI, EM-VII and EM-VIII.



TEESTA H.E.PROJECT, STAGE-VI

Any delay in engineering/ execution progress on account of non-availability of inputs pertaining to works under this package shall fall under the responsibility of Contractor of this package. In case of any dispute, the decision of the Employer shall be the final which shall be binding to all the Contractor(s).

The Contractor of this Package shall be fully responsible for following interfacing/ co-ordination works in addition to the normal works as stipulated under this Contract:

A) Layout Engineering

Layout engineering, as per applicability particularly related to works covered under this Contract shall be the responsibility of Contractor of this package. Further, for overall layout engineering and interfacing issues contractor of this package needs to coordinate with EM-I Contractor.

B) Functional & Physical compatibility

The Contractor shall ensure the functional & physical compatibility of all the E&M equipment under their scope in order to maintain efficient, reliable and safe operation of entire plant as a whole.

Additional contacts for multiplication along with auxiliary relays & potential free contacts as decided during detailed engineering, (in order to meet the functional compatibility with entire system), shall be made available in marshalling kiosk/ common marshalling kiosk without any extra cost to the Employer.

C) Grounding system

The earthmat along with risers shall be provided under EM-II contract for equipment earthing. Connection of equipment (for all packages EM-I to EM-VIII, except outdoor street light poles and transmission towers) for body earthing, neutral earthing as well as earthing bus in panels to the nearest available risers shall deemed to be included in the scope of EM-II contract. Necessary coordination with other Contractor(s) for connection of equipment/ system earthing.

D) Cables & Cabling Works

All cables and cabling works including covered perforated cable trays from individual equipment supplied under this contract to their respective individual marshalling kiosks as well as any other panel / equipment supplied under this package is deemed to be included in the scope of this Contract. Further cabling from marshalling kiosk / Local control cubicle to various LCBs / UCBs / Plant SCADA shall be the responsibility of EM-I Contractor.

E) Cable schedule

Preparation of cable schedule for interconnection of their respective equipment to marshalling kiosk or any other panel / equipment supplied under this package is deemed to be included in the scope of this Contract.

Further it would be mandatory that all necessary detail/ inputs of the contract of this package shall be provided to EM-I Contractor for preparation of overall cable schedule.

F) Commissioning



TEESTA H.E. PROJECT, STAGE-VI

Testing & commissioning of all equipment supplied under this contract is included in the scope of this contract.

Before charging of the equipment, Contractor shall satisfy itself about the adequacy of protection scheme of UCBs / plant SCADA system provided by Contractor of Package-EM-I in close co-ordination. A protocol shall be signed by Contractor to give "go ahead" for energising of system(s) as per the overall commissioning plan of the power house to avoid any complication at a later date. A commissioning team shall be deployed by contractor of this package for coordination with EM-I contractor at the time of overall commissioning of Unit(s).

1.2 Project Arrangement / Layout

1.2.1 Brief description of the project

Teesta H.E. Project Stage - VI is located on the river Teesta in District South Sikkim of Sikkim. The project is about 85 km from nearest rail-head New Jalpaiguri, West Bengal and 95 KM from nearest airport at Bagdogra, West Bengal. The nearest town is Singtam Sikkim and is also 80 Km from Siliguri, West Bengal by road. Barrage site is at near Sirwani, Sikkim, geographically, which is at 27°14'29.98" latitude and 88°28'35.39" longitudes.

It is a run of the river scheme for power generation. The installed capacity of Teesta H.E. Project Stage - VI is 500 MW comprising of four units of 125 MW each driven by vertical Francis turbine operating under net head of 105.4 m.

1.2.2 Main project features

The project shall comprise of following major components:

- i) Four units of 125 MW each at generator terminal at rated condition,
- ii) An underground Power house housing four (4) main inlet valves of butterfly biplane lattice type in MIV cavern, (4) vertical-shaft generating units, each composed of a Francis turbine directly coupled to a synchronous generator and other related auxiliaries in power house cavern,
- iii) A Transformer cavern having 13 nos. 11/220/√3kV single phase generator transformers,
- iv) A 245kV GIS hall in Transformer cavern for installing 245kV GIS,
- v) A 245 kV outdoor pothead yard for evacuation of generated power through 220kV transmission lines.

1.2.3 Salient features

Some of the features of the project are described below:

1	FRL	EL 360.0 m
2	MDDL	EL 354.0 m



TEESTA H.E.PROJECT, STAGE-VI

3	Maximum Tail Water Level	EL 242.4 m
4	Minimum Tail Water Level	EL240.0 m
5	Centre Line of the Turbine	EL 235.0 m
6	Gross storage	
	• At FRL	3.18 MCM
	• At MDDL	1.35 MCM
7	Live storage	1.73 MCM
8	Average Gross Head	115.6 m
9	Rated Net Head	105.4 m
10	Turbine Type	Francis
11	Installed Capacity	500 MW
12	No. and size of Units	4 units of 125 MW each
13	Generation voltage	11 kV
14	Transmission voltage	220 kV
15	Type of Power House	Underground
16	Type of Switchyard	Indoor type GIS
17	GSU Transformer	13 nos. 51 MVA, Single Phase, 50 Hz, 11/ 220/ $\sqrt{3}$ kV OFWF/ ODWF type
18	Method of connection between Transformer and GIS	GIB

1.3 Operating Requirement / Specification

The equipment/system to be supplied under this contract shall be suitable for continuous operation under varying grid parameters as allowed in latest "Indian Electricity Grid Code" and "Indian Electricity Rule". The equipment supplied shall also be compliant with latest Central Electricity Authority-Technical Standards for Construction of Electrical Plants and Electric Line Regulations and latest CERC norms at the time of supply of equipment.

The equipment/system shall be designed to operate continuously without any problem under $\pm 10\%$ voltage variation and $\pm 5\%$ frequency variation. Temperature rise/ variation limit for equipment shall be determined considering the above variation. Frequent start/ stop requirement of all equipment for daily operation shall be taken into consideration while designing.

1.3.1 Auxiliary voltages

The electrical equipment like switchboards, MCCB, Surge Protection Devices, motors, contactors, relays, luminaries, heaters, switches,



TEESTA H.E.PROJECT, STAGE-VI

sockets, Terminal Blocks, Power outlets etc. should be rated for any of the following voltages:

A) AC power

Three-phase system with grounded neutral for feeding three-phase and single-phase equipment (connected between phase and neutral), type TN-C 415/240V $\pm$ 10% and 50Hz $\pm$ 5%. All motors and other electrical apparatus should be designed to work continuously under $\pm$ 5% frequency variation and $\pm$ 10% voltage variation.

B) DC power

- i) 220V $\pm$ (Plus / minus) 10% DC Systems, ungrounded, with earth fault detection for the supply to main control circuits for high and medium voltage switchgear, protection circuits and to other larger essentials loads,
- ii) Other voltage systems eventually needed, shall be generated from the above systems by means of dc/dc converters, inverters etc.

1.4 Performance Guarantee

The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment/ systems covered in these specifications.

The Contractor shall demonstrate all the guarantees covered herein during functional guarantee/ acceptance tests.

1.5 Design and Construction

1.5.1 Design Criteria

The following design criteria shall be considered mutually complementary of one another and shall be applied by the Contractor to all aspects of the equipment and services supplied under this Contract.

1.5.1.1 Maximum allowable stresses

A) General

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 1.5.1.5 "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.

B) Direct or combined steady stresses



TEESTA H.E.PROJECT, STAGE-VI

- 1) 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.
- 2) 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.
- 3) Maximum unit stresses in rotating parts of the generator due to maximum runaway speed shall not exceed three-quarters of the minimum yield point.
- 4) 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 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

- 5) 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.
- 6) 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 Yield stress are allowed in such cases.
- 7) 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.

C) Stresses in standard products

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



TEESTA H.E.PROJECT, STAGE-VI

1.5.1.2 Water characteristics**A) General**

Water of Teesta River carries high sediment load during monsoon,
The characteristics of the water of Teesta River at Barrage site of Teesta VI H.E. Project are as follows:

a) Maximum temperature 25°C

1.5.1.3 Silt erosion consideration

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally during high flood. Even though material specification have been included and it is not the intention to ask guarantee yet it is mentioned that the underwater components are expected to operate under silt concentration upto 5000ppm during high flood.

1.5.1.4 Atmospheric condition

The temperature and humidity in the area of the project are as follows:

Maximum temperature	37°C
Minimum temperature	8°C
Maximum relative humidity	96.4%
Minimum relative humidity	5.8%

However, the data shall be subject to final verification during detailed engineering.

1.5.1.5 Seismic design

The project is situated in a hilly seismic area and falls within Zone IV of the seismic zoning Map of India. The forces being caused by earthquake including hydraulic loads which may occur additionally shall be taken in to account for computations. More over vertical and horizontal acceleration shall be combined in the most unfavourable way. For horizontal and vertical accelerations, a factor of 0.15 g and 0.075 g respectively shall be assumed. Stresses resulting after including these loads shall not exceed permissible stresses.

The Contractor shall design all equipment supplied under this contract to satisfy the seismic criteria. The Contractor shall submit to the Employer the method of calculation and relevant codes he intends to use for this purpose.

In addition to the above, the IS 1893 shall be adopted for seismic design. Hydrodynamic forces due to seismic conditions shall be considered on HM or EM equipment in addition to hydro static loads.



TEESTA H.E.PROJECT, STAGE-VI

1.5.1.6 Transportation limitations

For shipments, the Manufacturer shall pack the items to meet size and weight restrictions of the Indian railways and road systems.

Shipments from Manufacturer's work (in case offshore consignments) shall travel to Port of entry – India, from where these will be transported, after necessary port clearances etc., by the Contractor to nearest rail head for the Project, and further transported to site. However, in certain cases the Contractor may be required to transport the materials from Port of entry to Project site directly by road transport. For onshore consignments, the Contractor shall be responsible in all respects for transportation of all material and equipment up to the project site.

The Contractor shall consult with the concerned authorities in railways and highways to ensure that his packaging will be such as to permit him to transport the plant and equipment within such imposed limits. The Contractor shall arrange to deliver the maximum sized sub-assemblies consistent- with safe and convenient transport.

All materials and equipment etc. arrived at nearest railhead for the Project will be unloaded from rail wagons and reloaded on to road transport for shipment to project site by the Contractor.

All components shall be so designed and constructed as would enable easy assembly of components at works and at the same time permit easy transportation. The weights and sizes of the components/packages shall be within the permissible transport limits for the project site.

1.5.1.7 Equipment and facilities layout

As shown for drawings supplied by the Employer, the Employer has established, his own purposes, a preliminary layout of the facilities.

The Contractor shall verify and submit to the Employer, arrangement and layout, optimised for the actual equipment supplied under this contract, respecting the key dimensions, elevations and concrete outline of the powerhouse that shall remain same as shown in contract drawings and confirm the same in "Technical Data Sheets".

1.5.1.8 Temporary office during construction phase in power house area

Contractor shall provide a temporary porta cabin office (container) for construction period in power house area for the use of owner. It shall be equipped with partition and sitting arrangement with document storage racks, air-conditioning, green toilet & proper lighting. The size of the office shall be approx. 3m x 6m. The same shall be handed over to the Project after completion of the works.

1.5.1.9 Control and monitoring

The system shall be controlled and monitored by the SCADA system. The details of "Control and Monitoring System" and "Protection System" are covered under separate package EM-I.



TEESTA H.E. PROJECT, STAGE-VI

It shall be the responsibility of the Contractor to make all necessary provisions required to achieve seamless and compatible interfacing of control and monitoring systems of all equipment with plant SCADA system.

Provisions of all transducers/ sensors, instruments, gauges for mechanical parameters (temperature, pressure, flow, vibration, etc.) and electrical parameters (current, voltage, frequency, power, MVAR, KWH, etc.) and spare contacts of relays, breakers, isolators push buttons, control/selector switches etc. from various equipment for monitoring, alarm, annunciation, control function etc. through plant SCADA system are in the scope of this contract.

For connecting marshalling box/junction box with various equipment in field, multi-pin plug connector system shall be used, if feasible. The contact carriers shall have two capacitive PE contacts each to give the proper earthing to the system and it shall be suitable for electrical data equivalent to 250V/10A. The contact type shall fulfil the requirement of IEC 60 352/ DIN EN 60 352. The contact carriers shall be covered by housing made up of polyamide 6.6 of V0 inflammability class in accordance with UL 94 and fulfil the requirement of IP65 at least. The housing shall be directly sealable on the mounting wall without the need of any kind of wall mounting base. The complete arrangement shall be highly reliable even under harsh conditions, due to high degree of protection."

It shall also be possible to control locally the main elements of the system from local control cubicles. Local control shall be performed in a standalone manner independent of SCADA system, and all information (faults, alarms, measurements, status) necessary for such control shall be displayed locally. Provision of control selector switch for selection of control through Local Control Cubicle, Unit Control Board / Local Control Board and plant SCADA system shall be made in Local Control Cubicles and Unit Control Boards / Local Control Boards.

If the system consists of redundant subsystems, the priority of operation of such subsystems shall be selectable, either from SCADA system or locally.

1.5.1.10 Power supply for control and monitoring

A reliable surge protected power supply shall be provided for powering the electronic circuits of the equipment/ component. The power supply shall be from two independent DC station battery source, one as primary and other as secondary. Switchover from primary to secondary will follow automatically on failure of primary and return to the primary source automatically following restoration of primary supply. The primary source of supply and the charger of the battery should be protected with surge protection device. The surge arrester should be pluggable type and should have indication to show its life.

The power supply shall include redundant converter (dc-dc) connected to station battery source such that failure of any regulated output voltage shall cause instantaneous transfer to a redundant converter without affecting normal operation of the equipment/ component in any way. Contacts shall be provided to alarm on power supply failure and local



TEESTA H.E.PROJECT, STAGE-VI

indication shall be provided to identify the failed functional block. The Contractor shall provide full details of the proposed power supply system for approval by the Employer.

In case AC supply is required for any control function, same shall be sourced from two on line UPS, with one main and other standby and with automatic change over facility.

1.5.2 Colour schedule

Colour standard references to major equipment/ system shall be as mentioned in Annexure. The interior of all cubicle and panels shall preferably have a matt white finish unless specified otherwise.

1.5.3 Electrical equipment enclosures

1.5.3.1 General

Unless otherwise specifically called for or described in these Contract documents all electrical appliances shall conform to the applicable IEC Publications.

The cubicles and enclosures shall be of protection class IP 40 or higher according to their location. For outside installation and area which are humid, corrosive, and prone to dripping and/ or spray of water, the protection class of cubicles shall be IP 65. Cubicles housing electronic cards/modules such as of unit control boards/local control boards, digital governors, static excitation equipment shall be of protection class of IP 5X.

Cables shall have at least 1100 V PVC insulation except for 220V DC and tele-metering or communication system equipment for which 650V and 300 V ratings respectively are acceptable.

Wiring shall terminate at terminal blocks at one side only. Where tap connections are required, they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in wire ways accessible from the front door. The wire ways shall not be filled more than 70 %.

Each cubicle shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and other earthing terminals as well as all cable screens and PE-wires shall be connected to the earthing bar.

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Employer. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cable, having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC Recommendations 60204 shall be used.



TEESTA H.E.PROJECT, STAGE-VI

1.5.3.2 Terminal Blocks

Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks

The screw type modular Terminal Block should be manufactured as per IEC-60947-7-1. The insulating material of Terminal Block should be of polyamide 6.6 meeting VOV2 immflamability Class as per UL94. All metal parts including screws should be of copper alloy. The Terminal Block should be suitable for mounting on both 'DIN' as well as 'G' type rail. All the metal parts should be captive and touch proof. The Terminal Block should have screw locking design so that it can withstand vibration level up to 5g and also prevent accidental loosening of conductors. The terminal blocks shall also have necessary accessories like end clamp, separation plates etc. Terminal block for CT shall be provided with shorting and disconnecting arrangement. Test terminal block for CT and PT with plug shall also be provided in all protection and measuring circuit also provided in panel.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

1	All circuits except CT /PT circuits	Minimum of two of 2.5 sq. mm copper flexible
2	All CT/ PT circuits	Minimum of 2 nos. of 6 sq. mm copper flexible

At least 20% spare terminals shall be provided on each panel/ cubicle/ box and these spare terminals shall be uniformly distributed on all terminals rows.

1.5.3.3 Control switches, indicating lamps and instruments

A) Measuring converters

The converters shall be suitable for direct connection to the secondary circuits of the potential and current transformers used, or other sensors, each as they apply. The converters shall be static type, having all accessories to provide an output signal of 4-20 mA, filtered DC.

For the measuring converters the following minimum requirements shall be fulfilled:

- i) Current transducers shall be single-phase, of accuracy class 0.2 or better.
- ii) Voltage transducers shall be single-phase of accuracy class 0.2 or better.
- iii) W and VAr transducers shall be two elements, three-phase. Accuracy class of the transducers shall be 0.2 or better.

B) Measuring transformers

Potential transformer secondary windings shall be rated $110/\sqrt{3}$ V

Current transformer secondary windings shall have a rated current of 1A/2.5A /5A.



TEESTA H.E.PROJECT, STAGE-VI

1.5.3.4 Cautionary signs

Caution and warning signs must be displayed in English, Hindi and local language.

Identification plates and instruction plates shall preferably be bilingual i.e. English and Hindi/ local language.

1.6 Record and Documentation

1.6.1 Documentation / record of the work/activities

The documentation/ records of the work under this contract for future reference shall be included in the scope of work.

The Contractor shall document all the major activities, milestones related to installation of powerhouse from commencement of work under this contract and shall maintain the documentation/record in chronological order till the completion of the job specified under the contract.

The Contractor shall submit ten copies of above documentation/records to the Employer after completion of work under this Contract. The Contract shall be deemed as completed only after the Contractor submits the same.

1.6.2 Design memorandum

The Contractor shall prepare and submit to the Employer a "Design Memorandum" of the proposed equipment/system fulfilling the contract specification/requirement given in respective section for approval prior to submission of any drawings and documents. The memorandum shall include the design philosophy, methodology, system description, input parameters for design, standard and codes, design and selection criteria, equipment data, material specification, major technical features, basic arrangement/ layout etc.

Design memorandum of all the equipment / system shall be prepared and first draft shall be submitted within six (6) months from date of award of the contract.

1.6.3 Technical documentation

All the technical documents and drawings required to be furnished under this contract as per clause 2 "General Technical Specifications (GTS)" shall be prepared in internationally accepted software of latest version used for preparation of documents and drawings.

The Contractor shall submit six (6) copies (or as required) of drawings along with copy in electronic form media for approval / review as per GTS-Vol.-IIIA. At the time of completion of contract, the Contractor shall submit ten (10) copies along with five (5) copies in electronic form in DVD media, of approved and as built drawings together with operation and maintenance manual as specified in clause 2.6 of GTS.



TEESTA H.E. PROJECT, STAGE-VI

Electronic form of O&M manual shall be interactive and user friendly preferable in E-Manual form for easy retrieval of relevant information for assembly, disassembly and BOQ etc.

All the drawings and documents shall be submitted in presentable folders properly bound and catalogued for easy retrieval / reference. Drawings shall be submitted in A0 / A2 / A3 and all documentation in A4 size. All drawings shall be digitally printed/ plotted. Ammonia print/ blue print shall not be accepted.

1.7 Delivery, Installation and Commissioning

1.7.1 Packaging, handling and site storage

The Contractor shall follow the general requirement of Packaging, Handling and Storage elaborated in "Section 8 - Transport and Installation" of "General Technical Specification (GTS)".

The Contractor shall pack all the consignment in sea worthy packaging, wherever required, strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc. Packages shall be suitably and distinctly identified for type of handling and kind of storage.

The packaging and storage of electronic equipment shall be strictly in accordance with internationally accepted standards. Electronic equipment shall be packaged, shipped and stored in anti-static packing. All packages shall be stored indoor. Packages containing electronic equipment shall be stored in humidity controlled environment.

If required, dehumidifiers shall be deployed by Contractor to control the condition of storage space. Storage of the equipment till commissioning is responsibility of the Contractor.

1.7.2 Installation

The Contractor shall follow the requirements of installation elaborated in "Section 8 - Transport and Installation" of "General Technical Specification (GTS)".

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumables for performing installation, testing and pre-commissioning shall be provided by the Contractor.

The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance.

The Contractor shall provide and install the concrete inserts/embedment; support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Employer.

The Contractor shall use anchor fasteners for installation of piping, fixtures, mountings, conduits, cabling, panels etc. Chipping of concrete and/or taking support from reinforcement bars shall not be allowed.



TEESTA H.E.PROJECT, STAGE-VI

The design, location and approval tests of anchoring rings for the fixing of lifting apparatus necessary for assembly and dismantling of equipment and plant accessories shall be the responsibility of the Contractor.

1.7.2.1 Installation procedure

The Contractor shall submit six (6) copies of all detailed programs and the procedures to be adopted for erection / installation, testing and commissioning well in advance, before start of erection activities/ installation, for approval of the Employer.

The installation procedure shall also have a section "site quality assurance plan" containing erection data sheets for various components. These sheets should specify site measurements/ inspections required to be made for ensuring proper installation.

1.7.2.2 Field welding

The Contractor shall select the proper filler material with respect to parent material for all field welded connections and shall specify it on the applicable drawing, together with the detail design of the field weld joint.

All cutting, chamfering, and other shaping of metals necessary for the field connection shall be done as far as possible in the shop. Adequate temporary bolted field connections shall be provided to hold the assemblies rigidly and in proper alignment during shop and field assembly.

1.7.2.3 Cable laying

Wiring between equipment enclosures shall be made with cables, laid in trenches and/or cable trays and in cable conduits. The Contractor shall submit for review to the Employer a cable route layout-showing location of trenches, conduits and trays. All material for cable laying such as cable trays supports and fastening material shall be furnished and placed by the Contractor. Cables shall be properly fastened and marked where they enter enclosures by either cable clamps or nipples.

Cables in horizontal cable trays shall be fastened properly with clamps or plastic strips. Power and control cables shall be placed in separate trays or conduits. Cables shall be clearly marked at each terminal point.

1.7.2.4 Embedded parts and anchor bolts

All embedded anchor bolts, rods, welding plates and support plates shall be provided. Anchor bolts shall consist of a threaded steel rod installed inside a pipe sleeve to provide lateral adjustment after the sleeve is embedded. The embedded end of the rod shall be provided with a steel plate, which shall be welded to the rod and sleeve to provide anchorage and to prevent entry of concrete into the sleeve during installation.

The threaded end of the rod shall be provided with two steel nuts and two steel washers to permit levelling and anchoring the equipment prior to grouting.



TEESTA H.E.PROJECT, STAGE-VI

Approved types of expansion or chemical anchors shall be used where practicable for small equipment.

1.7.2.5 Installation records

The Contractor shall maintain the installation records including installation quality control (QC) records of each activity to ensure quality of installation as per specification/requirement. The QC record shall clearly show the achieved erection tolerances vis-à-vis the allowable limits. The installation records shall be submitted to Employer for approval/ acceptance to establish completion of installation milestones as per program of performance. All installation records shall be compiled and submitted to the Employer before taking over the respective unit. Completion certificate for any work shall be issued only after approval / acceptance of complete installation records.

1.7.2.6 Field inspection

The Contractor shall permit Employer to perform inspections of the assembly which will include a complete verification of the assembly of all parts as to their levels, clearances, pertinent fits, alignments and quality of workmanship. The field supervisor of the Contractor shall provide Employer with three (3) copies of all the clearances, tolerances and data of all pertinent fits, alignments and levels, so that the latter may repeat the Contractor's measurement, if desired.

Unless otherwise specified, any rejection based on the inspection will be reported to Contractor within fifteen (15) days and injurious defects subsequent to assembly and acceptance will be rejected.

1.8 Spare Parts

The Contractor shall supply the spares as defined in "Section 3 – Spare Parts and Tools" of "General Technical Specifications (GTS)".

In addition, the Contractor shall supply sufficient number of erection and commissioning spares based on their experience so that erection, testing and commissioning work progresses smoothly and is not hampered for want of such spares.

The spare parts provided by the Contractor shall be of the same quality and have the same mechanical and/or electrical properties as the original parts and be fully interchangeable with them. If modifications are made to equipment during erection, the Contractor shall ensure that these modifications are also made to all spare parts.

Conditions for tests, surface treatment, painting, etc., stipulated for the main items / equipment in the GTS/ GTR/ PTS, shall also apply for their spare parts.

Spare parts shall be conditioned, packaged, shipped and stored to ensure long term storage without degradation.

The complete set of the spare parts for the works or a section shall be delivered prior to taking over.



TEESTA H.E.PROJECT, STAGE-VI

1.9 Tools and Instruments

1.9.1 Special tools

Special Tools shall be supplied by the Contractor as necessary for erection, installation, operation and maintenance, etc. of each item of equipment supplied under this Contract.

Special tools shall include tools specified by the Employer and those others recommended as necessary and accepted at the time of award of the contract.

All special tools shall be clearly marked to identify their use and shall be made available for the erection to be undertaken by the Contractor. Special tools shall be shipped with the first consignment of equipment to be erected.

The tools shall be delivered to the Employer prior to taking over, in perfect condition or be replaced, if necessary, with new tools of equal or better quality than the original ones.

The tools and plants like mobile crane, trailer, truck, hydraulic jacks, welding generators, hydraulic test pumps, drill machines, torque wrenches, chain pulley blocks, dewatering pumps, HV testing kit, Drying out transformer, brazing equipment etc. for use by contractor during the course of work, shall be arranged by the contractor.

1.10 Training

The Contractor shall arrange training to familiarize the employer's personnel about constructional and O&M aspects of equipment wherever need of specialized training is felt during detail engineering. Cost of such training shall be borne by the Contractor. Travelling and living expenses, of the personnel deputed on such training, however, shall be borne by the Employer.

Besides above, the Contractor shall hold training sessions to familiarize the Employer's personnel with all aspects of operation and maintenance of the plant and sub-systems covered under the scope of this contract before the beginning of the dry tests on site. The technical documentation used in the training sessions shall include the Contractor's draft operation and maintenance manuals and test procedure descriptions approved by the Employer.

The Contractor shall provide training for each phase of work as per details agreed at the time of award.

1.10.1 General requirements of training

The Contractor shall provide suitable instructors, training material and facilities (instruments, apparatus, simulators, documents, drawings, protective clothing, rooms, office supplies, etc.) for the personnel made available by the Employer for training.

One month before the training start, the Employer will send the list of the trainees and any comments on the training program proposed by the



TEESTA H.E.PROJECT, STAGE-VI

Contractor. This program shall be adapted to the design and nature of the Works, and the needs of trainees. Trainees shall be suitably trained in the various aspects of design, manufacture, installation/erection, operation and maintenance, relevant to the training, of works similar to the Works

The Contractor shall supervise and provide direction to, and be liable for the acts or omissions, other than negligent or wilful misconduct of such personnel, of the Employer's trainees.

The Contractor shall provide the training described hereafter in accordance with any further specific requirements stated in the Employer's Requirements.

The Contractor shall assist the Employer in obtaining any visas and other formalities for entering or leaving the territory on which the training is being provided.

The Contractor shall bear responsibility for ensuring the safety of the trainees during their stay in the country of the training. On their part, the trainees shall comply with the laws, regulations and customs of the country in which training is being provided.

In the event of illness or accident, the Contractor shall take all steps to provide the trainees with the appropriate medical care.

1.10.2 Training of Employer's personnel

The scope of service under training of Employer's engineers shall include a training module covering the following:

1.10.2.1 Training during engineering / manufacturing phase

This shall cover all disciplines viz, Mechanical, Electrical, C&I & QA etc. and shall include all the related areas like design familiarisation, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. The training in areas of Operation and Maintenance shall take place preferably during end of manufacture/ tests.

The proposed training for various equipment and systems shall be minimum sixty (60) man-days.

1.10.2.2 Training during the erection / installation / testing & commissioning

Independently from the supervision and inspection functions of the Employer's Representative, the Contractor shall authorise the Employer's Personnel to follow the erection / installation / testing & commissioning and site work at his site.

The Employer's Start-up Personnel shall take no part in the equipment erection and/or installation operations, which shall be exclusively carried out by the Contractor and under his entire responsibility.



TEESTA H.E.PROJECT, STAGE-VI

This onsite training shall cover each phase of erection / installation / testing & commissioning and shall be of sufficient duration.

The Contractor shall supply the information or measurements concerning the erection requested by the Employer's Representative or/and by the Employer's personnel.

The Contractor shall also provide on the-job training in the operation and maintenance of the Works to the Employer's Operating Personnel. Such training shall start at least 30 days prior to commencement of Tests on Completion and continue until Taking Over. Its scope and quality shall be such as to provide the trainees with comprehensive understanding of all operational and maintenance aspects of the work. Such training shall also include safety and environmental protection aspects applicable to the work.

The proposed training for various equipment and systems shall be minimum sixty (60) man-days.



TEESTA H.E.PROJECT, STAGE-VI

ANNEXURE

STANDARD PAINTING SCHEDULE/ COLOUR GUIDELINES

Sl. NO.	DESIGNATION	COLOUR	REF. COLOUR
1	EOT Crane	Yellow	RAL 1004
2	EOT Crane Power Supply Box	Pearl White	RAL 1013
3	Transformers including marshalling box	Pearl White	RAL 1013
4	Bus Duct	Grey	RAL 7035
5	Oil purifying system (Tank, Pumps etc.)	Orange	RAL 2000
6	MCC for Drainage, Dewatering pumps	Pearl White	RAL 1013
7	Water Piping	Green	RAL 6029
8	GIS Bay	Grey	RAL 7038
9	GIB	Grey	RAL 7038
10	LCC for GIS	Pearl White	RAL 1013
11	DC Boards, Invertors, Charger	Pearl White	RAL 1013
12	Low Voltage Boards, Distribution Boxes, Starter Panels Etc.	Pearl White with Melon Yellow band	RAL 1013
13	UAB / SSB panel etc.	Pearl White with Melon Yellow band	RAL 1013
14	11kV Switchgear	Pearl White with dark brown band	RAL 1013

Note:- The minimum width of the colour band shall be 150mm. Colour schedule mentioned on the relevant drawings of the equipment shall be reconfirmed from Employer during detail engineering.



TEESTA H. E. PROJECT, STAGE-VI

9.5.3 415 V switchgear (MCCs and SABs and Other Service Boards)

9.5.3.1 General

The 415 V switchgear shall be metal enclosed indoor cubicles free floor standing type.

The cubicle assemblies shall be designed in accordance with the recommendations of IEC Publication 61439 with protection class IP 42 according to IEC Publication 60529. The Cubicles shall be type tested as per the standard IEC 61439. The assemblies must be built to suit the equipment shown on the single line diagram. Hinged doors and removable covers shall be provided wherever necessary to allow access to all equipment. The frame of the cubicles shall be sufficiently sturdy and the metal sheeting of sufficient thickness to ensure safe transport, mounting and operation without deformation or bulging. Natural ventilation as required shall be provided. Provision for future expansion of cubicles shall be made in end cubicles.

Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions. The design should have undergone internal Arc tests for different types of feeders. Continuous lifting angle or lifting hooks shall be provided to facilitate the installation of the cubicles.

9.5.3.2 Compartments

Each cubicle shall be divided into sections, or compartments, housing the incoming, interconnecting or outgoing feeder air circuit breaker units and moulded case circuit breaker units respectively. Degree of protection within compartments shall be at least IP2X.

Each ACB and MCCB unit shall be constructed so that the unit can be removed and replaced while the buses are energized. It shall have self-engaging definite position stops for disconnected, test and connected positions. All necessary means shall be provided for easy removal and handling of the unit.

9.5.3.3 Cable compartments

All feeders to and from the cubicle assemblies will be cables, except incomer to SAB-1/2 from SSTs shall be through sandwich busduct. The connection from UAT to SAB shall be through cables. The assemblies shall be accessible for the cables from bottom to each feeder circuit breaker via separate cable compartment. Solder less connectors shall be furnished for each power conductor entering the equipment. Provisions shall be made to clamp and fasten cables in the cable compartment. Terminals for cable connection will be suitable for Aluminium cables.

9.5.3.4 Name plates

Each feeder shall be clearly identified with suitably located nameplate(s). Nameplates shall be furnished for all instruments, control switches, etc.



TEESTA H. E. PROJECT, STAGE-VI

Each section of an assembly shall have an identifying name plate placed near the top edge.

9.5.3.5 Wiring

All secondary and control wiring shall be done with stranded copper wires, current transformer secondary leads shall not be less than 4.0 mm². All control wiring within the assembly housing shall be installed at the manufacturer's premises.

All connections shall be made with solder less lugs. All wires and connections to remote equipment shall be wired to terminal blocks.

9.5.3.6 Bus bars

Bus bar conductors shall be made of copper. All connections shall be in accordance with the best modern practice.

A continuous bus of the same cross section as the main bus shall be furnished and connection of ample size shall be brought to each feeder compartment, for bolted connection of the feeder.

Phase arrangements shall be R-Y-B from top to bottom, from back to front and from left to right when facing the front of the equipment. All bus bars shall be clearly marked by engraved letters.

Adequate provisions must be made for the expansion and contraction of the bus bars and other bus bar connections with variation in temperature. Bus bars shall be so arranged that they can be extended in length without difficulty.

All field connections shall be bolted. The connections shall be kept as short and straight as possible. Bus bars, connections and their insulating supports shall be of approved construction, mechanically strong and shall withstand all the stresses, which may be imposed upon them under ordinary working conditions due to vibration, temperature fluctuations, short circuit or other reasonable causes. The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature of 110° C at regular intervals, to withstand the forces arising from short circuit or other reasonable causes.

9.5.3.7 Instruments

Control switches and instruments shall be mounted on the circuit breaker compartment doors / front side of the panel.

9.5.3.8 Insulating mats

Insulating mats of appropriate size confirming to relevant standards are to be provided in front and back of all doors of the 415 V distribution panels for the safety of personnel.



TEESTA H. E. PROJECT, STAGE-VI

9.5.4 Air circuit breakers

9.5.4.1 General

The air circuit breakers shall be designed in accordance with the recommendations of IEC Publications 60947-1 and 60947.2. All circuit breakers shall be of the draw out type, housed in individual metal-enclosed compartments. Each air circuit breaker shall be mounted on a carriage assembly with wheels running on tracks secured to the inside of the compartment. The carriage shall have self-engaging definite position stops for disconnected, test and connected position. Means shall be provided for easy removal and handling of the breakers.

The air circuit breakers shall be three-pole electrically operated with motor driven stored-energy operating mechanism.

The motor for operating the spring loading device shall be for 220 V DC supply. The closing and tripping coils shall be for 220 V DC. The closing mechanism shall be trip-free and wired so that "pumping" is not possible. Manual charging and operation of the breakers shall be possible. The provision for remote indication and operation shall be made.

The operating handle shall be located so that the air circuit breakers can be operated without opening the compartment door.

A mechanical interlock shall prevent moving of the air circuit breaker from the connected position, while the breaker is closed, and prevent the access door being opened unless the circuit breaker is in test or withdrawn position.

The frame of the air circuit breakers shall be solidly grounded in both test and connected positions. In the test position, it shall be possible to operate the breaker and perform complete functional tests.

The air circuit breaker shall be equipped with shutters, which automatically cover live parts when the breaker is withdrawn. Provision shall be made for padlocking the circuit breaker in the disconnected and test position.

9.5.4.2 Contacts

The main circuit breaker contacts shall be of the self-cleaning type, made from an arc resisting material and provided with auxiliary arcing contacts as a protection against burning during the operating of the breaker. All contacts shall be self-aligning, and shall be readily replaceable.

Main and secondary disconnecting contacts shall be silver plated with springs, which will ensure high-pressure contacts. Secondary contacts shall be engaged both in connected and test position.

Auxiliary contacts for position indication, control, interlocks, etc., showing whether the breaker is in open, closed or tripped position and whether the operating spring is locked, shall be provided and wired to terminals. Mechanical position indicators, visible from the outside without opening the circuit breaker compartment door, shall also be provided. At least 2 NO and 2 NC auxiliary contacts shall be provided for each breaker as spares.



TEESTA H. E. PROJECT, STAGE-VI

9.5.4.3 Protection

The protection shall be as per single line diagram. The air circuit breakers shall be equipped with adjustable magnetic short circuit over current and instantaneous trip mechanism/ relay, with auxiliary magnetic short circuit contacts for indication of tripped condition. The protection equipment shall be interchangeable.

9.5.5 Moulded case circuit breakers**9.5.5.1 General**

The MCCBs shall be designed in accordance with the IEC Publications 60947.1 and 60947.2. All MCCBs shall be manually operated and shunt trip type.

All MCCB shall of draw out module type be housed in individual metal-enclosed compartments. Each MCCB shall be easily replaceable while the buses are energised and shall have self-engaging definite position stops for disconnected and connected position. Means shall be provided for easy removal and handling of the units. ON, OFF TRIP position of MCCBs should be indicated.

A mechanical interlock shall prevent moving of the MCCB from the connected position, while the breaker is closed, and prevent the access door being opened unless the breaker is in OFF position.

9.5.5.2 Contacts

The MCCB contacts shall be of the self-cleaning type, made from an approved arc resisting material. All contacts shall be self-aligning, and shall be readily replaceable.

Main and secondary disconnecting contacts shall be silver plated, with spring, which will ensure high-pressure contact.

9.5.6 Instrument transformers**9.5.6.1 Current transformers**

The current transformer shall be single phase single core inductive type. It shall be mounted within the cubicles and shall comply with the requirements of relevant IEC 61869. It shall be used for protection and metering as per single line diagram NH/DEM/TS-VI/LT/01 and NH/DEM/TS-VI /LT/02.

Air circuit breakers connected to MCCs, SABs and other distribution boards shall have single core CTs of suitable rating (based on capacity of breaker) for protection of 5P20 class.

The secondary windings of all current transformers shall be grounded at one point only and means shall be provided to facilitate the secondary windings to be short-circuited.



TEESTA H. E. PROJECT, STAGE-VI

The burden rating of all current transformers shall not be less than 200% of the overall computed burden of apparatuses connected to each transformer.

9.5.6.2 Potential transformers

Required no. of potential transformer shall be provided for metering and interlock as per single line diagram NH/DEM/TS-VI/LT/01 & 2. Accuracy class for voltage transformer should be as following

- | | |
|---------------------|-----|
| i) Protection cores | 3P |
| ii) Metering | 0.2 |

9.5.7 Control description

9.5.7.1 General

Each air circuit breaker shall be equipped with facilities for remote operation from the respective local control board (LCB)/CCR. Each air circuit breaker unit shall be equipped with a manual / auto selection switch, Local /Remote switch, local start-stop push button and an indicator showing the position of the breaker in the control room. The air circuit breaker shall be operable with the breaker in test position. Auxiliary contactors with an alarm contact for remote indication of tripped condition shall be provided for protection of the control circuits.

Auxiliary contacts for the following remote indications of the circuit breakers shall be wired to terminal blocks:

- i) Main contact position,
- ii) Test and connected /service position,
- iii) Trip condition,
- iv) Fault condition.

MCCBs shall be operable by means of push button switches/ handle. Switches for Manual, local auto, remote, etc. for SABs/ MCCs shall be provided. All CTs circuit shall be equipped with TBs of disconnecting and shorting link.

On, OFF and Trip LED indication in addition to in-built indication of MCCB/MPCB shall be provided.

9.5.7.2 Metering

All instruments, relays and control switches mounted in the switchgear shall be in accordance with single line diagram. Instruments shall be furnished with all necessary resistors, shunts etc.

Each incoming feeder containing current transformers and voltage transformer shall have energy meter, digital ampere meters and ammeter selector switches, digital voltmeters and voltmeter switches located in the respective feeder compartment doors.



TEESTA H. E. PROJECT, STAGE-VI

All metering circuits shall be terminated in terminal blocks for remote metering purposes.

9.5.7.3 Interlocks

The breakers connecting the SABs, MCCs to the unit auxiliary transformers shall be interlocked mutually in order to prevent paralleling of the supply during normal operation. Interlocking scheme to prevent parallel operation of incoming supplies shall also provided by the Contractor. In case of sustained voltage drop an automatic changeover of source at SABs/MCCs shall be provided. Hard wired safety interlock shall be provided.

9.5.8 Numeric relay

9.5.8.1 Numeric Relay

The numerical relay shall have at least following features

The relay used in protection system shall be of the numerical, and plug in type arranged in protection cubicles. All relays including all ancillary devices, such as interposing transformers, tripping matrix and relays, test facilities, power supply units, etc. with all circuits shall comply with IEC 60255 Recommendation,

- i) Main protection relays shall be of numerical type and communication protocol shall be as per IEC-61850. Communications of protection system with the control system shall be based on universally accepted Protocol namely IEC61850.
- ii) There shall be one RS 232 port on front and one RS 485/Ethernet port on rear. The front port shall be used to connect the laptop locally for any change in settings/ downloading the data etc. and the rear port shall be used to inter connect the relays and for remote setting/auto extraction of disturbances/events etc. The relay shall have preferably front panel back lit display,
- iii) The relay shall have self monitoring features.
- iv) All numerical relays shall have an inbuilt event recorder

9.5.9 Protection and Tripping Relays

Relays shall be of approved types with IEC 60255 or British Standard 142 and 5992, parts 1, 2, and 3 or IS, as appropriate, fully tropicalized and shall have approved characteristics.

The system shall be coordinated with the protection system of the interconnected stations. All interface installations shall be included to provide fully functional systems.

The numerical protection relays shall have an operating time of less than 20 ms and single function protection relays shall have the operating time less than 15 ms. The total time taken by the protection system including auxiliary and tripping relays to send trip command to circuit breaker from the occurrence of the fault shall not exceed 70 ms.



TEESTA H. E. PROJECT, STAGE-VI

9.5.10 Auxiliary relays

Auxiliary relays for inputs from the protection sensors and devices such as thermal relays, pressure switches etc. shall be provided as specified in the following sections, and as necessary for the installation.

The relay modules (consisting of relays, base etc.) shall be DIN rail mountable and must have self locking type Screw terminals. Screw terminals shall be made of polyamide 6.6 meeting VOV2 inflammability Class as per UL94. All metal parts including screws shall be of copper alloy. Each relay module shall also have necessary signalling and protection circuitry on board.

Each relay shall have self-resetting potential free contacts of suitable rating as needed for connection in the tripping circuits and at least two self-resetting potential free contacts for local and remote alarm and supervision, both wired to terminals.

All relays shall be clearly marked with the corresponding relay function.

9.5.11 Power Supply Requirements

220V DC shall be provided for the power supply to the control and protection of AC switchgear equipment.

All components of the protection system shall function properly at DC voltages from 80%-115% of nominal voltage.

The protection systems shall be fed by the 220 V battery banks installed in the control block. Relay shall be suitable for operation on 220V DC systems without the use of voltage dropping resistors. Each DC supply shall be designed to protect it from high voltage and surge and provide electrically isolated contacts for annunciation.

9.6 Motor Protection

The motor for each pumping unit shall be provided with at least the following device:

- i) Over load protection,
- ii) Under voltage protection,
- iii) Single phasing protection,
- iv) Moisture sensor for moisture ingress in winding,
- v) High bearing temperature
- vi) Winding temperature protection (Bimetallic and thermistor protection)
- vii) Bearing oil level low protection
- viii) Earth Fault protection



TEESTA H. E. PROJECT, STAGE-VI

9.7 Drawings, Documents and Design Calculations

9.7.3 Design memorandum

The Contractor shall submit to Employer a design memorandum prepared in accordance to clause 1.6 "Record and Documentation" of "Section 1- General Technical Requirements."

9.7.4 Drawings and documents

The Contractor shall submit all the drawings and documents in accordance with requirements stipulated in "Section 2 - Technical Documents" of "General Technical Specification (GTS)".

9.7.5 Design calculation

The Contractor shall submit the design calculation in accordance to Clause 2.4 of "General Technical Specification (GTS)" covering at least the following, for review / acceptance.

- i) Fault level at each board taken in consideration for their design,
- ii) Burden on CTs,
- iii) Temperature rise calculation,
- iv) Thermal ability to withstand short circuit.

9.8 Delivery, Installation and Commissioning

The Contractor shall follow the requirements of Delivery, Installation and commissioning elaborated in clause 1.7 "Delivery, Installation and commissioning" of "Section 1 - General Technical Requirements."

9.9 Spare Parts

Specified spare parts to be supplied under this section are as follows:

S.No.	Description	Quantity
A) 415V Switchgear		
1	Air circuit breakers	
a	Air circuit breakers of type used	20% of each type
b	Arcing chamber assemblies for circuit breaker	2 nos. of each type
c	Main contacts for three poles, with spring, bolts, nuts etc.	10 nos. of each type
d	Primary isolating contacts used	10 nos. of each type
e	Coils for tripping and closing of type used	10 nos. of each type



TEESTA H. E. PROJECT, STAGE-VI

S.No.	Description	Quantity
f	Complete motor drives of type used	4 nos. of each type
g	Complete spring closing mechanism	4nos. of each type
2	MCCB of type used 200A & above	4 nos. of each type
3	MCCB of type used less than 200A	6 nos. of each type
4	Current transformer of type used	3 nos. of each type
5	Bus bar Supporting insulator	20 nos.
6	Overload and instantaneous trip mechanism for circuit breakers	4 nos. of each type
7	Indication lamps (LED)	20 nos. of each colour (Red, Green, Yellow, Blue, Amber)
8	Fuses	10 nos. of each type
9	Control and instrumentation switches such as breaker control switch, auto/manual selector switch, local/remote selector switch, VSS and ASS selector switch etc.	3 nos. of each type
10	Relay Contactors	2 nos. of each type
11	Indicating instruments (Ammeter, Voltmeter, Energy meter)	2 nos. of each type
12	Under voltage relays	4 nos.
13	Over current and E/F relays	2 nos. of each type
B) Auxiliary Transformers (UATs, SSTs, FDT & ST)		
14	11 kV, terminal bushing (each type)	3 nos.
15	433 V, terminal bushing (each type)	3 nos.
16	Winding temperature protection relay for each type transformer (HV & LV)	2 nos. of each type
C) MCC PANEL		
a.	MCCB, MPCB and MCB	20% of each type used



TEESTA H. E. PROJECT, STAGE-VI

S.No.	Description	Quantity
b.	Power Contactor	20% of each type used
c.	Relay	20% of each type used
d.	CT	20% of each type used
e.	Indicating Lamp	8 nos. of each type used
f.	Control Transformer	20% of each type used
g.	Fuse	6 nos. of each type used
h.	Control and instrumentation Switch	20% of each type used
i.	Push Button	8 nos. of each type used
j.	Indicating Instruments	20% of each type used
k.	Timer	2 nos. of each type used
l.	Multiplier/Auxiliary contactor	20% of each type used
m.	Space heater	20% of each type used
n.	Thermostat for Space Heater	20% of each type used
o.	Power and Control Terminal Block	30% of each type used
p.	Air Circuit Breaker	1 no. of each type used
q.	Supporting insulator	20% of each type used
r.	Coils for tripping and closing of type used	20% of each type used
s.	Complete motor drive of type used	20% of each type used

Note: Next higher integer nos. shall be given in case of fraction.

9.10 Tools and Instruments

The Contractor shall supply all necessary tools and instruments etc. for installation, repair and maintenance in accordance to clause 1.9 "Tools and Instruments" of "Section 1 - General Technical Requirements".

9.10.3 Special tools

The Contractor shall list and supply all special tools. List of such tools including their make and detailed specification, shall be submitted for acceptance by the Employer.

The list of special tools must include the following in addition to tools recommended by manufacturer(s)

- i) 5 nos. manual closing/spring charging handle for ACBs
- ii) 1 nos. breaker handling trolley



TEESTA H. E. PROJECT, STAGE-VI

9.11 Quality Assurance and Testing

The Contractor shall follow the quality assurance and testing requirements specified separately in "Quality assurance and Testing Specifications (QTS)".



TEESTA H. E. PROJECT, STAGE-VI

10. ELECTRIC OVERHEAD TRAVELLING (EOT) CRANES

10.1. Scope of Work

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, site storage and preservation, installation, commissioning, performance testing, acceptance testing, training of Employer's personnel, handing over to employer and guarantee for two years of EOT cranes for MIV Cavern, ~~GIS area~~ as per the specifications hereunder, each complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

The scope of work shall be a comprehensive functional system complete in every respect including but not be limited to following:-

1. ~~One (1) no. 5 T EOT crane for GIS area,~~
2. One (1) no. 90/10T EOT crane for MIV Cavern,

As per the specifications hereunder, each complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

The scope of work shall be a comprehensive functional system complete in every respect including but not be limited to following:

10.1.1. ~~5 T EOT crane for GIS area~~

~~One (1) no., 5 metric tonnes electric over head travelling bridge crane of span approximately 7.75 m (tentative), complete with electric control panels, pendant and remote radio control, main and auxiliary hoists on a common trolley, brakes, safety devices, platform, ladders, fittings and connections and all necessary accessories,~~

10.1.2. 90/10 T EOT crane for MIV Cavern

One (1) no., 90/10 metric tonnes electric over head travelling bridge crane of span approximately 6.10 m (tentative), complete with electric control panels, operator cabin, ~~pendant~~ and remote radio control, main and auxiliary hoists on a common trolley, brakes, safety devices, platform, ladders, fittings and connections and all necessary accessories.

10.1.3. Miscellaneous items

- i) One (1) set of main runway rails with base plates, anchor bolts, rail clips, lock nut, end stops, limit switches, striker's plates, buffers etc. for each of the cranes,
- ii) Two (2) sets of bridge rails with rail clips, lock nut, end stops, limit switches, striker's plates, buffers etc. mounted on each of the crane girders,
- iii) One (1) set each of long travel feed rail power supply system complete with metal enclosures, conductors, collector trolleys, all fittings and connections etc. for total runaway length of the respective cranes as per



TEESTA H. E. PROJECT, STAGE-VI

layout drawings,

- iv) Load testing of cranes at site including load arrangement and all logistics,
- v) Lubricating oil, grease and hydraulic brake fluid for first filling of all components with 100% reserve, in non-returnable drums, for all the cranes.
- vi) Spare parts in accordance to clause 10.8 "Spare Parts" of this section.
- vii) Tools and instruments in accordance to clause 10.9 "Tools and Instruments" of this section.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

10.2. Specific Parameters and Layout Conditions

10.2.1. ~~5 T EOT crane for GIS area~~

~~The 5 T EOT crane shall be used for handling of GIS equipments in the GIS area. The contractor shall supply the required capacity of crane if requirement is higher than 5 T for hook without any additional cost implication to employer. The hook of the EOT crane shall have anti-sway arrangement.~~

~~The crane design shall be co-ordinated with the transformer, GIS and DT gate manufacturers for capacity and other provisions in the cranes with respect to installation layouts.~~

~~The GIS area EOT crane runway length and lift are anticipated as per layout drawing no. NHTS-VI-4GT241-GA-003 and 17m tentative respectively for hook. The runway length and lift of hook may vary as per the site condition which shall be finalised during detailed engineering and no extra cost for the same shall be paid, at any stage.~~

10.2.2. 90/10 T EOT crane for MIV CAVERN

The 90/10T EOT crane shall be used for handling of MIV in the MIV cavern. The contractor shall supply the required capacity of crane if requirement is higher than 90 T for main hook without any additional cost implication to employer. The hooks of the EOT crane shall have anti-sway arrangement.

The crane design shall be co-ordinated with the MIV manufacturers for capacity and other provisions in the cranes with respect to installation layouts.

The MIV cavern EOT crane runway length and lift are anticipated to be 89.75 m tentative and 16 m tentative respectively. The runway length and lift of hook may vary as per the site condition which shall be finalised during detailed engineering and no extra cost for the same shall be paid, at any stage.



TEESTA H. E. PROJECT, STAGE-VI

10.3. Rating and Functional Characteristics

10.3.1. 5 T GIS area EOT crane

1.	Number of Cranes	One (1)
2.	Duty or class of Crane	Class M3 using VVVF control
3.	Rated Capacity :	5 metric Tonnes
4.	Crane Span	7.75 m (tentative)
5.	Runway length	As per layout drg. No. NHTS VI 4GT241 GA-003
6.	Total Lift (with Load) :	17.0m (tentative)
7.	Tentative clearances/ hook approaches are as per below:	
a.	Minimum working clearance required for crane movement/ maintenance from the centreline of rail and nearest side obstruction on both sides	400 mm
b.	Maximum distance between top of gantry rail and the highest point of Crane	2500mm
8.	Terminal Position of Crane	
a.	Main hook from the centre of the gantry rail on Power House side	500 mm
b.	Main hook from the centre of gantry rail on Draft tube gate side	500 mm
c.	The distance of main hook from inner edge of wall/nearest obstruction in their terminal positions at both the ends	2000 mm

10.3.2. 90/10 T MIV CAVERN EOT crane

1.	Number of Cranes	One (1)
2.	Duty or class of Crane	Class M3 using VVVF control
3.	Rated Capacity :	
a.	Main Hoist	90 metric tonnes



TEESTA H. E. PROJECT, STAGE-VI

b.	Auxiliary Hoist	10 metric tonnes
4.	Crane Span	Refer "Crane clearance diagram"
5.	Runway length	
6.	Total Lift (with Load) :	
a.	Main Hook	
b.	Auxiliary Hook	
7.	Tentative clearances/ hook approaches are as per below:	
a.	Minimum working clearance required for crane movement/ maintenance from the centreline of rail and nearest side obstruction	
b.	Maximum distance between bottom of gantry rail and the highest point of Crane	
8.	Terminal Position of Crane	
a.	Main / auxiliary from the centre of the gantry rail on Downstream side	
b.	Main / Auxiliary from the centre of gantry rail on Upstream side	
c.	The distance of main and auxiliary hooks from inner edge of wall/nearest obstruction in their terminal positions at both the ends	

10.3.3. Common for (5 T) GIS area and 90/10 T MIV Cavern EOT crane

1.	Maximum operating speed (loaded) :	
a.	Long (bridge) Travel	3 m/min.
b.	Cross (trolley) Travel	1 m/min.
c.	Main Hoist lift	1 m/min.
d.	Auxiliary Hoist lift	5 m/min.
2.	Travel of Bridge	Maximum possible
3.	Travel of Trolley	Maximum possible
4.	Minimum Incremental movement (not greater than the given values) :	
a.	Main Hoist	1.5 mm



TEESTA H. E. PROJECT, STAGE-VI

b.	Auxiliary Hoist	1.5 mm
c.	Bridge Travel	3.0 mm
d.	Trolley Travel	3.0 mm
5.	Acceleration/deceleration for	
a.	Bridge Travel	0.10 m/sec ²
b.	Trolley Travel	0.08 m/sec ²

The dimensions are tentative and shall be finalized at the detailed engineering stage for achieving better dimensions only. The Contractor shall, however, co-ordinate the lifting requirement of machine components for erection with respect to the layout and dimension of powerhouse.

10.4. Performance Guarantee

The electric overhead travelling (EOT) cranes along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

The cranes shall be capable of raising, lowering holding and transporting their rated loads without any damage to or excessive deflection of any component.

The following shall be maintained in the operation of the cranes, with all brakes adjusted and functioning correctly and hook carrying rated load. Minimum possible travel/incremental movement are given below:

- | | | |
|------|-----------------------------------|--------|
| i. | Main Hoist vertical movement | 1.5 mm |
| ii. | Auxiliary Hoist vertical movement | 1.5 mm |
| iii. | Bridge travel | 3.0 mm |
| iv. | Trolley travel | 3.0 mm |

The vertical deflection of crane girders caused by the rated load plus all dead load should not exceed 1/1000 of the crane span.

10.4.1. 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.

In the event of extreme variation in supply voltage outside the expected limits defined in "Clause 1.3.1 of General Technical Requirements", there shall be total load control and measures shall be taken to place the handled equipment in a secure position.

Correct vertical motion functioning shall be guaranteed within the above mentioned ranges of expected frequency and supply voltage variation.

In the event of a loss of electrical supply, load control shall be ensured.



TEESTA H. E. PROJECT, STAGE-VI

Collisions of trolleys and pieces of equipment with buffers shall not endanger load control.

10.5. Design and Construction

10.5.1. Standards

Unless otherwise stated hereafter, rating, characteristics, design, test and test procedures, etc. concerning all the EOT cranes shall comply with the provisions and requirements of IS 3177-1999, IS 807-1984 and other applicable Indian Standards. Any design feature or detail not specified herein shall be in accordance with the above-mentioned standards which shall supplement these specifications.

10.5.2. General

The EOT Cranes shall be electrically driven, single trolley, double girder, and overhead travelling type. The cranes 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 and 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 feed rail power supply system mounted on convenient height along the length of powerhouse.

The dimensions of run length and crane span are tentative and shall be finalized at detailed engineering stage only. The Contractor shall supply the materials/equipment as per approved drawings and bill of materials and no extra cost shall be paid for any variation on this account.

The control system shall contain all the necessary controls for the operation of all the movements of bridge, trolley, main hoist, auxiliary hoist and monorail.

Along with operator cabins, EOT cranes shall be provided with necessary radio controls to perform all operations of the cranes. These radio controls shall be in addition to the control provided from operator cabins of the EOT cranes with suitable interlocks so that only one control is available for use at any time to perform the crane operations. EOT cranes shall be provided with detachable type pendant controller and remote radio control.

10.5.3. Allowable stresses

The structure parts of the crane shall be designed for the following load combinations and unit stresses.

1. Dead load, live load, impact load and horizontal forces with resulting unit stresses not exceeding 70% of the calculated allowable unit stresses as per standard.
2. Dead load, live load and collision forces resulting unit stresses.



TEESTA H. E. PROJECT, STAGE-VI

10.5.4. Bridges

The Crane Bridge shall be of box type all welded construction with web plates stiffened by suitable diaphragms. All parts of the crane and runway rails shall be designed to sustain the loads and the combination of loads listed. The bridge girder shall be designed in accordance to the IS: 3177 and IS: 807.

1. Dead load
2. Live loads
3. Vertical impact load
4. Braking load
5. Temperature effect

Each crane shall consist of two bridge girders supported on end trucks. The girder end connections to trucks shall be rigid so as to prevent skew in operation of crane. The girders shall be designed to safely carry the full rated load without undue vertical or, lateral deflection or vibrations.

Bridge shall carry the rails on which a wheeled trolley is to run. The girder shall be designed so that vertical deflection caused by the safe working load and weight of crab in the central position (without taking into consideration the impact factor) shall not exceed 1/1000 of the span. The unit stress, slenderness ratio as well as factor of safety assigned on designing various members shall be given in Technical Data Sheets. The design of the bridge girder shall take into account the transport limitations as mentioned in "Clause 1.5.1.6 of General Technical Requirements". If a split joint is required it shall be of bolted type.

10.5.5. 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.

The motor shall drive the bridge wheel through a totally enclosed gearbox. Gears shall be herringbone/helical type. The motion shall be free from vibration, rocking etc. under all conditions of operations and the crane structure shall not have tendency to get out of line. All gear reducers and drive mechanisms shall be designed and located to enable easy bridge wheel replacement within the confines of the powerhouse or other space limitations.

Foot switch shall be provided which shall be, operated from the cabin of crane to release/ apply the brakes. Wheel stopper shall also be provided along with buffer stopper for long as well as cross travels, so that in case of buffer stopper failure, the wheel stopper shall prevent the trolley from derailling.

10.5.6. Trolley

The trolley shall consist of a welded form of structural steel section adequately braced to withstand vertical, lateral and torsional strains



TEESTA H. E. PROJECT, STAGE-VI

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. Bearing housing shall be so designed as to permit easy removal of shaft. On the bottom of the trolley frame on each side, double end spring buffers shall be provided to engage stops at each end of the bridge. The hoisting arrangement shall be so installed on the trolley, so that the rope reeving arrangement resulting there from shall ensure lifting of load in almost vertical line with minimum swing or side movements.

10.5.7. 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 at least two (2) nos. 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.

10.5.8. End trucks, wheel and axles

The Crane Bridge shall be carried on the end trucks fitted with drive and idle wheels. Trucks shall be fabricated from high-grade structural steel. Heavy gusset plates shall be attached to the bottom of the truck to insure rigidity and squareness. Each truck shall be fitted with double flanged rail wheels with roller bearings mounted on rotating axles, buffers etc. for easy maintenance. The truck shall be arranged so that wear may be compensated in order to maintain the drive gear in proper condition. The size of journals shall be ample to carry the rated capacity load at specific speed without excessive heating during continuous operation. All trucks shall be designed to permit easy wheel removal.

Trucks shall be equipped with rail sweeps, extending below the top of rail and projecting in front of the truck wheels, to push forward off the track, any object placed across the rail.

Safety lugs shall be provided which shall extend below the top of rail on both sides to prevent the trucks from leaving rails. Wheel assembly shall be arranged such that, replacement of a wheel can be achieved from the side without undue difficulties.

The end trucks shall be designed to contact end stops and the contact faces shall be fitted with resilient bumpers or, spring buffers. The end stops shall be provided and they shall be designed such that they contact the face of the buffer fitted on end truck and not the wheel. The stops shall be attached at each end of runway rails.



TEESTA H. E. PROJECT, STAGE-VI

The design and construction of track wheels shall be in accordance with IS: 3177-1999. All wheels shall be double flanged, machined or ground to size. The wheels shall be made of forged steel or rolled steel and shall be mounted in such a manner so as to facilitate removal and replacements. The steel shall not contain more than 0.06 percent of either sulphur or phosphorus. The hardness of the wheel rim should be maintained between 300 to 350 BHN with minimum depth of 10mm.

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 Indian Standards. The tread diameter shall be as per relevant Indian Standards and preferably be standardized to size specified in relevant standards. The truck axes shall be made of forged carbon, or alloy steel and shall be accurately turned ground and polished at the wheels. All axes shall be forced fit into the wheel and the driving wheels shall be keyed to the axes 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.

10.5.9. Hoisting machinery

The main hoist and an 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.

10.5.9.1. Hoist drum and wire rope

The trolley shall be provided with separate rope winding hoisting drum for main and auxiliary hoists. Each drum shall be designed to take full length of hoisting rope in one layer without layer winding. The end of the wire rope shall be anchored to the drum in such a way that the anchorage is readily accessible. Hoisting drum shall be flanged or guarded and provided with deep-machined grooves in sufficient nos. to leave at least two coils of rope in the groove when the hook is in the lowest position. At least, one groove shall remain unused when the hook is at highest position. Drum shall be designed to withstand compressive stress caused by the wound on rope, the bending stress due to beam action on the drum and torsional stress. The factor of safety of the rope drum shall not be less than five (5).

The wire ropes shall be corrosion resistant and of proper design and construction for crane service. The wire ropes shall be of extra flexible plow steel or alloy steel conforming to latest relevant Indian Standard. Factor of safety based on the nominal breaking strength and safe working load of the rope shall not be less than six (6).

10.5.9.2. Design of hoist drum

Hoist drums shall be of rolled steel, welded construction and shall be duly stress relieved. Lead angle, grooving, diameter and other parameters of



TEESTA H. E. PROJECT, STAGE-VI

hoist drum design shall conform to relevant Indian Standards (IS 3177:1999).

10.5.9.3. 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. For GIS area and MIV cavern EOT cranes, the main hook shall be "Ramshorn" type conforming to Indian standards and auxiliary hook shall be of Shank type point hook conforming to Indian standards. Hooks shall be swivelled on antifriction thrust bearings and have adequate capacity to handle maximum load. The thrust bearings shall be provided with facilities for lubrication.

The hooks shall be free to rotate 360° when supporting rated load. Hooks shall be fitted with safety latches designed to preclude inadvertent displacement of slings from the hook saddle.

Hooks and lifting eyes shall be made of forged annealed alloy or carbon steel. Hooks shall be designed such that the resultant load on the hook passes through the centreline of the shank. Prior to machining, all hooks shall be subjected to ultrasonic test and wet magnetic particle inspection of all surfaces of the forging.

10.5.10. Runway rails

The runway rails along with sole plates, fixing clamps etc. for bridge travel, shall be designed and supplied by the Contractor as per relevant Indian Standards. The rails for power house EOT crane shall be at least CR-100 and shall extend to the full length of the power house including the service bay in power house. The EOT crane rails shall be provided with continuous sole plate of at least 12mm thick. The trolley rails shall be of the same size, quality, material and class as that of main runways rails. The rails shall also be supported side way to withstand the starting and stopping of trolley with load. The Contractor shall supply all the materials required for fixing the bridge and trolley rails.

10.5.11. Operator's cabin

The MIV cavern EOT crane shall be equipped with operator 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 girders of the crane and braced to the crane so as not to sway, swing or shake.

Cabin shall have ample space for containing the control equipment and for performing all crane operations and maintenance as per provisions of IS 3177:1999. An operator's seat, an electric fan and a background light shall be provided.

A ladder shall be provided for access from the cabin to the bridge walkway. Another ladder shall be provided on the back of the cabin to



TEESTA H. E. PROJECT, STAGE-VI

provide access from the catwalk to the walkway on the cabin side of the crane. Suitable doors with safety position detector and an emergency light shall also be provided.

Adequate number of CO₂ gas cylinders, each of 4.5 kgs capacity, for fire extinguishers shall be provided in the cabin, on the bridge, suitably located and properly authorized.

10.5.12. Brakes

Automatic electro-mechanical DC brakes and electro hydraulic thrusters brake for each motor of LT travel shall be provided. In addition foot switch shall be provided in the cabin for operation of the electro-mechanical DC brakes and electro hydraulic thrusters brakes for LT.

An automatic electro-mechanical DC brakes 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. The monorail hoist's holding brakes shall be rated for not less than 150% of the full load torque of the hoist motor.

Two brakes working on different principles shall be provided for all hoists. Hoisting motion shall be fitted with an electro-mechanical DC brake and electro hydraulic thruster brakes. The hoisting brakes shall be fail safe and shall have adequate capacity to bring the fully loaded crane to rest in shortest possible time and to arrest the motion and sustain any load up to and including test load at any position while hoisting and lowering. Each brake shall be capable of meeting the complete hoisting requirements independently.

Springs for the electro-mechanical brakes shall be of the compression type and shall have adequate factor of safety. The brake pedals shall have a non-slip surface and it shall be possible to apply foot brake with a force not exceeding 25 kg force.

All brakes shall have ample thermal capacity for the frequency of operation required by the application and shall be adjustable to compensate for lining wear. The friction surfaces of all brake drums, wheels and discs shall be free of defects that interfere with operation.

All brakes on travelling motions shall be selected for 1-hour intermittent duty and shall be equally effective in both directions of movement. All holding brakes on hoist motions shall be designed for continuous duty. Magnets for all brakes shall be rated for continuous duty.

Braking system shall be automatically set when controls are released or power is interrupted.

10.5.13. Gears

All cranes shall be provided with proper gearing, using least number of gears and pinions to accomplish the needed reduction. All gears in power-operated motions shall be machine cut conforming to relevant Indian Standard. The gear trains shall be in totally enclosed oil tight gear cases with welded seams. An inspection cover on the top of gear case shall be



TEESTA H. E. PROJECT, STAGE-VI

provided for quick and easy inspection of gears and for adding oil in the case. Adequate breathing and drainage facilities shall be provided on all gear cases. Means for clear and correct indication of the oil level in gear cases shall be provided. All gears not enclosed in gear case shall be properly guarded.

All gears shall be of cast steel/forged steel, shall be designed for the specified crane duty, and shall conform to relevant Indian Standards. The gears and pinion for all the motion 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.

10.5.14. Bearing

Bearings shall be of the ball or roller type and shall be designed to permit easy removal of the shaft. Bridge and trolley wheel bearings shall be of the roller type. All bearings shall be provided with proper lubrication or means of lubrication. Bearings shall be designed to exclude dirt, prevent leakage of oil or grease, and to eliminate the need for frequent lubrication. Shaft bearings shall be placed as close as possible to points of loading. Bearings shall be easily replaceable. Bearing housings shall be of cast iron, cast steel, or welded steel construction. The service life of all bearings shall be not less than 10,000 hrs at the design speed and power. These service hours shall represent the life that 90% of the bearings shall complete or exceed.

10.5.15. 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. Means for cleaning the drip pans shall be available. Dust cover shall be provided where necessary to protect sliding and rotating parts and to prevent dust from mixing with lubricant.

10.5.16. Guarding

All gears, wheels, pinions and chain drives shall be totally encased unless such parts are so situated in relation to the structure of crane as to be as safe as if complete encasement were provided. Effective guards shall be provided for revolving shafts and couplings unless every setscrew, bolt or key on any revolving shaft is sunk, shrouded or, otherwise effectively guarded. The sheaves of hook blocks fitted with two sheaves or less shall be guarded to prevent the trapping of a band between a sheave and the in-running rope. Guards shall be fastened securely.

10.5.17. 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.



TEESTA H. E. PROJECT, STAGE-VI

The sheave pins shall be made of annealed carbon or alloy steel. All revolving sheaves shall be equipped with standard replaceable roller bearings with dust seals.

The diameter of the sheaves at the bottom of the groove, the lead angle and other parameter of sheave design shall conform to relevant Indian Standards (IS 3177:1999).

10.5.18. Couplings

All couplings shall be as per relevant standards and shall be designed to suit the maximum torque that may be developed. Alignment shall be such that solid couplings mate accurately. Flexible couplings shall be initially aligned with the same accuracy as solid couplings. Flexible couplings shall be fitted between motor shaft and gear drive when they are directly coupled. Hoist drums shall preferably be connected to gear box output shaft by means of flexible hoist drum couplings or by any other suitable method to cater for misalignment, frame distortion etc. and also to facilitate easy removal of hoist drum.

10.5.19. Electrical apparatus and control

10.5.19.1. General

A two way supply control switch shall be installed which shall be fed A.C supply from two boards. A.C supply to runway conductors shall be fed from this switch. The Contractor shall supply all equipment and devices required for this.

Allowable temperature rise of the equipment shall be as prescribed in the relevant Indian Standards.

10.5.19.2. Motors

The crane shall be equipped with motors of ample capacity for performing the duties specified without exceeding the rated full load torque and shall conform to latest version of relevant Indian Standards.

All the motors should be totally enclosed type and shall be strong and sturdy to withstand shock and vibrations transmitted to them. The IP protection class shall be 55 and insulation class 'F' with temperature rise limited to class 'B'.

All motors shall be suitable for frequent start-stop, frequent reversing, frequent acceleration and mechanical braking. Motor shall be so located that terminals are accessible for inspection and maintenance and normal ventilation is not restricted.

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.

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.



TEESTA H. E. PROJECT, STAGE-VI

10.5.19.3. Controllers

All hoist and travel motions of MIV cavern EOT crane shall have cabin and remote control operated. ~~All hoist and travel motions of GIS area EOT crane shall be pendant and radio remote controlled.~~

The controllers shall be so located that they can easily be operated by one person and permit an unrestricted view of the load. The controllers shall be designed to permit easy inspection, adjustment and replacement of parts. All electrical equipment shall be suitably enclosed so that live parts shall not be exposed to accidental contact under normal operating conditions. All master control switches, manually operated switches, circuit breakers, starters, contactors, limit switches and relays shall be clearly and permanently identified by attached nameplates.

i) Pendant controllers

The GIS area EOT crane shall be independent travelling pendant controlled having its own electrification track and can move anywhere along the span of crane without being tied to the hoist. The pendant switches shall be capable of withstanding rough handling and harsh environmental conditions without being damaged and the cover shall be effectively secured.

Means shall be provided to prevent inadvertent operation from the floor while maintenance work is being carried out on the crane. Push buttons or switches shall be used in pendant control, which shall automatically return to the "Off" position immediately after they are released. One lockable type push button shall be provided to switch off control power when the crane is not in use and if other means of switching off is not available. The weight of the pendant shall be supported independently of the electric cables by means of chain or wire rope.

ii) Radio control

Radio controls shall be provided for control of the MIV cavern and GIS area cavern EOT cranes. Radio controls provided shall be in addition to the main controls with necessary interlocks so that the operator shall be able to use only one type of control at a time.

Main components of radio control shall consist of the following:

1. A portable transmitter,
2. An antenna and receiver on the bridge,
3. Amplifiers and other associated electronic circuitry,
4. Each radio-controlled crane shall be equipped with a 100-W amber indicator lamp located beneath the centre of one of the bridge girders. This light shall be energized whenever the crane is in the radio control mode and the crane's master contactor has been energized.

Reliability, dependability and ease of maintenance shall be prime considerations in the design and construction of all components and parts of the equipment, to ensure positive operation of the system under all conditions of dust, moisture, temperature, vibration and electrical interference.

Radio control should be so designed that if the control signal for any crane motion becomes ineffective, that crane motion shall stop, and conversely



TEESTA H. E. PROJECT, STAGE-VI

signals received from any other source other than the transmitter shall not result in operation of any motion of the crane. The crane shall not take off on its own, respond to, or generate false commands. In case of power failure, the crane must stop.

Frequency ranges of 450 – 470 MHz shall be used for radio control communications

The range of control shall be approx 100 meters.

A key switch or equivalent security device on the transmitter, that can be used to prevent unauthorized use of the transmitter, shall be provided. Reduced maintenance requirements and long service shall be achieved through simplicity and use of conservatively rated, heavy-duty industrial type parts.

The design of the equipment circuitry and the application of components shall represent the state of the art. Wherever practicable, replaceable modules with reliable plug-in connections shall be used. The system shall be designed so that no field tuning adjustments is required when replacing a faulty module and shall permit a field change of the operating frequency by replacement of plug-in type components with minimum adjustment.

The radio control equipment shall be the type accepted by and shall conform to all applicable Indian standards, rules and regulations. The Contractor shall perform a frequency search and shall obtain necessary operating license on behalf of the Employer.

A carrying harness, belt shoulder strap or lanyard shall be provided on the transmitter.

Different motion switches shall be with different shaped knobs so that the motion can be selected by feel and the operator's vision.

10.5.19.4. Operation

1. The following functions of EOT cranes shall be radio controlled (as per applicability):
 - a) Forward and reverse speed control of the bridge travel motion;
 - b) Right and left speed control of each trolley travel motion;
 - c) Up and down speed control of each hoist motion;
 - d) On and off control of the crane's master contactor;
 - e) On and off control of the lights on the underside of the crane bridge;
 - f) On and off control for the crane's alarm gong.
2. The speed control of each motion shall provide for the direct radio control specified for that motion.
3. Radio control shall be accomplished with a speed set point tele-metering system utilizing pulse rate, pulse width, or other similar systems. The speed of a motion shall be a direct function of the control lever's position and shall preferably utilize a logarithmic scale for greater control of the slower speeds. A "Jogging" system of controlling a motorized potentiometer or any other system in which



TEESTA H. E. PROJECT, STAGE-VI

the control lever's position corresponds to acceleration rather than a speed is unacceptable.

4. Control information shall be transmitted using digitally coded information. The radio control system shall allow simultaneous transmission of all crane functions. A means of checking and detecting error in the digital data stream shall be provided to prevent a false operation of the crane. Radio interference signal shall not cause operation of any of the crane functions.

The power supply to the radio receiver shall be obtained from a branch circuit in the power distribution panel.

10.5.19.5. Speed regulation

Speed regulation shall be accomplished utilizing WVF drive control system for all crane motions. The hoist and travel motions shall be provided with speed-regulations from 5 to 100% of rated speed. Minimum 6 (six) steps controller shall be provided for each hoist, CT and LT motion to accomplish any speed between 5 to 100% of rated speed. It shall be possible to set any speed at site without any problem within the above range. Speed control shall be achieved by adjusting the frequency of the motor electrical supply using thyristors. (Combination of power Rectifier Bridge and inverter).

The maximum acceleration produced by the control system shall be independent of the rate of change of the control lever position. The speed in the first lowering position shall not exceed 5% of the synchronous hoist speed when lowering any load up to rated load. The speed in the first hoisting position when lifting any load up to 125% of rated hoist capacity shall not exceed 5% of the synchronous hoist speed.

10.5.19.6. Control system details

1. For Travelling Movements:
 - a) Each travel motion shall have a separate control lever or set of push buttons.
2. For Hoists:
 - a) General: Separate controllers shall be provided for each hoist. Smooth acceleration shall be provided for all loads in both directions,
 - b) Lowering: The lowering speeds for all loads within the rated capacity shall be gradually increased by advancing the controller from the off position toward the full-on lowering position. The lowering speed shall not exceed 125% of the rated speed on any control position,
 - c) Hoisting: The hoisting speeds for all loads within the rated capacity shall be smoothly increased by advancing the controller from the off position toward the full-speed hoisting position. In no case shall any load up to 125% of rated capacity cause a hoist to lower when the controller is in any raising position.



TEESTA H. E. PROJECT, STAGE-VI

10.5.19.7. Control levers and push buttons

All lever-operated controls shall have self-resetting controllers provided with a notch or latch, which in the "off" position prevents the handle from being inadvertently moved to the "on" position. Switch levers shall have automatic spring return to the "off" position. All pushbutton controls shall be of the momentary contact type, which make contact only while the button is depressed. Wherever possible, controls shall be arranged so that the movement of each controller handle shall be in the same relative direction as the resultant movements of the load. Pushbuttons shall be oriented in the same relative direction with respect to each other as the resultant movements of the load.

10.5.19.8. Limit switches

Necessary limit switches shall be provided for all cranes including monorail hoists to prevent over winding, over traversing and over travelling. At least the following limit switches shall be provided for each crane:

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

Each limit switch shall be positive and unidirectional in action and its contact shall be so designed that it shall not freeze. Contacts shall be enclosed and protected from dust, moisture, and mechanical injury and shall be easily removable for replacement. The switches shall be of quick-break type, capable of stopping the equipment quickly under all conditions of speed and loading. The limit switches after being tripped shall automatically get reset. The actuation of the limit switch shall trip the main incoming circuit breaker or contactor and shall operate an audio-visual warning to the operator.

The manufacturer shall fit one or more devices to the bridge of the crane to give warning of the approach to the danger or another crane using infrared light sensors. Limit switches shall be so arranged that they can be readily tested.

10.5.19.9. Detection devices

1. Over speed detection - Each handling device (AH, MH, CT & LT motion) shall be equipped with an over speed detection device, to check the maximum speed under any load. They shall be set at 115% of rated speed.
2. Load control device - Load control device shall be provided for main and auxiliary hoist of EOT cranes which shall display the hoisted load value.
3. Unbalance Detection - Unbalance detection shall be provided during tandem operation. Balancing system shall be equipped with an unbalance detection device that shall stop the hoisting motion.



TEESTA H. E. PROJECT, STAGE-VI

4. Detection of brake wear – Brake wear detection shall be provided for EHT brakes of all motions. This protection shall set off a sound alarm.
5. Overload detection – Each hoisting (MH and AH) motion shall be equipped with an overload detection device that shall stop the hoisting motion. In case of overload and after local resetting, uptake shall remain prohibited but other motions shall be allowed. After removal of the cause of overload, normal operation shall resume.

10.5.19.10. Protective panels

The power supply from main collectors shall be protected by a three pole main line contactor and totally enclosed circuit breaker with a minimum interrupting capacity of 40 kA at 415 V to switch off power supply to the crane with provision to lock in open position. Electrical interlocks shall be provided to prevent the main circuit breaker from being closed unless all the controllers are in 'OFF' position. The circuit breaker control circuit shall be so arranged that it shall not be possible to close main circuit breaker when the contactor of a particular motion has failed to open although the corresponding controller has been brought to its 'OFF' position. Indicating lamp for 'ON' and 'OFF' position of circuit breaker shall be provided. The following protection shall be provided for all motors:

1. Single phase protection,
2. Instantaneous over current protection,
3. Thermal overload relays,
4. Under voltage protection.

The contacts of protective relays shall be so worked that the operation of any relay shall trip the main contactor, thus making it necessary to bring all the controls to OFF position before restarting the motor. The instantaneous relays shall be adjustable between 200 - 300% of motor full load current.

All switches, contactors shall be enclosed in suitable cabinet placed in accessible location.

10.5.19.11. Long travel current collection system

Each crane shall be provided with an approved feed rail power supply system. The feed rail system shall be of the shrouded metal enclosed, collector bus way type with internally supported conductors and collector trolley and shall have no live parts outside of the enclosure. Material of the conductor shall be copper.

The full current-carrying capacity of the system shall be maintained throughout. The feed rail system shall consist of an assembly of standardized, fully interchangeable units and shall include expansion sections at each building contractions joint, feed box, door track sections or other means of removing the collector trolley, coupling sets, dead-end caps track hangers and power take off collector trolleys as required for the complete system.



TEESTA H. E. PROJECT, STAGE-VI

10.5.19.12. Power conductors for the crane trolley and monorail hoist (cross travel current collection system)

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.

10.5.19.13. 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 carrying capacity as per relevant Standard specification. Conductor for power and control cables shall be armoured copper and FRLS type.

10.5.19.14. Lighting and convenience outlets

The permanent 230 volts lighting system for each crane shall consist of suitable nos. of 400W lighting units to illuminate uniformly the area under the crane and 2 nos. 40W 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.

Convenience outlets at each end of the bridge and two in operator's cabin shall be provided. One all purpose fan shall be fitted in operator's cabin.

10.5.19.15. Alarm gong

An electrically operated loud alarm gong or buzzer, which shall 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.

10.5.19.16. 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.

10.5.19.17. Emergency push button

Emergency push button shall be provided in the cabin/pendant controller/remote control unit 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.

10.5.20. Other construction details

10.5.20.1. General

All fastening shall be adequate to hold the parts in place under all condition of service. All steel castings, steel forgings and wrought steel wheels and sheaves shall be annealed properly. Steel used in crane shall be of tested quality. The unit stresses values and slenderness ratio



TEESTA H. E. PROJECT, STAGE-VI

assumed in designing various members, shall be furnished by the Contractor.

10.5.20.2. Bolts, nuts, screws, washers and fasteners

Bolts and nuts for mechanical equipment shall be semi-finished and shall have hexagonal heads. All bolts and setscrews in rotating parts shall be locked. Bolts in tension shall be avoided wherever possible. Tapered washers and tapered pads shall be provided on the underside of steel sections with tapered flanges and shall be tack-welded in place.

10.5.20.3. Keyways

Connections subject to torsion such as couplings, driving wheels, and drive gears shall be keyed to the shafts with rectangular keys. The keys shall be sized to be within safe bearing and shearing limits of the materials in contact.

10.5.21. Miscellaneous components

10.5.21.1. Walkways and 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. Walkways shall be provided on both sides along the entire length of the bridge. All walkways and stair ways shall be of rigid construction, with hand railing and non-skid checker plate treads or grating, toe-boards not less than 0.1 m high. Walkways shall be continuous and permanently secured. Walkways shall have a clear passageway.

10.5.21.2. Bumpers

Bumpers shall be attached to the bridge trucks and the trolley. The bridge shall have four bumpers one at each corner arranged to meet the crane stops. The trolley shall have two bumpers on each side placed to meet the trolley stops. The bumpers shall be fastened to the trucks and the trolley and shall be capable of bringing the crane and the trolley to a gradual stop when travelling at rated speed in either direction.

10.5.21.3. Holding clamps

As a safeguard against movement of crane off the rail during an earthquake, suitable provision to contain the movement of crane shall be made. Clamps to keep the crane in a locked condition while not in operation and indication of locking in cabin/pendant shall be supplied and arranged.

10.5.21.4. Cradles for load test

For load and overload tests suitable cradles, complete with hoisting attachments, slings etc. capable of accommodating test load shall be



TEESTA H. E. PROJECT, STAGE-VI

supplied. The design of cradle should be got approved by Employer indicating its iron weight. The cradle shall become property of Employer.

10.5.22. Auxiliary system and devices

10.5.22.1. Lubrication system

Provision shall be made for lubricating all bearings, gears and other moving parts, which shall be easily accessible from working platform of the crane. The wheel bearings, shaft bearings, sheave and drum bearings shall be provided with fittings for grease lubrication. For bearings that are not accessible from a safe position, tubing or piping should extend the grease fittings from the bearings to accessible locations. Positive oil bath lubrication shall be provided for the hoist, bridge and trolley gear cases and their integral bearings. A lubricating chart shall be provided indicating all the lubricating points, the type of lubricant and recommended frequency of lubrication. Grease, lubricating oil and hydraulic brake fluid required for initial filling of all the equipment plus 100% reserve shall be furnished with each crane.

10.5.22.2. Anti-drip provisions

Cranes shall be designed to preclude leakage of lubricants onto the lifted loads or the floor. Equipment and components which cannot be made leak-proof shall be fitted with suitable drip pans. Drip pans shall be manufactured of steel and designed to permit removal of collected lubricant.

10.5.22.3. Safety devices

Following safety devices shall include but not limited to the following:

- i. Rail sweeps at extremities of end carriage,
- ii. Safety lugs under end carriage to prevent failing of crane beyond 25 mm in the event of breakage of axles,
- iii. Safety guards shall cover pulleys and exposed rotating parts like couplings and shafts,
- iv. A guard between the two bridge girders to prevent contact between wire rope and conductors,
- v. Hand railing on walkways and staircases,
- vi. Toe-guard and hand railings along other edges of platform,
- vii. Off-position interlock on the controllers so that a motion cannot be started unless the controller handle is first brought down to off-position,
- viii. Emergency STOP push button in cabin/pendant/ remote control unit,
- ix. Electrical interlock for reversing contactors,
- x. Limit switches for all motions,
- xi. Anti collision devices to prevent collision of the two powerhouse EOT cranes,



TEESTA H. E. PROJECT, STAGE-VI

- xii. Overload relays, MCCBs and HRC fuses for protection of motors,
- xiii. MCCBs in the service bay to trip A.C power supply to crane in case of overloading/ short circuit.)

10.6. Drawings, Documents and Design Calculations

10.6.1. Design memorandum

The Contractor shall submit to Employer a design memorandum prepared in accordance to clause 1.6 "Record and Documentation" of "Section 2- General Technical Requirements."

10.6.2. Drawings and documents

The Contractor shall submit all the drawings and documents in accordance with requirements stipulated in "Section 2 - Technical Documents" of "General Technical Specification (GTS)".

10.6.3. Design calculation

The Contractor shall submit the design calculation in accordance to Clause 2.4 of "General Technical Specification (GTS)" covering at least the following, for review / acceptance.

1. Calculation for allowable stresses , factor of safety and other parameters for designing the EOT cranes,
2. Calculations for selection of motor, brakes, DSL conductor, runaway rails and cross travel rails etc.,
3. Calculation for design of bridge girder, end carriage, lifting beam, cradle, girder joint,
4. Calculation for design and selection of wire rope, rope drum sheaves and wheel size.

10.7. Delivery, Installation and Commissioning

The Contractor shall follow the requirements of Delivery, Installation and commissioning elaborated in clause 1.7 "Delivery, Installation and commissioning" of "General Technical Requirements."

10.8. Spare Parts

Specified spare parts to be supplied under this section are as follows:

S. No.	Description	Quantity
A. GIS AREA EOT CRANE		
1.	Main hoist	
a.	Wire rope	1 full length
b.	Set of brake lining, pad, motor, springs, seal kit, solenoid coil etc. complete with	1 no.



TEESTA H. E. PROJECT, STAGE-VI

	rivets etc. for each type brake supplied	
e.	Electric motor	1 no. of each type
d.	Limit switches	1 nos. of each type
2.	Bridge drive	
a.	Electric motor	1 no. of each type
b.	Set of brake lining, pad, motor, springs, seal kit, solenoid coil etc. complete with rivets etc. for each type brake supplied	2 nos.
e.	Limit Switches	1 no. of each type
3.	Trolley drive	
a.	Set of brake lining, pad, motor, springs, seal kit, solenoid coil etc. complete with rivets etc. for each type brake supplied	1 no.
b.	Electric motor	1 no. of each type
e.	Limit Switches	1 no. of each type
4.	Other miscellaneous spares for complete crane;	
a.	Circuit breaker of each type	1 no.
b.	Fuses including fast acting fuses used in thyristor circuits	2 nos. of each type
e.	Indicating lamps/ LED	2 nos. of each colour (red, blue, green, amber, white etc.)
d.	Overload relays and time delay relay	2 no. of each type
e.	Bearings for wheels, gear boxes, hooks, hoist drum and motors for complete crane	2 nos. each type and size
f.	Push button	2 nos. of each colour (red, blue, green, amber, white etc.)
g.	Module (Rectifier/ MOSFET/Thyristor)	1 no. for each MH, GT and LT
h.	VVVF drive complete assembly	1 no. for each MH, GT and LT
B. MIV CAVERN EOT CRANE		
1.	Main hoist	
a.	Wire rope	1 full length
b.	Set of brake lining, pad, motor, springs, seal kit, solenoid coil etc. complete with	1 no.



TEESTA H. E. PROJECT, STAGE-VI

	rivets etc. for each type brake supplied	
c.	Electric motor	1 no. of each type
d.	Limit switches	1 nos. of each type
2.	Auxiliary hoist	
a.	Wire rope	1 full length
b.	Set of brake lining, pad, motor, springs, seal kit, solenoid coil etc. complete with rivets etc. for each type brake supplied.	1 no.
c.	Electric motor	1 no. of each type
d.	Limit switches	1 nos. of each type
3.	Bridge drive	
d.	Electric motor	1 no. of each type
e.	Set of brake lining, pad, motor, springs, seal kit, solenoid coil etc. complete with rivets etc. for each type brake supplied	2 nos.
f.	Limit Switches	1 no. of each type
4.	Trolley drive	
d.	Set of brake lining, pad, motor, springs, seal kit, solenoid coil etc. complete with rivets etc. for each type brake supplied	1 no.
e.	Electric motor	1 no. of each type
f.	Limit Switches	1 no. of each type
5.	Other miscellaneous spares for complete crane;	
a.	Circuit breaker of each type	1 no.
b.	Fuses including fast acting fuses used in thyristor circuits	2 nos. of each type
c.	Indicating lamps/ LED	2 nos. of each colour (red, blue, green, amber, white etc.)
d.	Overload relays and time delay relay	2 no. of each type
e.	Bearings for wheels, gear boxes, hooks, hoist drum and motors for complete crane	2 nos. each type and size
f.	Push button	2 nos. of each colour (red, blue, green, amber, white etc.)
g.	Module (Rectifier/ MOSFET/Thyristor)	1 no. for each MH, AH, CT and LT



TEESTA H. E. PROJECT, STAGE-VI

h.	VVVF drive complete assembly	1 no. for each MH,CT and LT
----	------------------------------	--------------------------------

The contractor shall furnish the list of recommended spares in accordance to clause 1.8 "Spare Parts" of "General Technical Requirements".

10.9. Tools and Instruments

The Contractor shall supply all necessary tools and instruments etc. for installation, repair and maintenance in accordance to clause 1.9 "Tools and Instruments" of "General Technical Requirements".

10.9.1. Special tools

The Contractor shall list and supply all special tools. List of such tools including their make and detailed specification, shall be submitted for acceptance by the employer.

The proposed list of special tools must include the following in addition to tools recommended by manufacturer(s)

1. Two (2) sets of Grease gun hand lever type,
2. One (1) sets of Grease gun trolley mounted type,
3. One (1) set of hydraulic jack of 7.5 T capacity,
4. One (1) set standard kit of tools.

10.10. Quality Assurance and Testing

The Contractor shall follow the quality assurance and testing requirements specified separately in "Quality assurance and Testing Specifications (QTS)".



VOLUME-III C

TECHNICAL DATA SHEETS (TDS)



TEESTA H.E. PROJECT, STAGE-VI

10 ELECTRIC OVERHEAD TRAVELLING (EOT) CRANES

10.1 Guaranteed Technical Particulars

Item / Clause No.	Parameter	Unit	Employer's Requirement	Bidder's Confirmation / seal / signature
2	MIV AREA CAVERN EOT CRANE			
2.1	Type	-	Electrical Overhead Double Girder	Confirmed
2.2	Number of cranes	Nos.	1	Confirmed
2.3	Duty class of cranes	-	M3	Confirmed
2.4	Rated capacity of			
2.4.1	Main hoist	tonnes	90	Confirmed
2.4.2	Auxilliary hoist	tonnes	10	Confirmed
2.5	Crane span (centre to centre of rails)	m	6.10 (approx.)	Confirmed
2.6	Runway length	m	89.75 (approx.)	Confirmed
2.7	Total lift (with load) of :			
2.7.1	Main hook	m	Not less than 16	Confirmed
2.7.2	Auxiliary hook	m	Not less than 16	Confirmed
2.8	Maximum operating speeds (at rated load)			
2.8.1	bridge travel (long)	m/min.	Not more than 15	Confirmed
2.8.2	trolley travel (cross)	m/min.	Not more than 10	Confirmed
2.8.3	main hoist lift / lower	m/min.	Not more than 1	Confirmed
2.8.4	auxiliary hoist lift / lower	m/min.	Not more than 5	Confirmed
2.9	Maximum vertical deflection of bridge girder at rated load including dead load	mm	Span/1000	Confirmed
2.10	Speed Regulation	-	5% to 100%	Confirmed
2.11	Crane motors			
2.11.1	Drive	-	VVVF	Confirmed
2.11.2	Insulation class and protection class	-	F, IP55	Confirmed
2.11.3	Duty factor of motor for normal speed	-	40%	Confirmed
2.12	Type of brakes for			
2.12.1	LT travel	-	DCEM + EHT	Confirmed
2.12.2	CT travel	-	DCEM + EHT	Confirmed
2.12.3	Main hoist	-	DCEM + EHT	Confirmed
2.12.4	Auxiliary hoist	-	DCEM + EHT	Confirmed
3	Compliance of latest standards as per PTS clause no. 10.5.1	-	Yes	Confirmed
4	Complete Compliance of Specification	-	Yes	Confirmed

Bidder's Seal and Signature
of Authorized Representative



Vol.V

Forms & Procedures



ATTACHMENT-5

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
1	Bus duct	
1.1	Bus duct	BHEL C&S Best & Crompton Narmada
1.2	CT & PT	Prayog Elect. Pragati Silkaans Kappa AE
1.3	Lightening / Surge Arrestor	Elpro Oblum
1.4	Neutral Grounding Transformer	Pragati Prayog Elect.
1.5	Procelain Insulators	BHEL Aditya Birla Insulators W S Industries India Limited Modern insulators Ltd
1.6	Epoxy Insulators/ Epoxy Seal Off Bushing	Baroda Bushing & Insulator Baroda Mould & Dies India Insulator A Bond Strands Texplas
1.7	Surge Capacitor	Madhav Capacitors Shakti Capacitors Pvt Ltd, Sangli Magnewin Energy Pvt Ltd ABB
2	GSU transormer	BHEL GE CGL TELK ABB TOSHIBA
2.1	Moisture Detector (Water in Oil Detector)	BHEL GE Robertshaw Onix instruments MAPE Nederman SART Vaisala GE Hydro Endress + Hauser
2.2	Double Walled oil Coolers	Kelvion India Pvt. Ltd. Bloksma Netherland
2.3	HV Bushings	BHEL/CGL/ABB/ HSP (HOCHSPANNUNGSGERATE PORZ) GMBH TRENCH UK
2.4	Transformer Oil	SAVITA APAR RAJ Petrochemicals

373955/2021/PS-PEM-MAX

Attachment-5A

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
2.5	Buchholz Relay	ATVUS, Kolkata / SUKRUT ELECTRIC Pune
2.6	OTI / WTI (Micro Switch Type)	PRECIMEASURE / PERFECT CONTROLS
2.7	Magnetic Oil Level Gauge (MOLG)	SUKRUT UDYOG / YOGYA ENTERPRISES, Jhansi / ATVUS, Kolkata
2.8	Nitrogen Injection System	GK POWER TRANSMISSION COMPANY PVT. LTD., INDIA SERGI, FRANCE CTR EASUN-MR
3	220 KV XLPE cables	Sudkabel GmbH SAGEM SA Nexans Brugg kables Viscas Corporation (Earlier Fujikura Ltd) ABB J Power systems Corp. LS Cable Pirelli Iljin Taihan
4	Gas insulated Switchgear	ABB GE Toshiba Siemens
5	220 KV Out door Pothead yard equipments	
5.1	CVT	BHEL ABB CGL ELPRO GE
5.2	L.A./Surge Arrestor	ABB CGL ELPRO GE WSI Obulum Electrical Industries Pvt Ltd LAMCO
5.3	Line/wave trap	BPL GE ABB Trench Electric BHEL

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
5.4	CT & PT	ABB BHEL GE CGL
5.5	Lattice Structures	Jyoti structures Utkal Mengi steel Products Ltd Sujana Towers Ltd AV Forging L&T ECC GKW Salasar Techno Engg. KEC
5.6	Isolator	CGL ABB ELPRO HIVELM GR Power Switchgear GE Oblum Lamco S&S Siemens Versatek
5.7	Earth Switch	BIMCO GE BHEL S&S
5.8	Post Insulator/ Insulator Stack	Modern insulators Ltd BHEL Aditya Birla Insulators
6	DC System	
6.1	Battery Bank	Amara Raja Caldyne AMCO HBL Nife Power Systems Exide
6.2	Battery Charger	HBL Nife Power Systems Amara Raja Statcon Chhabi DB Electronics Caldyne Siemens APLAB Chloride
6.3	DC Distribution Board	Siemens Schneider L&T GE Statcon C&S DB Electronics Caldyne ELPRO GEMCO

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
6.4	UPS, Inverter	TATA Libert DB Electronics Amara Raja HBL Nife Power systems Emerson Network Power Dubass Masstech Controls Pvt. Ltd.
7	Cabling Sytem	
7.1	11 KV XLPE Cables	Poly cab CCI Universal Cable Incab Nicco Fortgloster RPG Nexan KEC International Ltd. Torrent Havells
7.2	Power Cables	CCI Universal RPG / KEC International Ltd. Poly cab Incab Nicco Fortgloster Torrent KEI Havells
7.3	Control Cables	Havells Universal Poly cab Finolex Nicco Fortgloster CCI RPG / KEC International Ltd. Torrent Incab KEI Delton LAPP
7.4	Instrumentation Cables	Fortgloster RPG / KEC International Ltd. Poly cab CCI Delton Finolex Universal LAPP Nicco Torrent KEI Havells

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
7.5	Cable trays & Supports	Venus Profab Steelite Indiana Globe electrical Industries Rattan Engineering Company Pvt Ltd. Patny System
8	MV switchgear	
8.1	MV switchgear	BHEL Siemens ABB KEC CGL GE Andrew Yule Control & Switchgear L&T S&S Power Switchgear Schneider
8.2	CT & PT	Prayog Electrical Pvt Ltd Pragati Silikaans Elect Mfg Co Pvt Ltd AE Kappa
9	415 KV Switchgear and Auxiliary Transformer	
9.1	MCC / SABs / 415 V switchgear Panels	Siemens Pyrotech Schneider CGL L&T ABB GE Havells C&S BCH
9.2	UAT, SST, Auxiliary Transformsers, etc	BHEL VOLTAMP CGL Kanochar Mirzapur Electricals Ames Impex KPE LG GE Andrew Yule Kirloskar Electric Co Ltd ABB
9.3	CT & PT	Prayog Electrical Pvt Ltd Pragati Silikaans Elect Mfg Co Pvt Ltd AE Kappa

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
9.4	Surge Suppressor (ZnO TYPE)	RAYCHEM / ELPRO / OBLUM ELECTRICAL INDUSTRIES (P) LTD.
9.5	MCCB and ACBs	SIEMENS / SCHNEIDER / BCH / L&T / C&S/ABB / HAVELLS
10	EOT Cranes	
10.1	EOT Cranes	Mukand WMI Anupam TATA Growth shop Fafeco Unique
	(For 5T EOT)	AVON (For 5T) Automech (For 5T)
10.2	VVF Drive & Control	L&T Yokogawa ABB Siemens Schneider
10.3	Motors	GE ABB CGL Siemens kirloskar KEC BBL Jyoti NGEF GEC
10.4	Wire rope	Usha Martin Fort william Industries Ltd
11	Oil Handling system	
11.1	Transformer Oil Filtration Plant	Fowler Westrup India Pvt Ltd VPI Sumesh Petroleum CBS
12	Miscellaneous items	
12.1	Electrical Testing Equipment	
12.1.1	AC / DC Insulation Resistance Tester	Megger Fluke
12.1.2	Digital Multimeters For AC & DC (0-30A)	Fluke Yokogawa
12.1.3	Portable Relative Oil Saturation	B&K Precision Vaisala Extech Instruments Vaiseshika
12.1.4	High Voltage Insulation Oil testing Devices	Baur Megger
12.1.5	Transformer Oil DGA Test Set	GE

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
12.1.6	Circuit Breaker Timing Measurement Analyser	GE Programma Megger Scope T & M
12.1.7	Dc Earth Fault Locator	Megger Eumac Salumber Energie Technik Pvt Ltd GSS
12.2	General Control & instrumentation items	
12.2.1	Pressure Transmitters	Endress + Hauser HART Fisher Rosemount Pvt. Ltd. Yokogawa Emerson Process Mgt. Honeywell
12.2.2	Level Swith/ Indicator	Endress + Hauser Emerson Process Mgt. Omega Kobold Barksdale Bosch Rexroth M/s Nivelco Ipari Elektronika Zrt M/s Pune Techtrol Pvt. Ltd. Pune
12.2.3	Temperature sensing devices/DTTs	Budenberg Kobold Ashcroft Dresser Europe Gmbh
12.2.4	Thermostats/ Temperature Switches	Indfoss Industries Danfoss Seimens Honeywell M/s Wika Instruments India Pvt Ltd
12.2.5	Pressure switch	Hydac Bosch Rexroth Wika Instruments (I) Pvt Ltd Kobold Barksdale Ashcroft
12.2.6	Pressure Gauge	Wika Instruments (I) Pvt Ltd Waree Ashcroft Forbess Marshal Budenberg Gauge Co. Toshniwal Bourdon M/s Manometer India Pvt. Ltd.

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
12.3	General Mechanical Items	
12.3.1	Oil Pumps/ Filtration Pumps	Tushaco Pumps Dowty Pump G L Rexroth Industries Ltd Roto Pump sets & Hydraulics Pvt Ltd Allweir IMO UT Pumps VPI Bornemann
12.3.2	Valves(For Oil Service)	BHEL Vickers System Rexroth Tyco Yuken Moog Control Ltd Keystone Audco India Ltd Mannesmann Rexroth Wandfluh KSB
12.3.3	Valves (For Water service)	BHEL Levcon Valves Pvt Ltd Leader Valves Ltd L&T Audco India Ltd Keystone Tyco Fouress Engineering Glenfield & Kennedy
12.3.4	Butterfly Valves	EAPEN JOSEPH & CO. (PETSON) LEADER AUDCO LEVCON
12.3.5	Gate & Globe Valves	LEADER AUDCO LEVCON
12.4	General Electrical Items	
12.4.1	Motors	Kirloskar CGL ABB NGEF Siemens GE BBL KEC Jyoti

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
12.4.2	CT & PT (415 V)	Prayog Electricals(P) Ltd Pragati Electricals Pvt Ltd Silkaans AE Kappa
12.4.3	Numerical Relays	ABB GE Andritz L&T Siemens SEL Schneider
12.4.4	Static / Electro-Mechanical Protection / Auxiliary / Tripping Relays	ABB GE Easun Reyrolle Limited VATECH Siemens Telemecanique Schneider Guardian Finder L&T Phoenix
12.4.5	Circuit Breakers / MCBs / MCCBs	Siemens Schneider L&T ABB C&S Havells
12.4.6	Panels/ Cubicles/ Control Boards	Siemens BHEL CGL L&T ABB GE Havells Pyrotech Rittal BCH Schneider
12.4.7	Starter & Contactor	Siemens L&T Havells ABB Schneider C&S
12.4.8	Terminal Blocks & Accessories, Side Clamps	Phoenix Wago And Controls (India) Ltd. Elmax M/s Connectwell Industries Pvt. Ltd.

373955/2021/PS-PEM-MAX

Attachment-5A

Teesta H. E. Project, Stage - VI		
A. List of approved Sub Contractors/vendors:		
Names of Vendors considered based on earlier NHPC Projects		
Sl.No	Item description	Vendor's Name
13	PLCC	ABB GE ZIV PUNCOM
14	Installation services	Mahati PES L&T ECC Fitwell UB Engg Steel Builder Purvanchal

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
			SECTION IA	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		REV. 00	20-07-2021
	SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)			
SECTION IA ANNEXURES				

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

ANNEXURE-I

MAKES OF SUB-VENDOR ITEMS

1. The sub vendor list at **Customer's Specification** "Volume: V, Attachment: 5-A (PTS)" shall be applicable.
2. The items / makes indicated below but not covered at "Volume: V, Attachment: 5-A (PTS)" of **Customer's Specification** for makes as proposed by bidder shall be put up for Customer's approval during detailed engineering stage without any commercial & delivery implication to BHEL.
3. Bidder to propose sub vendor within 4 weeks of placement of LOI, thereafter no request for additional sub-vendor shall be entertained.
4. The inspection category will be finalized after award of contract during detailed engineering. Same will be adhered by the bidder without any commercial and delivery implication to BHEL.

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		
5.	BEARINGS	SKF		
		FAG		
		TATA		
		NBC		
6.	MOTORS	GE		
		ABB		
		CGL		
		SIEMENS		
		KIRLOSKAR		
		KEC		
		BBL		
		JYOTI		
		NGEF		

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		GEC		
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)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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	
		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	

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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	
		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	

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
23.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
24.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		

373955/2021/PS-PEM-MAX



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

20-07-2021

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		JAINSON		
		DOWELL		
		ALLIED TRADERS & EXPORTERS	NOIDA	
		BALIGA LIGHTING EQPT.PVT.LTD.	CHENNAI	
		ELECTROMAC INDUSTRIES	MUMBAI	
		INCAB	KOLKATA	
25.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		
26.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
27.	MASTER CONTROLLER	SPEED-O-CONTROL		
		ELECTROMAG		
28.	SAFETY SWITCHES	ALSTOM		
		L&T		
		SIEMENS		
29.	PENDENT PUSH BUTTON STATION	OEM		
30.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		
		STANDARD		
31.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER		
32.	PANELS	OEM		
		RITTAL		
		PYROTECH		
33.	RESISTANCE BOXES	ENAPROS		
		OEM		
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD.		
		ASHOKA ENGINEERING COMPANY		
		KANADIA FYR FYTER PVT. LTD		
		NITIN FIRE PROTECTION INDUSTRIES LTD		

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		NEW ENGINEERING CORPORATION		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	L&T		
		YOKOGAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
36.	SHROUDED DSL	SUSHEEL		
		STROMAG		
37.	ANTI COLLISION DEVICE	ELECTRONIC SWITCHES INDIA		
38.	LOAD CELL	IPA		
		SARTORIUS		
39.	RRC	ACROPOLIS ENGINEERING	-	
		SNT CONTROLS	-	
40.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
41.	RAIL	JSPL		
		SAIL		
42.	LIGHTING FIXTURES, LAMPS	BAJAJ ELECTRICALS LTD.		
		PHILIPS		
		CROMPTON		
		GE		

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

ANNEXURE-II

MANDATORY SPARES

Mandatory spares list shall be as per “**Customer’s specification**” Volume IIIB (PTS), Clause no. 10.8(B). Also refer “**Customer’s specification**” Volume IIIA(GTS), Clause no. 3 (Spare Parts and Tools).

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

ANNEXURE III TOOLS & TACKLES

One (1) lot of following 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.

- a) One (1) set of wrench, spanner having sockets.
- b) One (1) set of sliding bar for socket wrench.
- c) One (1) torque wrench
- d) One (1) each pen hammer 1 lb. & 2 lb.
- e) One (1) set of Allen key set.
- f) One (1) feeler gauge set.
- g) One (1) oil can size 1 pint cap along with a funnel for oil filling.
- h) Fuse Puller
- i) Panel indicating lamp puller
- j) Hydraulically operated jack of 7.5T Capacity
- k) Two (2) sets of Grease gun hand lever type
- l) One (1) set of Grease gun trolley mounted type
- m) One (1) tool box with lock and double keys.
- n) Any other Tool/Tackle required for maintenance

Note:

- 1) 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 crane, the same shall also be included as a part of maintenance tools by the bidder.
- 2) Refer “**Customer's specification**” Volume IIIA(GTS), Clause no. 3 (Spare Parts and Tools).



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

20-07-2021

ANNEXURE IV PAINTING SPECIFICATION

1.0 PAINTING shall be as per “Customer’s specification” Volume: III-A, Annexure-1 (GTS)

2.0 Color Shade:

Sl no	Components	Color	Reference color	Reference clause
a.	Crane structure & trolley hook and block assembly, Platforms, ladders and handrails	Yellow	RAL 1004	Type B, Annexure -1, Painting System Volume III A.
b.	Panels	Pearl White	RAL 1013	Type D, Annexure -1, Painting System Volume III A.
c.	Motor	As per manufacturer’s standard	---	As per manufacturer’s standard.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2 TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-484-501-A001	
		SECTION IA	
		REV. 00	20-07-2021

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/Consultant's approval /information:

The (*) marked drawings are basic engineering drawings. After CAT 1, Cat 1*, Cat 2, Cat 3 & Cat 5 approval /BHEL clearance on these drawings, manufacturing/procurement activities shall be initiated.

Sl. No.	BHEL DRG.NO	DRAWING TITLE	Drawing category	Submission schedule (Days from LOA/LOI)
A	Documents			
1*	PE-V0-484-501-A501	Manufacturing Quality Plans with sub vendor list for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	15
2*	PE-V0-484-501-A503	Technical Specification data sheet for 90/10T MIV cavern Double Girder EOT crane with painting details	APPROVAL	10
3*	PE-V0-484-501-A527	Data sheet of motors for 90/10T MIV cavern Double Girder EOT crane.	INFORMATION	12
4*	PE-V0-484-501-A504	Design calculation for Mechanism of 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	10
5*	PE-V0-484-501-A512	Design calculation for Structural parts of 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	10
6*	PE-V0-484-501-A519	DSL selection calculation,Cable selection calculation, Voltage drop calculation & cable schedule for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	29
7	PE-V0-484-501-A520	Crane Operational write up/Design Philosophy for electrical system for 90/10T MIV cavern Double Girder	APPROVAL	35



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

20-07-2021

		EOT crane.		
8	PE-V0-484-501-A521	Type test certificate for motors of 90/10T MIV cavern Double Girder EOT crane.	INFORMATION	54
9	PE-V0-484-501-A523	Mandatory spare parts list for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	63
10	PE-V0-484-501-A514	Erection Procedure and O & M Manual including tools and tackles for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	63
11	PE-V0-484-501-A502	Field Quality Plan including commissioning procedure , Site test schedule and Procedure for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	63
12	PE-V0-484-501-A515	Storage Manual for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	63
13	PE-V0-484-501-A516	Site test document & procedures (to be submitted to site for approval)	APPROVAL	63
B	Drawings			
1*	PE-V0-484-501-A505	General arrangement drawing for 90/10T MIV cavern Double Girder EOT crane with CT power feeding arrangement and crane load data.	APPROVAL	10
2*	PE-V0-484-501-A506	General Arrangement drawing for Crab sub assembly of 90/10T MIV cavern Double Girder EOT crane including CT wheel and rope drum assembly.	APPROVAL	10
3	PE-V0-484-501-A532	Rail fixing arrangement for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	21
4	PE-V0-484-501-A507	DSL fixing arrangement for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	29

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
5*	PE-V0-484-501-A509	Main and Auxiliary hook snatch block assembly with details of hook, nut and check plate for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	10
6*	PE-V0-484-501-A510	General Arrangement drawing for Long travel Machinery Assembly /End carriage of 90/10T MIV cavern Double Girder EOT crane including LT wheel assembly	APPROVAL	10
7	PE-V0-484-501-A550	Crane lubrication drawing for 90/10T MIV cavern Double Girder EOT crane.	INFORMATION	35
8	PE-V0-484-501-A508	Electrical equipment layout in cabin for 90/10T MIV cavern Double Girder EOT crane.	INFORMATION	35
9*	PE-V0-484-501-A517	Single line diagram and Schematic circuit diagram for 90/10T MIV cavern Double Girder EOT crane. 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 f) Earthing diagram.	APPROVAL	21
10*	PE-V0-484-501-A518	GA drawing of panels etc for 90/10T MIV cavern Double Girder EOT crane. a) Protective panel b) Main hoist panel c) Aux. hoist panel d) Cross Traverse panel e) Long Traverse traverse panel. f) Pendant g) Remote Radio Control.	APPROVAL	10
11	PE-V0-484-501-A508	Gear Box drawings for 90/10T MIV cavern Double Girder EOT crane	APPROVAL	42

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

12*	PE-V0-484-501-A511	Girder drawings for 90/10T MIV cavern Double Girder EOT crane	APPROVAL	10
13*	PE-V0-484-501-A513	Cradle & wire rope sling drawings & calculation for 90/10T MIV cavern Double Girder EOT crane.	APPROVAL	10
14		Other drawings/documents as required by employer, time to time during detailed engineering.	INFORMATION	

Notes:

- 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.
- Drawings shall be prepared to the scale 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.
- 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.
- 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.
- 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.:-
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - 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.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - 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

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021
quantity, material of construction indicating its applicable code / standard, weight, make etc. e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc. f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication. g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity. h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No. i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time. j) Bidder to follow the following the drawing submission schedule: i. 1st submission of drawings as per the submission schedule. ii. Every revised submission incorporating comments – within 10 days. k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.				

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IA	
			REV. 00	20-07-2021
			SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	

ANNEXURE VI – PACKING PROCEDURE

COMMON GUIDELINES FOR PACKING

1. GENERAL:

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.

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.

2. TYPES OF PACKING:

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

- 1) 'OP' - Open Type.
- 2) 'PP' - Partially Packed.
- 3) 'CP' – Crate/Box Packing - Components/Equipment requiring physical protection.
- 4) 'CQ' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
- 5) 'CR' - Case Packing – Electrical/Electronic Components/ Assemblies, which require special packing viz. Water Proof, Shock Proof etc...

3. DESCRIPTION OF TYPES OF PACKING:

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

3.1 'OP' - Open Type

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

3.2 'PP' - Partially Packed

Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film.

3.3 'CP' - Crate Packing

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

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

Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with 100GSM (Colourless) Multi Layered Cross Laminated Polyethylene Film, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.

For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.

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

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM (Colourless) Multi Layered Cross Laminated Polyethylene Film before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel.

Empty space in the cartons shall be filled with rubberized coir to get proper cushioning effect. The cartons shall be manufactured from corrugated Fiber Board.

4 PREPARATION OF PACKING CASES

4.1 DIMENSIONS:

- a) Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units.
- b) Width of all planks including the tongue shall be more than 125mm and after planing it shall be minimum 100mm.
- c) Minimum number of planks shall be used for a shook.
- d) Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel).
- e) Width of binding planks shall be minimum 100mm.
- f) Distance between any 2 binding planks shall be less than 750mm.
- g) diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm
- h) Distance of the outer edges of these planks from the edge of case shall be less than 250mm.
- i) Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

4.2 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

4.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

4.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

depth all along the length is not allowed.

4.5 OTHER MATERIALS

4.5.1 NAILS
The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

4.5.2 BLUE NAILS
These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

4.5.3 HOOP IRON STRIPS
These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust.If sufficient nailing is done for bigger boxes, strapping need not be done.

4.5.4 CLIPS
These shall be used for strapping the hoop iron strips on the boxes.

4.5.5 BRACKETS
These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

4.5.6 FASTENERS
Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by the vendor. Drilling of holes will have to be done using contractor's tools.

4.5.7 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM
100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

4.5.8 RUBBERISED COIR:
The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

4.5.9 FOAM RUBBER / 'U' FOAM:
This is used for covering the delicate items. This material is provided by the vendor.

4.5.10 MARKING PLATE:
This shall be of anodized aluminium sheet. Size of the marking plate shall be maintained minimum of size as per the details specified in the Figure 4.

4.5.11 PACKING SLIP HOLDER:
This shall be of galvanized iron tinned sheet /Aluminium sheet

4.5.12 SILICA GEL:
Silical gel shall be used for such products only where moisture needs to be avoided.

4.5.13 COTTON BAGS:
These are used for holding silica gel. The bags shall have the following matter indicated on them:

BHEL-UNIT NAME PLACE

SILICA GEL

-PINCODE

-INDICATING TYPE

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2 TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-484-501-A001	
		SECTION IA	
		REV. 00	20-07-2021

BLUE : -ACTIVE
ROSE : -REDUCED ACTIVITY
WHITE : -NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

4.5.14 COTTON/ PLASTIC TAPE:
This is used for tying small items. And also to prevent vibrations of moving parts within the cubicles.

4.5.15 MARKING INK:
The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

4.5.16 POLYETHYLENE BAGS:
These are to be used for keeping the Packing slips. The bag shall be of size 70mm X 100mm (minimum).

4.5.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.

4.5.18 Mechanical Latching clamps:
For CLW Railway panels and similar Panels self-locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. For reusable boxes, these clamps provide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

4.5.19 STICKERS
The following stickers to be put by the vendor on cubicles/Boxes after packing.

1) Case No sticker: 2 nos. Size 25.Cm x 0.45Cm

2) BHEL Monogram sticker: 1 no. Size 1.75Cm x 2.3Cm

3) Address sticker: 2 nos. Size 3.8Cm x 3.0Cm

4) Direction sticker “Front” & “Back” - 4 nos. Size 2.0Cm x 0.75Cm

5) Chain Mark Sticker: 4 Nos. Size – 3.0Cm x 0.75Cm

6) "Fragile" sticker: 2 Nos. Size. 2.1Cm x 1.5Cm

7) "DO NOT STACK" sticker - 2 Nos. Size 3.0Cm x 2.2Cm

In place of stickers, writing all the details legibly with paint shall be allowed & respective units may take decision accordingly.

5. PACKING OF CUBICLES:

5.1 The packing is to be done as per clause 4 in all respects.

5.2 The cubicles are already fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets normally.

5.3 The cubicles will be of different sizes both width wise and lengthwise. The cubicles may be made up of single suite, 2 Suite, 3 Suite, 4 Suite, etc., The width of the cubicles generally varies from 400 mm to 1650mm. The length of the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases, the height may be less/more.

5.4 MULTI LAYER CROSS LAMINATED POLY FILM
The inner surface of 4 sides of shoo's shall be nailed with Multi-layer cross laminated poly film (as per 4.5.7) using blue nails (as per 4.5.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.
The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 4.5.7). This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2	SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SECTION IA	
		REV. 00	20-07-2021

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 4.5.7).

5.5 SILICA GEL:
Silica gel (as per 4.5.12) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 4.5.13).

5.6 LOOSE PARTS:
Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

5.7 WOODEN BATTENS:
In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

5.8 RUBBERISED COIR:
Gap between the cubicle and the case shall be filled with rubberized coir (as per 5.5.8) with distance between consecutive layers less than 500mm.

5.9 CLAMPING:
Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 5.5.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

5.10 PACKING SLIP:
Packing slip kept in the polyethylene bag (As per 5.5.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 5.5.11) shall be nailed to front / rear of case.

5.11 MARKING PLATE:
One no. (As per 5.5.10) shall be nailed to the front side of the case.

5.12 CASE MOUNTING:
After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

5.13 Different types (Typical) of Cubicles with sizes for Packing

1. Single suite cubicle - 900 x 950 x2500
2. Two suite cubicle - 1650 x 950 x 2500
3. Three suite cubicle - 2400 x 950 x2500
4. Four suite cubicle - 3150 x 950 x 2500
5. Regulation cub - 1300 x 1350 x 2500
6. Thy cub - 2870 x 1350 x 2500
7. VFD Cub - 3800 x 1550 x 2500

6 PACKING OF LOOSE ITEMS/SPARES

- 1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.
- 2) Wood with Tongue and Groove joint as per clause 4.3.
- 3) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.
- 4) External surface of planks on front and rear shall be plane 100% (except bottom plank).

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2 TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-484-501-A001	
		SECTION IA	
		REV. 00	20-07-2021

- 5) Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 4.5.7) using blue nails.
- 6) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
- 7) Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film. Any space left between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.
- 8) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.
- 9) Silica gel as per clause 4.5.12 held in cotton bags as per clause 4.5.13 shall be kept at proper places in the box.
- 10) Packing slip kept in polyethylene bag (clause 4.5.16) shall be placed in the box.
- 11) Marking plate as per clause 4.5.10 shall be nailed to side of the box.
- 12) Two numbers of hoop iron strips as per clause 4.5.3 shall be strapped tightly on the case using clips.
- 13) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
- 14) Loose items to be kept inside the cubicle

- The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.
- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

7 BOX SIZES

7.1 BOX SIZES

Table 1 – SPARES WOODEN BOX DETAILS

SNO	BOX	BOX SIZE	BOX Wt	Carrying Capacity
	TYPE	(in mm)	(in KG)	
1	A	800 X 200 X 200	15	
2	B	1500 X 200 X 200	22	
3	C	2000 X 200 X 200	27	
4	D	1100 X 200 X 200	15	
5	E	200 X 200 X 200	5	
6	F	320 X 250 X 260	13	
7	G	320 X 250 X 430	16	
8	H	430 X 370 X 430	23	
9	I	1100 X 400 X 400	45	
10	J	1500 X 500 X 400	65	
11	K	2000 X 500 X 400	93	
12	L	2500 X 500 X 400	88	
13	M	900 X 600 X 600	100	
14	N	3000 X 400 X 400	60	
15	P	600 X 500 X 400	35	
16	Q	710 X 630 X 600	90	



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

20-07-2021

17	R	850 X 630 X 670	102	
18	S	1000 X 770 X 670	140	
19	T	2500 X 850 X 800	180	
20	U	1500 X 700 X 700	120	
21	W	1200X900X600	120	
22	Y	450 X 200 X 200	10	

Table 2 – WOODEN BOX DETAILS

BOX TYPE	BOX SIZE (in MM)	BOX Wt (in KG)	Carrying Capacity
1	320X250X260	10	
2	320X250X430	15	
3	430X370X430	25	
4	670X670X470	65	
5	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	
9	1300X770X1050	155	
10	2500X850X800	225	
11	2000X1500X1200	305	
12	1850X1050X1250	260	
13	2000X800X800	180	
14	2600X1500X1600	470	
15	250X250X600	20	
16	250X250X880	30	
17	300X300X700	25	
18	380X380X880	45	
19	510X510X1400	60	
20	570X570X1400	80	
21	575X575X1875	105	
22	3600X1100X1100	390	
23	900X500X800	110	
24	2000X950X740	225	
25	1600X1120X700	220	
26	2500X2000X1200	490	
27	2900X1900X1400	525	
28	3000X1000X900	370	
29	3200X2200X950	450	
30	2150X1100X750	325	



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

20-07-2021

31	2000X2000X700	130	
32	700X1200X1325	130	

TABLE 3 STEEL BOXES

S.NO.	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
1	I	2480	1680	1500	339	4500
2	II	1200	900	600	61	2000
3	IIB	1800	850	950	115	2500
4	III	900	600	600	29	1000
5	IV	600	450	500	19	750
6	V	400	350	300	11	500

TYPICAL PATTERN OF WOODEN BOX

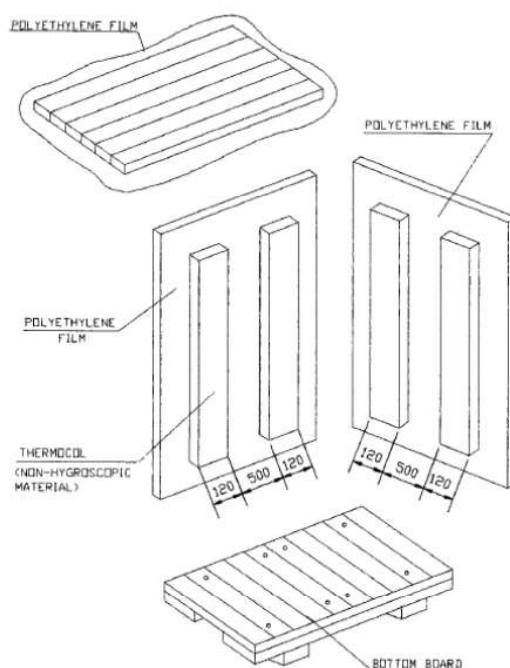


Figure 1

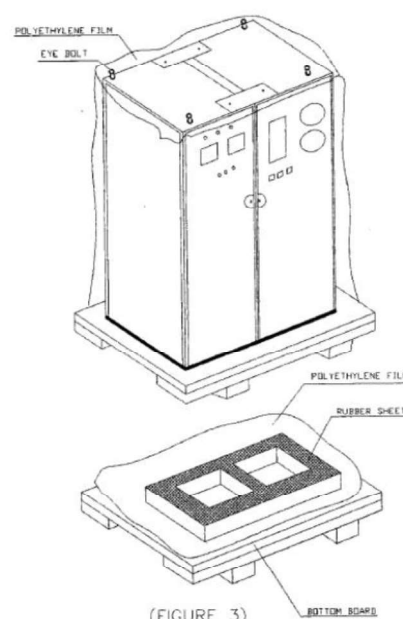


Figure 2

7.3 SEALED PACKING:

Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

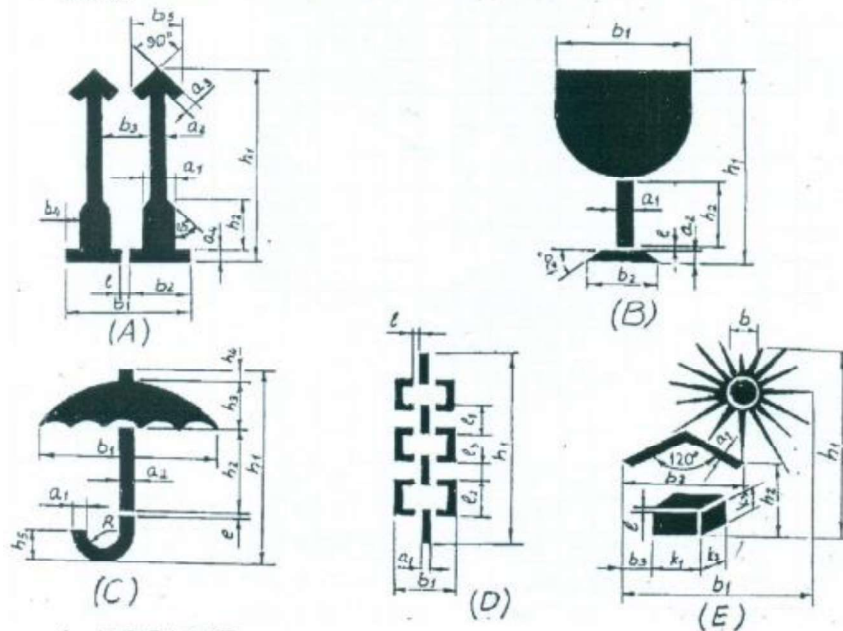
REV. 00

20-07-2021

8 MARKINGS/STENCILINGS

MARKINGS ON PACKING CASE S

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



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



Figure 3



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

20-07-2021

DESIGN- ATION	DIMENSION IN MM																							
		a1	a2	a3	a4	b1	b2	b3	b4	b5	b	l	h1	h2	h3	h4	h5	k1	k2	k3	l1	l2	l3	R
A	1	12	5	5	4	52	25	19	8	21		2	84	23										
	2	17	7	7	6	75	36	29	11	30		3	119	33										
	3	24	10	10	8	104	50	38	16	42		4	168	46										
	4	34	14	14	11	147	71	59	23	60		5	239	65										
B	1	5	5			50	33					2	84	25										
	2	7	7			71	47					3	119	36										
	3	10	10			100	66					4	168	50										
	4	14	14			142	94					5	239	71										
C	1	4	3			66						2	80	39	19	5	11							6
	2	6	4			85						3	114	55	27	7	16							9
	3	8	6			120						4	160	78	38	10	22							12
	4	11	9			170						5	227	110	54	14	31							17
D	1	6				30						4	148								30	30	10	
	2	9				42						5	209								42	42	14	
E	1	3				69	47	10			16	2	91	26				17	8	11				
	2	4				98	67	15			23	3	128	33				24	11	16				
	3	6				138	94	20			32	4	182	62				34	16	22				

Table 4

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

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

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

Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height. In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel.

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.

Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

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

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IA	
	SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		REV. 00	20-07-2021

	BHEL – <unit> - <location> - <pin>			
CONSIGNEE				
MATERIAL				
CUSTOMER REF.			MO. NO.	
DESPATCH ADVICE NOTE NO			CASE NO	
DIMENSIONS(MM) L x B x H			NET WT -KGS	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT			

Figure 4 – TYPICAL MARKING PLATE (225 X 170)



Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

9 STANDARD METHOD OF PACKING

Table 5 - Standard Method of Packing

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
PRESSUE VESSELS								
TOWERS					O			
TANKS					O			

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2				SPECIFICATION No: PE-TS-484-501-A001			
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)				SECTION IA			
					REV. 00	20-07-2021		
VESSLS					O			
GASKETS	O							
FASTENERS	O							
COVERS		O						
EXCHANGERS								
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
AIR BOTTLES	O							
TITANIUM BOTTLE	O							
WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							
BOILER DRUMS					O			
BOILER ITEMS								

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2				SPECIFICATION No: PE-TS-484-501-A001			
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)				SECTION IA			
					REV. 00	20-07-2021		

COILS			O					
PANELS					O			
HEADERS			O		O			
FEEDERS								
MACHINED ITEMS								
SHELL SEGMENTS					O			
SHELL SEGMENTS IN STACKS					O			
SPHERE PETALS								
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O			
ROLLERS	O							
VALVE TRAYS								
VALVE TRAY COMPONENTS	O							
LATTICE GIRDERS		O						
FASTENERS	O							
GASKETS	O							
SUB CONTRACTS								
FAB STRUCTURALS					O			
SUPPORTING STRUCTURALS					O			
STRUCTURE SUB ASSEMBLY					O			
FAB PIPES					O			
GRATINGS					O			
STAIR CASES					O			
HANDRAILS/ PLATFORMS					O			
BOUGHT OUT COMPONENTS								
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)					O			
PIPE FITTINGS								
CS PIPES, TUBES					O			
SS PIPES, TUBES					O			
FIN TUBES	O							
ELBOWS		O			O			
DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
FLANGES	O	O						
VALVES	O							
GAUGES	O							
DEMISTERS		O						
ABSCRBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2 TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-484-501-A001	
		SECTION IA	
		REV. 00	20-07-2021

SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								
MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

10 PROCEDURE FOR HANDLING OF COMPONENTS

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

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

10.2 Appropriate material handling equipment like fork lifters, cranes etc. shall be used where needed.

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

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

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

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

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

10.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

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

- The markings showing the upright position.
- The markings showing the sling position
- Markings showing the fragile contents.
- Other required markings as per clause no.10

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

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IA	
			REV. 00	20-07-2021
			SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	

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

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

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

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

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

11 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH
Based on the Dimensions/Weight indicated in the Transportation Sketch, the type of Trailer is decided and indicated in the Tender Enquiry.

11.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):

Well Bed Length : 10000mm

Over Gooseneck : 13000mm

Width : 3000mm

Carrying Capacity : 40MT

2. LOW BED TRAILERS (LB 16):

Well Bed Length : 12000mm

Over Gooseneck : 16000mm

Width : 3000mm

Carrying Capacity : 75MT

3. TOW TYPE TRAILERS (WITH FRONT DOLLEY 16 TYRES): 12000MM length
(for Exceptional equipment length: 30000mm and above)

Bigger Dia equipment are loaded in the Well with overhanging.

Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.

The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/Weight of the Consignment

11.2 PACKING:
For all ODCs, Wooden Saddles are cut to the diameter of equipment as per the Transportation Sketch.



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

REV. 00

20-07-2021

Wooden Saddles	For Diameter up to 4000mm	For Diameter above 4000mm
Length:	1836/2743mm (6'0"/9'0")	3353mm (11'0")
Width:	300mm (1'0")	300mm (1'0")
Height:	Saddle + one/two wedges a top	Saddle + three/four wedges a top

Number of Saddles:	
Minimum	3 in case of Loading inside Well +1 when loaded on Gooseneck
Maximum:	4 in case of Loading inside Well +2 when loaded on Gooseneck

For Securing the equipment firmly on the Trailer, 19mm (3/4"), wire rope with 25mm (1") Heavy Duty Turn Buckles / BD Clamps are used as Lashing for the equipment.

12 GUIDELINES FOR HANDLING/LOADING/LASHING

- Jobs to be checked for complete painting before loading.
- Components to be lifted with Nylon belts. This protects painting, edges and attachments.
- All the components to be transported by putting inside the properly fabricated Crating
- Small components may fall down while transporting without closed crating and there are chances of missing of small parts. Hence, it is always better to transport small components in closed containers/crating. Loose to be being shipped in a closed crating.
- No component loaded over the crating.
- **LASHING:** Use Nylon belts only for lashing of all components. It prevents removal off painting and cut in the materials.

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)		SECTION IA	
			REV. 00	20-07-2021

ANNEXURE-VII**SUPPLY PRICE PERCENTAGE BREAKUP FOR ONE (1) NO 90/10T CRANE**

S. N.	Details of Works or Equipment/System	Quantity	Percentage (%) Break up proposed for billing purpose during contract for Supply price
1.	Supply of One (1) no. 90/ 10T capacity x 7.1 m span, 16 m (approx.) lift for Main hook, 18.5 m lift of Auxiliary hook and 90 m travel length double girder EOT crane along with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	1 set	61 %
2.	Supply of PVC shrouded bus bar type DSL for 90 m bay length for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	1 set	4 %
3.	Supply of Gantry rail along with alignment blocks, clamps etc. for 90 m bay length for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	1 set	10 %
4.	Supply of embedded parts, sole plate, anchor bolts and other accessories for rail fixing and insert plate and , anchor bolts for DSL fixing arrangement complete for 90 m bay length for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	1 set	9%
5.	Supply of armored copper, FRLS type power cable 200m long of suitable size as per load calculation from two nos. supply boards (SAB-1 & SAB-2 installed in control block at EL 242.0) to the Main Isolating switch/Changeover for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	2 Nos.	8%
6.	Supply of Temporary cable for operation of crane during erection stage of the plant (half the bay length plus 25m) for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	1 set	2%
7.	Supply of One (1) number cradle for test load frame and associated slings suitable for rated load and overload tests for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	1 set	5 %
8.	Supply of Maintenance tools and Tackles for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	1 set	1 %

NOTE: -These prices shall be used for billing purpose during contract stage.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2 TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-484-501-A001	
		SECTION IA	
		REV. 00	20-07-2021

Note:

1. The supply price percentage breakup is for progressive payment purpose only. This breakup does not relieve vendor from any contractual obligations and responsibilities with respect to condition of technical and commercial scope of contract.

2. Any item/quantity not specifically indicated in this break up but required as per system requirement, shall be supplied by vendor without any additional financial implication to BHEL.

3. Any variation in length will be adjusted during detail engineering stage based on unit rates arrived for DSL, gantry rail, power cable, temporary cable and other accessories for rail fixing and DSL fixing arrangement from 2, 3 , 4 , 5 & 6 above.

373955/2021/PS-PEM-MAX



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

SPECIFICATION No: PE-TS-484-501-A001

SECTION IA

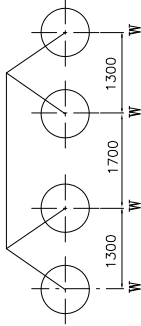
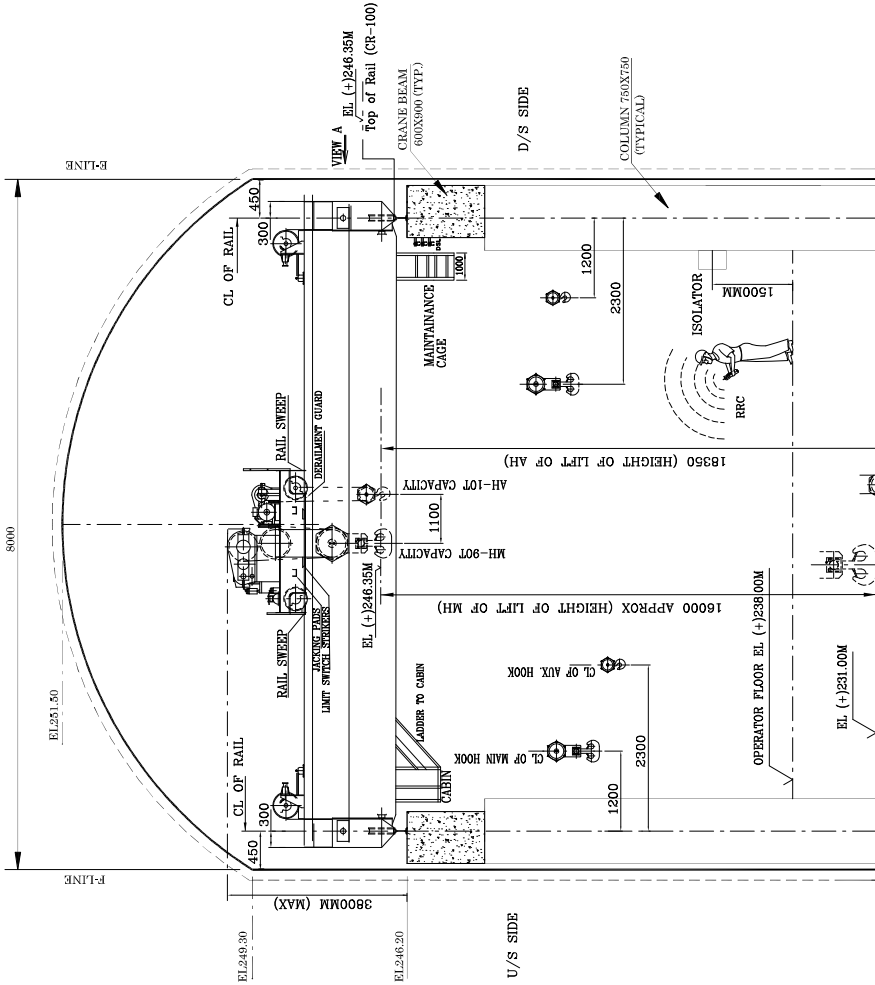
REV. 00

20-07-2021

SECTION IA

CRANE CLEARANCE DIAGRAM

DRG NO. PE-DG-484-501-A001



W = 26 TONS
MAXIMUM WHEEL LOAD DIAGRAM WITHOUT IMPACT

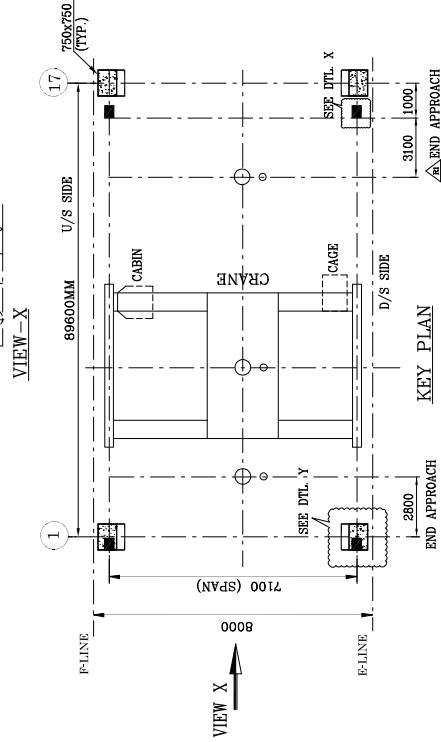
NOTES

- 1) DRAWING IS NOT TO THE SCALE.
- 2) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
- 3) THE LOAD AND DIMENSIONS ARE INDICATIVE AND SUBJECT TO CHANGE DURING DETAIL ENGINEERING AFTER AWARD OF CONTRACT TO BHEL'S SUB CONTRACTOR.
- 4) REFERENCE DRGS:
 - a) Power House-MIV Chamber General Arrangement Plans and Section. Drg no NHTS-VI- 4FC2-41-GA-001-00.
 - b) Power House-MIV Chamber General Arrangement Cross Sections. Drg no NHTS-VI- 4FC2-41-GA-002-00.
 - c) Main Inlet Valve Cavern Plan and Section General Arrangement drawing. Drg no HINTST310DALD000001 REV F.

OWNER	LTHP LTD. (A wholly owned subsidiary of NHPC Ltd.)
Consultant	एन एच पी सी लिमिटेड NHPC Limited
PROJECT	Teesta-VI H.E. Project (4x125 MW)
DOC. TITLE	CRANE CLEARANCE DIAGRAM OF MIV CAVERN 90/10T DOUBLE GIRDER EOT CRANE.

CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD (A Govt. of India Enterprise)
PROJECT ENGINEERING MANAGEMENT	NODA
NHPC DOC. NO.	TSVI-EOT01GA001-B
BHEL DOC. NO.	PE-DG-484-501-A001

Transmission Status:			
For Approval			
REV.	PREPARED	CHECKED	APPROVED
DATE	DATE	DATE	DATE
REVISIONS AS PER IES COMMENTS			
01	YK	VM	RR
02	YK	VM	RR
03	YK	VM	RR
04	YK	VM	RR
05	YK	VM	RR
06	YK	VM	RR
07	YK	VM	RR
08	YK	VM	RR
09	YK	VM	RR
10	YK	VM	RR
11	YK	VM	RR
12	YK	VM	RR
13	YK	VM	RR
14	YK	VM	RR
15	YK	VM	RR
16	YK	VM	RR
17	YK	VM	RR
18	YK	VM	RR
19	YK	VM	RR
20	YK	VM	RR
21	YK	VM	RR
22	YK	VM	RR
23	YK	VM	RR
24	YK	VM	RR
25	YK	VM	RR
26	YK	VM	RR
27	YK	VM	RR
28	YK	VM	RR
29	YK	VM	RR
30	YK	VM	RR
31	YK	VM	RR
32	YK	VM	RR
33	YK	VM	RR
34	YK	VM	RR
35	YK	VM	RR
36	YK	VM	RR
37	YK	VM	RR
38	YK	VM	RR
39	YK	VM	RR
40	YK	VM	RR
41	YK	VM	RR
42	YK	VM	RR
43	YK	VM	RR
44	YK	VM	RR
45	YK	VM	RR
46	YK	VM	RR
47	YK	VM	RR
48	YK	VM	RR
49	YK	VM	RR
50	YK	VM	RR
51	YK	VM	RR
52	YK	VM	RR
53	YK	VM	RR
54	YK	VM	RR
55	YK	VM	RR
56	YK	VM	RR
57	YK	VM	RR
58	YK	VM	RR
59	YK	VM	RR
60	YK	VM	RR
61	YK	VM	RR
62	YK	VM	RR
63	YK	VM	RR
64	YK	VM	RR
65	YK	VM	RR
66	YK	VM	RR
67	YK	VM	RR
68	YK	VM	RR
69	YK	VM	RR
70	YK	VM	RR
71	YK	VM	RR
72	YK	VM	RR
73	YK	VM	RR
74	YK	VM	RR
75	YK	VM	RR
76	YK	VM	RR
77	YK	VM	RR
78	YK	VM	RR
79	YK	VM	RR
80	YK	VM	RR
81	YK	VM	RR
82	YK	VM	RR
83	YK	VM	RR
84	YK	VM	RR
85	YK	VM	RR
86	YK	VM	RR
87	YK	VM	RR
88	YK	VM	RR
89	YK	VM	RR
90	YK	VM	RR
91	YK	VM	RR
92	YK	VM	RR
93	YK	VM	RR
94	YK	VM	RR
95	YK	VM	RR
96	YK	VM	RR
97	YK	VM	RR
98	YK	VM	RR
99	YK	VM	RR
100	YK	VM	RR



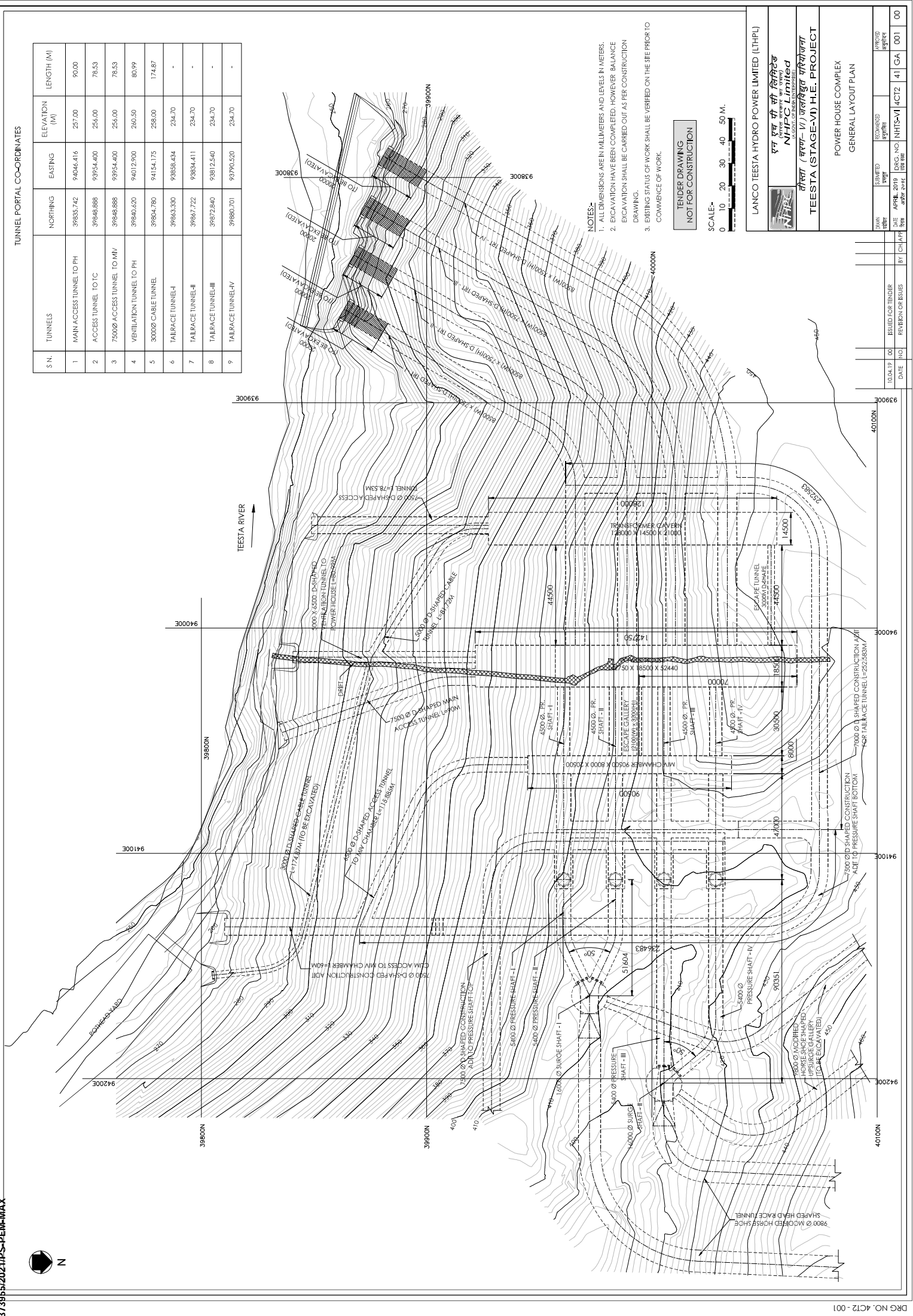
COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
It must not be used directly or indirectly in any way detrimental to the interest of the company.

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
			SECTION IA	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		REV. 00	20-07-2021
	SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)			
SUB-SECTION IA PROJECT DRAWINGS				

TUNNEL PORTAL COORDINATES

S.N.	TUNNELS	NORTHING	EASTING	ELEVATION (M)	LENGTH (M)
1	MAIN ACCESS TUNNEL TO PH	39835.742	94046.416	257.00	90.00
2	ACCESS TUNNEL TO TC	39848.888	93954.400	254.00	78.53
3	7500Ø ACCESS TUNNEL TO MV	39848.888	93954.400	254.00	78.53
4	VENTILATION TUNNEL TO PH	39840.620	94012.900	260.50	80.99
5	3000Ø CABLE TUNNEL	39804.780	94154.175	258.00	174.87
6	TAILRACE TUNNEL-I	39863.330	93858.434	234.70	-
7	TAILRACE TUNNEL-II	39867.722	93834.411	234.70	-
8	TAILRACE TUNNEL-III	39872.840	93812.540	234.70	-
9	TAILRACE TUNNEL-IV	39880.701	93790.520	234.70	-



- NOTES:-
1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS.
 2. EXCAVATION HAVE BEEN COMPLETED HOWEVER BALANCE EXCAVATION SHALL BE CARRIED OUT AS PER CONSTRUCTION DRAWING.
 3. EXISTING STATUS OF WORK SHALL BE VERIFIED ON THE SITE PRIOR TO COMMENCEMENT OF WORK.

TENDER DRAWING
NOT FOR CONSTRUCTION

SCALE:-
0 10 20 30 40 50 M.

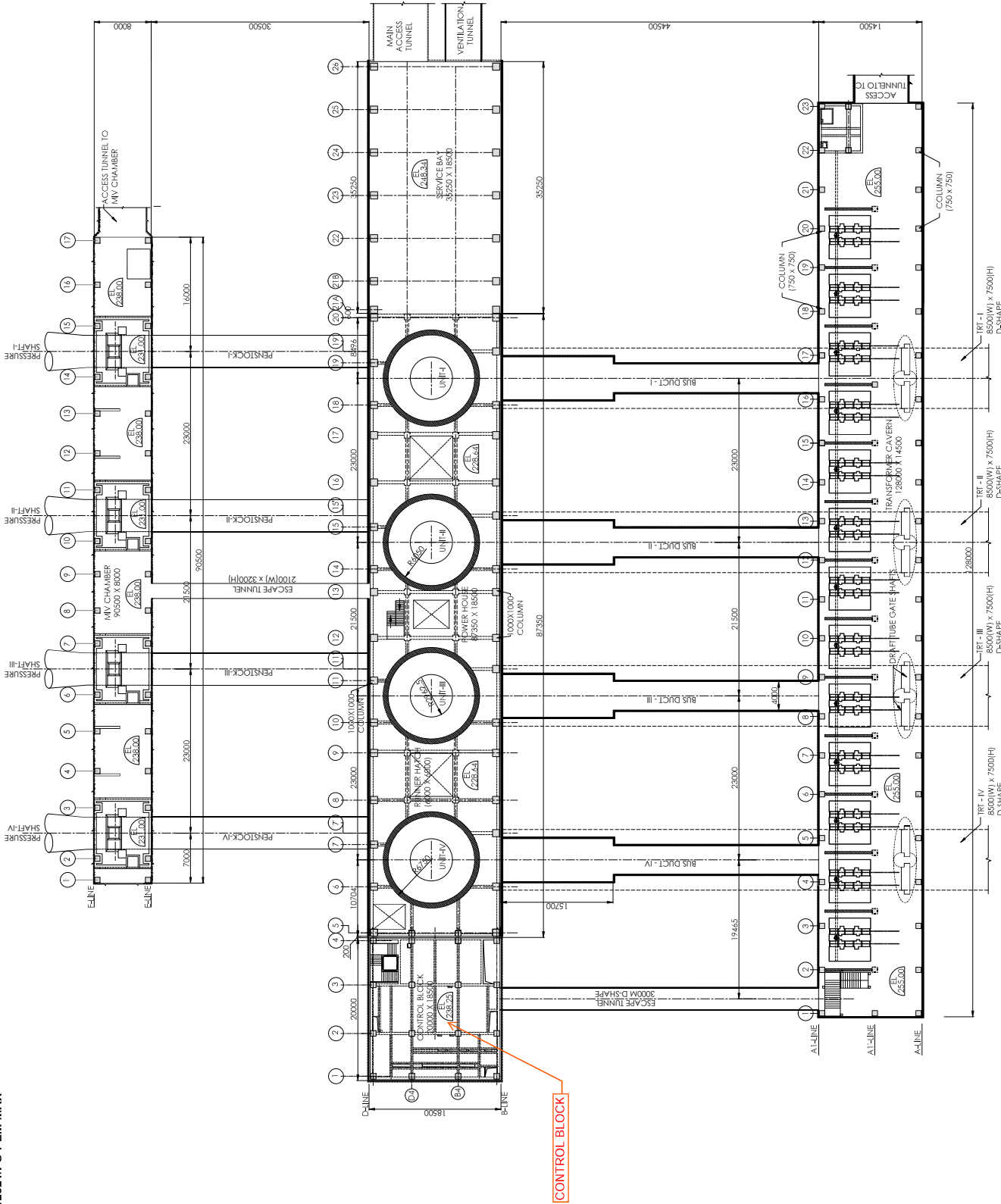
LANCO TEESTA HYDRO POWER LIMITED (LTHPL)

NIPCL Limited
(A PUBLIC SECTOR ENTERPRISE)
नियंत्रण (बचत-वि) प्रविष्टि प्रयोगशाला

TEESTA (STAGE-VI) H.E. PROJECT

POWER HOUSE COMPLEX
GENERAL LAYOUT PLAN

DATE	NO.	ISSUED FOR TENDER	BY	CHARTER	SUBMITTED	RECOMMENDED	APPROVED
APRIL 2019	DRG. NO.	NHTS-VI	41	CA	001	00	



CONTROL BLOCK

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS.
2. EXCAVATION HAVE BEEN COMPLETED BALANCE IF ANY SHALL BE DONE AS PER SITE.
3. EXISTING STATUS OF WORK SHALL BE VERIFIED ON THE SITE PRIOR TO COMMENCEMENT OF WORK.

TENDER DRAWING
NOT FOR CONSTRUCTION



PLAN
POWER HOUSE

LANCO TEESTA HYDRO POWER LIMITED (LTHPL)		एन एच पी सी लिमिटेड NHPCL Limited (A HYDRO POWER COMPANY)		RECOMMENDED BY एन एच पी सी लिमिटेड		APPROVED BY एन एच पी सी लिमिटेड		DATE April 2019		PROJECT NO. NHTS-VI		DRAWING NO. 4CT2		SHEET NO. 41		TOTAL SHEETS 00	
TEESTA (STAGE-VI) H.E. PROJECT		TEESTA (STAGE-VI) H.E. PROJECT		POWER HOUSE		GENERAL ARRANGEMENT		PLAN									

373955/2021/PS-PEM-MAX

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IC	
			REV. 00	20-07-2021
DATASHEET A				

SUB-SECTION IC

DATASHEET

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IC	
			REV. 00	20-07-2021
			DATASHEET A	

DATA SHEET FOR DOUBLE GIRDER EOT CRANE WITH VVVF DRIVES**Details are to be furnished by bidder during detail engineering stage only**

S.N.	Description	Technical Particulars
1.0	Design, fabrication and testing of the crane confirm to standard / code number	IS: 3177 & IS 807 (latest edition)
2.0	Number of crane/s	One (1) nos.
3.0	Crane classification	M3 duty for Mechanical and Electrical as per IS: 3177– (latest edition) & Structural design as per IS 807 – 2006.
4.0	Suitable for outdoor or indoor duty	Indoor duty
5.0	Capacity (T)	
5.1	Main hoist	
	Rated SWL – tonnes	90
5.2	Aux. Hoists	
	Rated SWL – tonnes	10
6.0	Span	As per attached crane clearance diagram
7.0	Operation from	Operator's Cabin + Radio Remote Control (RRC)
8.0	CRANE PERFORMANCE	
8.1	Crane speed with full load	
a	Main Hoist (M/Min.)	1.0
b	Aux. Hoist (M/Min.)	5.0
c	Crab travelling speed (CT motion) (M/Min.)	1.0
d	Crane travelling speed (LT motion) (M/Min.)	3.0
e	Creep speed M/Min	5% of respective speed for all the motions through VVVF drive. Crane shall also be provided with anti -sway feature.
8.2	Minimum Incremental movement (not greater than the given values) :	
a	Main Hoist	1.5mm
b	Auxiliary Hoist	1.5 mm
c	Bridge Travel	3.0mm
d	Trolley Travel	3.0mm
8.3	Acceleration/deceleration for	
a	Bridge Travel	0.10 m/sec ²
b	Trolley Travel	0.08 m/sec ²
8.4	Lift in Meters	
a	Main Hoist	As per attached crane clearance diagram
b	Aux Hoist	As per attached crane clearance diagram
8.5	Hook Approaches	As per attached crane clearance diagram
8.6	Hand rail pipes	32 mm NB heavy duty GI pipes as per IS 1239 having top and bottom rail At height of 1000 mm and 600 mm and vertical post spacing not Exceeding 1500 mm with provision of kick plate (minimum 100 mm high and 6mm thick)
9.0	COMPONENT DETAILS	
9.1	Trolley/ Bridge girder	
a	Type	Fabricated

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IC	
			REV. 00	20-07-2021
DATASHEET A				

b	Method of fabrication	Welded	
c	Material conforming	IS: 2062 Gr. B	
9.3	Rope details		
a	Standard	IS:2266	
b	Construction	Extra flexible plough steel / 6 x 36 or 6x37 construction	
c	Factor of safety	6	
d	Type of core	Fibre/Steel	
9.6	Gear box details		
a	Material(gear/pinions)	Cast steel/forged steel	
b	Gear box housing material	Gearbox casing shall be fabricated from tested quality cast steel or welded steel plates and duly stress relieved	
9.8	Lifting hooks	Main Hoist	Aux hoist
a	Type	Rams horn type with Safety Latch swiveling type as per IS: 5749 with anti-swivel arrangement	Point hook with shank with safety latch Swiveling type as per IS: 15560. with anti-swivel arrangement
b	Material	Refer "CUSTOMER SPECIFICATION – PARTICULAR TECHNICAL SPECIFICATION"	
9.9	Brakes		
A.0	Hoist Motions	Main Hoist	Auxiliary Hoist
a	Type of brake	electro-mechanical DC brake and electro hydraulic thruster brakes.	electro-mechanical DC brake and electro hydraulic thruster brakes.
b	Number provided	Two (2) nos for each motor	Two (2) nos for each motor
c	Braking capacity of each brake	150% of full load torque	
B.0	Travel motion	CT	LT
a	Type of brake	electro-mechanical DC brake and electro hydraulic thruster brakes.	electro-mechanical DC brake and electro hydraulic thruster brakes.
b	Number provided	Two (2) nos for each motor	Two (2) nos for each motor
c	Braking capacity	150% of full load torque	150% of full load torque
10.0	Motors		
a	Type	Squirrel cage	
b	Enclosure	TEFC	
c	Voltage, phase and frequency	3 Ph, 4 wire, 415V ±10%, 50 Hz ±5% Combined voltage & frequency variation = 10% absolute	
d	Rated capacity (KW)	Refer "CUSTOMER SPECIFICATION – GENERAL TECHNICAL SPECIFICATION"	
e	Service class	S4	
f	Number of starts/ hour	As per IS 3177	
g	Pull out torque	2.5 times the rated load torque	
h	Space heater requirement	Refer "CUSTOMER SPECIFICATION – GENERAL TECHNICAL SPECIFICATION"	
11.0	Power conductors (DSL)		
	Type	LT: PVC shrouded Cu conductor bus bar. DSL phase indicating lamps to be provided at both end of bay. CT: Trolley power conductors shall be of the festooned wire Type.	
12.0	Control panel		

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION IC	
			REV. 00	20-07-2021
DATASHEET A				

a	Material	Refer "CUSTOMER SPECIFICATION – GENERAL TECHNICAL SPECIFICATION"	
b	Numbers and location	One each for Protective, MH, AH, CT and LT located on bridge platform.	
c	Degree of Protection	Refer "CUSTOMER SPECIFICATION – GENERAL TECHNICAL SPECIFICATION"	
d	Features		
13.0	Cable (Fixed)	Power	Control
a	Material	Armored Copper, FRLS	
b	Size	Minimum 2.5 mm ²	
c	Voltage grade	Refer "CUSTOMER SPECIFICATION – GENERAL TECHNICAL SPECIFICATION"	
14.0	Fire Extinguisher		
a	Type and size	4.5 kg , CO ₂ type	
b	Numbers per crane & Location	Three on bridge and one no. in Cabin	
15.0	Power Supply	A two way supply control switch shall be installed which shall be fed A.C supply from two boards. A.C supply to runway conductors shall be fed from this switch.	
16.0	Transformer	Qty. / Rating	
a	Control	2 X 100 % - 415/110V/24V	
b	Lighting	2 X 100 % - 415/230V	
17.0	Illumination		
a	In Cabin	Refer "CUSTOMER SPECIFICATION – PARTICULAR TECHNICAL SPECIFICATION"	
b	Over Bridge		
c	Under bridge		
d	For inspection of crane components		
18.0	Type of platform required on the full length of bridge.	Chequered plate platform minimum 6 mm thick as per IS :3502.	
a	Type of access from gantry girder level to crane bridge	Rung ladder at ends of crane bridge from gantry girder level walkway to crane bridges walkway.	
b	Type of access to maintenance cage from crane bridges walkway	Rung ladder.	
c	Type of access to Cabin from crane bridges walkway	Refer "CUSTOMER SPECIFICATION – PARTICULAR TECHNICAL SPECIFICATION"	
19.0	Type of control for Various motions	Through VVVF drive.	

373955/2021/PS-PEM-MAX



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

SPECIFICATION No: PE-TS-484-501-A001

SECTION III

REV. 00

20-07-2021

SECTION III

1. DOCUMENTS TO BE SUBMITTED ALONG WITH BID
2. PRE-BID CLARIFICATION SCHEDULE
3. COMPLIANCE CUM CONFIRMATION CERTIFICATE

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION III	
	LIST OF DOCS TO BE SUBMITTED ALONG WITH BID		REV. 00	20-07-2021

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid for technical offer:

- Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the 'Deviation Schedule' (Cost of withdrawal) format as attached in GCC.
- Un-priced copy of price format indicating "quoted/ not quoted" against each row/column.
- Copy of technical pre-bid clarifications/ amendment/ corrigendum issued by BHEL, if any, duly signed & stamped.
- Signed/ Stamped copy of Compliance cum Confirmation Certificate.

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.



TEESTA H E PROJECT, STAGE V1, 4X125MW
ELECTROMECHANICAL WORKS PACKAGE EM-2

TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN
DOUBLE GIRDER EOT CRANE

PRE-BID CLARIFICATION SCHEDULE

SPECIFICATION No: PE-TS-484-501-A001

SECTION III

REV. 00

20-07-2021

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE		SECTION III	
	COMPLIANCE CUM CONFIRMATION CERTIFICATE		REV. 00	20-07-2021

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

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

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

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

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

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

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

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

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

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

- 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.

	TEESTA H E PROJECT, STAGE V1, 4X125MW ELECTROMECHANICAL WORKS PACKAGE EM-2		SPECIFICATION No: PE-TS-484-501-A001	
	TECHNICAL SPECIFICATION FOR 90/10T MIV CAVERN DOUBLE GIRDER EOT CRANE COMPLIANCE CUM CONFIRMATION CERTIFICATE		SECTION III	
			REV. 00	20-07-2021

- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.