

**TAMIL NADU GENERATION AND
DISTRIBUTION CORPORATION LTD.**

**2 X 660 MW SEZ ENNORE STPP
AT ASH DYKE OF NCTPS,
CHENNAI**

VOLUME – II B & III

**TECHNICAL SPECIFICATION
FOR
DOUBLE GIRDER EOT CRANES (225/45T)**

SPECIFICATION NO.: PE-TS-412-501-A001



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA



**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)**

SPECIFICATION No: PE-TS-412-501-A001

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SPECIFIC TECHNICAL REQUIREMENT

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SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

SUB-SECTION IA

SUB-SECTION IB

SUB-SECTION IC

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)

DATA SHEET A

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SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to design, engineering, material selection, manufacturing and assembly, inspection, testing at manufacturer's works, packing, forwarding and transportation to site, unloading, storage & handling at site, erection, commissioning and final load test at site of two (2) nos. 225/45T capacity double girder EOT Cranes with operator's cabin and necessary accessories including supply of mandatory spares, operation and maintenance of cranes for 16 x 7 hours operation and maintenance of crane for 24 months after load testing at site.
- 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 of the responsibility of providing such facilities to complete the supply, erection and commissioning of the cranes and its accessories.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification. 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 schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or RUVNL including their consultant as interpreted by BHEL in the relevant context.
- 1.11 The standard quality plan is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan's minimum requirement during manufacturing and testing.
- 1.12 Site Visit before submission of offer.
Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details wrt existing facility at site. Customer approval on any

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drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

1.13 Other requirements

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

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

In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of drawing beyond one month will be to customer's account.

1.14 Engineering for this project is being carried out in 3D environment at BHEL end. This is being done to have automated interface checking and thereby minimising rework at site. Hence bidder in their own interest, is requested to prepare all layout drawings using 3D Modelling software. These drawings will also be made available to BHEL in soft for checking interface with other agencies in consolidated layout drawings. However, bidder's inability to prepare drawing using 3D Modelling software will not be criterion for evaluation of their bid.

Note:

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

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



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1.0.0. SCOPE OF WORK

1.1.0. SCOPE OF SUPPLY

- 1.1.1. Equipment and services to be furnished by the bidder for the EOT CRANE with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the EOT crane complete for efficient operation shall also be under the bidder's scope of work.
- 1.1.2. Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.
- 1.1.3. Crane shall include but not be limited to the following: -
- Bridge girders
 - End carriages with wheels
 - Crab (trolley)
 - Cross Travel & Long Travel drive arrangement
 - All electrical equipment including cables, junction box, VVVF drive, RRC & pendent and panels etc.
 - MS angle type runaway conductor / PVC insulated shrouded bus bar conductor type DSL
 - Earthing arrangement
 - Fill of lubricant till commissioning of cranes
 - Painting of cranes and accessories
 - Temporary cables for operation of each crane during erection stage of the plant (Half the bay length + 25m)
 - Rail including all accessories and end stopper
 - Maintenance tools & Tackle
 - Erection & Commissioning spares
 - Mandatory Spares
 - Pendant Push Button etc.
 - Main Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the crane.
 - Slings and cradle for load testing on returnable basis

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1.1.4 Maintenance Tools and Tackles

As per Annexure III, section-IA , Vol. IIB of this specification

1.1.5 Mandatory Spares

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

1.1.6 Erection and Commissioning spares

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

1.2.0 Services to be provided by the bidder

1.2.1. Packing, forwarding and transportation to site, storage and handling at site.

1.2.2. Arranging test load at site

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

1.2.3 Erection and Commissioning

1.2.4 Performance Guarantee Test/ Demonstration / Load test

1.2.5 Obtaining clearance and acceptance certificate from the concerned competent



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Authority after site test. Necessary fees/expenditure as required shall be borne by the supplier.

1.2.6 Training to customer's O&M staff

1.3.0. PAINTING & COLOUR SCHEME

As per Annexure IV, section-IA , Vol. IIB of this specification

2.0.0. Works Excluded

Supply feeder and cable from MCC to isolating switch.

3.0.0. Drawing and documents submission schedule along with number of prints.

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

4.0.0. Deviations

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

5.0.0. Makes of Sub - Vendor items

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

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

1.0.0. Performance Test requirement

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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.

1.1.0 Testing at site

Completely assembled crane at site shall be check for 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 site

- i. Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
- ii. Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated. Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177
- iii. All Other tests as per IS-3177.
- iv. Load & overload test along with deflection test of lifting beam in line with BHEL approved MQP for lifting beam (if applicable).
- v. Speed test at rated load for hoisting, CT and LT mechanism.
- vi. Brake test.
- vii. Any other test as per IS-3177
- viii. The test shall be carried out with actual panel, RRC, Master Controller etc.



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Annexure – A

OPERATION AND MAINTENANCE SERVICES SHALL INCLUDE BUT NOT LIMITED TO FOLLOWING (FOR TG HALL CRANE ONLY)

- 1.0 Scope covers operation and maintenance service including manpower, supervision, consumables etc for complete operation and maintenance for 48 crane months of the cranes after successful erection, commissioning & load testing. The services period required for each crane shall vary based on actual site requirement. The O & M period shall be started after successful load testing at site. Final handing over of the crane/s to the end client shall be after successful completion of O & M contract.
- 2.0 For Operation of the Crane An experienced crane operator or shall be available for each crane as and when required by BHEL for at least 16hrs a day, daily.
- 3.0 For Maintenance of the Crane
 - a) Break-Down Maintenance
 - i) In case of any break-down of the crane during the contract period, service engineer shall be made available at site within 72 hrs.
 - ii) All the critical spares and consumables, as deemed necessary by the manufacturer shall be made available at the site. No delay in crane maintenance shall be allowed by BHEL due to non-availability of required spare at site.
 - b) Preventive Maintenance
 - i) Following work should be carried out quarterly

Bridge and Trolley wheel assembly	Checking for wear, flat spots and cracks in flange. Ensure drive wheels are of the same diameter.
Runway	Checking alignment and elevation of gantry track. Checking rail clamp bolts.
Machine Bolts	Checking all foundation bolts of Electrical and Mechanical equipment for tightness.
Structural Bolts	Checking for tightness. They should also be checked after



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



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Testing	After completion of checking and required rectification, trolley will be checked for idle operation, for brake operation, limit switch operation & safety switch operation. All motor currents will be checked on no load.
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ii) Following work should be carried out annually

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

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

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



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QUALITY ASSURANCE AND INSPECTION REQUIREMENT

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1.1.0. Inspection and Testing

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

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 attached with this 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

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2. Defects giving indication larger than ‘4 (four) mm diameter equivalent flaw’ except for wheels for which Defects giving indication larger than ‘6 (six) mm diameter equivalent flaw.’

3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.

4. Defects giving indication of 2 to 4 mm dia. equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per 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



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FINAL INSPECTION- Testing At Works.

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

- a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
- b) Load test and Overload test (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.

Demonstration test for hydraulic rail clamps: Holding capacity of the rail clamps shall be demonstrated by making suitable facility at the manufacturer's works which may also be witnessed by BHEL/End customer. Hydraulic or mechanical jack with calibrated gauges for load indication can be used for this purpose. The actual procedure for this shall be got approved by the bidder from BHEL/Customer during detail engineering.

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

Refer Testing requirement as mentioned at ANNEXURE-VII.



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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	The gear boxes shall be run under no-load condition at the rated speed for minimum four



TITLE
2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)
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	hours in each direction and the following are to be checked: i. All bolts at the joints remain tight ii. All gear mesh lines are getting enough lubrication iii. All bearings are getting enough lubrication iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour. v. Vibration : Maximum limit 125 microns (peak to peak) vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm. vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.
6.0.0	General
6.1.0	In addition to the above specific points, the following general points shall be ensured: i. Inspection pockets are provided as required. ii. Gear box casings are provided with at least two fit bolts/dowels at the parting line. iii. Dip sticks with minimum / maximum level markings are provided. iv. Drain plugs are provided at convenient locations preferably at vertical wall of the housing. v. Breathers are provided. vi. Lifting lugs or eye bolts are provided as required. vii. Wherever bearings have splash lubrication, oil retainers are provided. viii. Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint. ix. In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided. Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.



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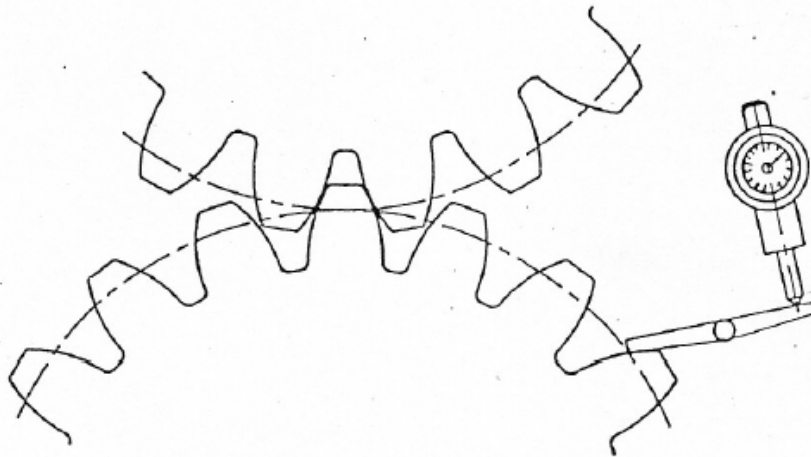


FIG.1 MEASUREMENT OF BACKLASH

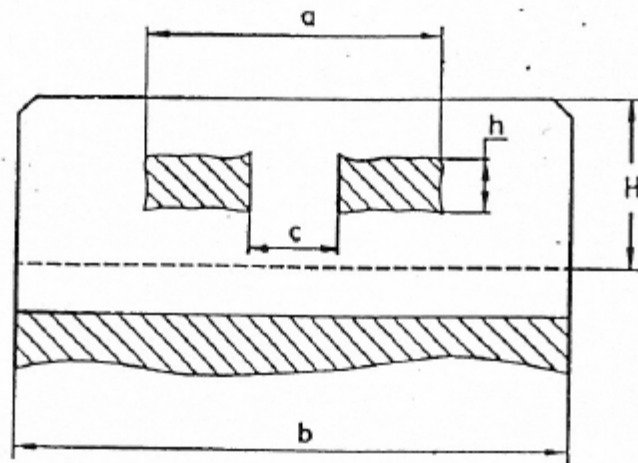


FIG.2 AREA OF CONTACT OF GEAR TEETH



TITLE
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AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)
SPECIFIC TECHNICAL REQUIREMENTS

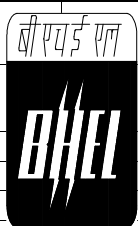
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Table-1

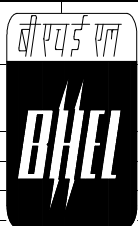
Backlash for Gearing specified by module
(Clause 3.1.0)

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

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI						
				ITEM:				PACKAGE : DOUBLE GIRDER CRANES (225/45T)						
				QP NO : PE-TS-412-501-A001				CONTRACT NO :						
				REV : 0				CONTRACTOR :						
				DATE : 02.11.16				VENDOR'S QAP No :						
SL. NO.	COMPONENTS & OPERATION		CHARACTERISTCS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY			REMARKS
											M	C	N	
1	4		3	4	5	6	7	8	9	D*	**	10		11
1	Fabricated components													
	Box Girder, End Carriage, Crab Frame, Rope Drum, Rope													
a	Material		Chemical & Physical Properties	Major	Corelation	1/Heat/Batch	IS:2062-Gr B	IS:2062-Gr B	Mfr's T.C/	√	P	V	V	
					with T.C.				Vendor's					
					Check test in				T.C.					Refer note: 1
					absence of T.C.									
			U.T of plates.		Ultrasonic	100%	ASTM A435	ASTM A435	T.C. / I.R.	√	P	V	V	The plates of thickness 25mm and above shall be ultrasonically tested
b	weld setup		dimensions	Major	Measurement	100%	Components drawings	Components drawings	Vendor's inspection report		P			
1A	Seamless pipe for rope drum		Chem,physical,	major	Co relation with TC, check in absence of TC	100%	ASTM A106Gr B	ASTM A106Gr B	MTC/Lab TC	√	P	V	V	Refer note: 1
			NDT	Major	,macro etching & flattening	100%	ASTM A106Gr B	ASTM A106Gr B	MTC/Lab TC	√	P	V	V	
			NDT	Major	UT	100%	ASTM E-213-2007	notch depth shall not be more than 12.5% of thickness of pipe	IR	√	P	V	V	
2	Welding WPS (Welding procedure specification) in line with ASME sec. IX (QW - 482) - For Box Girder, End Carriage, Crab Frame, Rope Drum													
a	Check for welding procedure qulification, welder's performance		Welding parameters	Major	check & test	100%	ASME Sec-IX	ASME Sec-IX	QW-482,QW-483	√	P	V	V	CUSTOMER APPROVED WPS AND QUALIFIED WELDERS ACCEPTABLE.
									QW-484 ASPER asme Sec-IX					
b	Back chipping		surface defect	Major	DPT	100%	ASME Sec-VIII, Div-I, Appen - 8	ASME Sec-VIII, Div-I, Appen - 8	Vendor insp. Report		P	V	V	

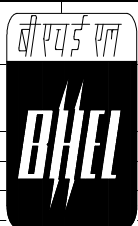
		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI					
						ITEM:		QP NO : PE-TS-412-501-A001	PACKAGE : DOUBLE GIRDER CRANES (225/45T)				
								REV : 0	CONTRACT NO :				
						DATE : 02.11.16	CONTRACTOR :						
								VENDOR'S QAP No :					
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D*	**	AGENCY M C N	REMARKS	
1	4	3	4	5	6	7	8	9			10	11	
c	Butt Welds	NDT	Critical	Gamma ray	100% in tension	ASME Sec - VIII	ASME Sec-VIII, CL UW51	Vendor insp	√	P	V	V	Review of inspection report & radiography report and RT films . Refer note: 2 DP test of filletweld for ropedrum to be conducted after final machining Random witness by BHEL
				Radiography	10% in compression			Repot					
					100% in rope drum			RT film					
			Critical	DPT	100%	IS: 3658	ASME Sec-VII, Appen - 8	Vendor insp		P	W	V	
								Repot					
d	fillet welds	Size and surface defects	Major	Visual	100%	Component Drg.	Component Drg.	Vender insp. Report		P	V	V	
			Major	DPT	10% RANDOM	ASME Sec VIII- Div1- Append 8	ASME Sec VIII- Div1- Append 8	Vender insp. Report	√	P	W	V	
e	final insection of fabricated components listed in Sr.1 above	Dimensions for Girder, end carriage rope drum etc. Camber, Verticality, bend etc	Major	Dimensional Measurement	100%	Vendor Mfg. Drg.	Vendor Mfg. Drg.	vendor route card/vendor insp report		P	V	V	
f	Heat treatment of rope drum	Stress relieving	Major	Review of SR chart	100%	ASME Sec-VIII, Div - I	ASME Sec-VIII, Div - I	SR Chart	√	P	V	V	If fabricated from M.S Plate
3	Gear box casing												
a	Material	Surface condition	Major	Visual	100%	Componet Drg.	Componet Drg.	Vendor insp Report		P			Refer note 1
		Chemical & mech	Major	Measurement	100%	Componet Drg.	Componet Drg.	T.C. & I.R.	√	P	V	V	
				Correlation with T.C. Check test in absesnce of T.C. Correlation	100%	IS:2062	IS:2062						

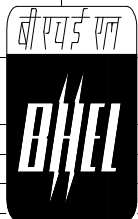
		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI				
				ITEM:				PACKAGE : DOUBLE GIRDER CRANES (225/45T)				
				QP NO : PE-TS-412-501-A001				CONTRACT NO :				
				REV : 0				CONTRACTOR :				
				DATE : 02.11.16				VENDOR'S QAP No :				
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTCS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS
									M	C	N	
1	4	3	4	5	6	7	8	9	D*	**	10	11
b	welding	Welding & Dimensional conformity	Major	Measurement	100%	Componet Drg.	Componet Drg.	Vendor insp Report		P		
c	Heat treatment	stress relieving	Major	Review of SR chart	100%	Component Drg./	Component Drg./	Vendor insp	√	P	V	V
						ASME Sec-VIII, Div - I	ASME Sec-VIII, Div - I for procedure.	Report				
4	PLATFORMS	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp Report		P		Refer note: 1
5	L.T.FRAMES	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp Report		P		
6	HAND RAILINGS	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp Report		P		
7	CABIN	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp Report		P	V	
8	Current collerctor arms	Dimensional conformity	Minor	Measurement	100%	Mfr. Catalog	Mfr. Catalog	Vendor insp Report		P		
9	DSL Guard	Dimensional conformity	Minor	Measurement	100%	Components Drg.	Components Drg.	Vendor insp Report		P		
10	Rails	Dimensional conformity,	Minor	Measurement	100%	G.A.drg./IS : 3443 Vendore T.C./Appd.Data Sheet	G.A.drg./IS : 3443 Vendor T.C./Appd.Data Sheet	IR	√	P	V	V
		Chemical , tensile & hardness	Major	Chemical & hardness	100%	IS-3443	IS:3443	IR	√	P	V	V
11	MECHANICAL COMPONENTS											PT/MPI shall be done after hardfacing and machining.
A	a) wheels											

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI					
								PACKAGE : DOUBLE GIRDER CRANES (225/45T)					
				ITEM:		QP NO : PE-TS-412-501-A001		CONTRACT NO :					
						REV : 0		CONTRACTOR :					
						DATE : 02.11.16		VENDOR'S QAP No :					
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY			REMARKS
1	4	3	4	5	6	7	8	9	D*	**	10		11
	i) raw material	Chemicals composition and Mechanical Properties.	Major	Corelation with mfr's TC	100%	Mfg.drg./IS:1570 / BS - 970	Mfg.drg./IS:1570 / BS - 970	Test Certificate	√	P	V	V	Refer Note:1
	ii) Machined	a) Dimensions	Major	Measurement	100%	Component Drawing	Component Drawing	Vendor insp.		P	V	V	
		b) Hardness		Mechanical	100%	Approved Data Sheet / Mfg. Drg.	Approved Data Sheet / Mfg. Drg.	Report	√	P	V	V	
		c) UT		NDT	100%	Refer Note : 6	Refer Note 6		√	P	V	V	
		d) DPT		NDT	100%	8	App-8		√	P	W	V	
	b) Raw material for Gears , Pinions, Shafts,Axles etc	i) Chemicals Composition & heat treatment, Physical Properties.	Major	Correlation with mfr's TC	100%	Component Drawing, BS : 970 / IS : 1570	Component Drawing, BS : 970 / IS : 1570	Vendor insp. Report	√	P	V	V	
				Check test in absence of TC		Approved Data Sheet	Approved Data Sheet						
		ii) UT (after proof machining)	Major	check for UT (above 50mm dia)	100%	ASME Sec-V	Refer Note 6	Vendor insp. Report	√	P	V	V	Hardness witnessing by BHEL before teeth cutting.
		iii) Hardness	Major	check for Hardness	100%	Mfg. drg. & Approved Data	Mfg. drg. & Approved Data	Vendor insp. Report	√	P	W	V	
		iv) Dimensions	Major	Measurement	100%	Component Drawing	Component Drawing	Vendor insp. Report	√	P	V	V	
		V) D.P.Test on teeth	Major	NDT	100%	ASTME-165	No Crack and line of indication	Vendor insp. Report	√	P	V	V	
B	Pulleys, Brake drums, coupling, other steel castings & forging												All forgings greater than or equal to 50 mm diameter or thickness shall be subjected to Ultrasonic test.
	i) Materials	Physical/Chemical/Hardness	Major	Corelation with mfr's TC	100%	Components Drawing	Components Drawing	Mfr's T.C.	√	P	V	V	
	ii) Machined	a) Dimensions	Major	Measurement	100%	Components Drawing	Components Drawing	Vendor insp report		P	V	V	
		b) DPT after machining.	Major	NDT	100%	ASTM E-165	No. crack /Liner indication	Vendor insp. Report	√	P	V	V	
C	Gear box assy & idle running	Check for oil leakage,Noise level,vibration , rise in temp. after 2 Hrs. of running. reduction ratio, backlash and contact pattern	Major	Visual & Measurement	100%	Vendor standard	Smooth running no oil leakage, Noise 85 db at 1 Mtr. Max. Temp. rise 40°C above amb	Vendor insp. Report	√	P	V	V	

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI						
				ITEM:				QP NO : PE-TS-412-501-A001		PACKAGE : DOUBLE GIRDER CRANES (225/45T)				
								REV : 0		CONTRACT NO :				
								DATE : 02.11.16		CONTRACTOR :				
										VENDOR'S QAP No :				
SL. NO.	COMPONENTS & OPERATION		CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS	
1	4		3	4	5	6	7	8	9	D*	**	10	11	
D	a) Top block, bottom block		dimensional conformity	Major	Masurement	100%	Assembly drawing	Assembly drawing	Vendor insp.		P	V	V	
									Report					
	b) Hook		i) Chemical composition, Heat treatment, Mechanical properties on integral test bar	Major	Chemical, heat treatment & Tensile , % elongation	100%	IS:1875		Test Certificate , HT chart & Insp. Report	✓	P	V	V	
			ii) UT on raw material of hook	Major	UT	100%	ASME sec--v	Annex-1 (Attached)		✓	P	V	V	
			iii) Forging operation of hook	Major	Visual	100%	IS:5749 /IS:15560	IS:5749 /IS:15560		✓	P	V	V	
			iv) Proof load test	Major	Mechanical	100%	IS:5749 /IS:15560	IS:5749 /IS:15560		✓	P	W	W	
			v) UT & MPI / DPT after proof load test	Major	UT & MPI/DPT	100%	ASME sec - v	Annex-1 for UT &		✓	P	W	W	
								No crack & linear						
								indication (For MPI/DPT)						
E	Rope drum assembly		Diemnsional conformity	Major	Measurement	100%	Component Drawing	Tolerance as per drg	Vendor insp		P	V	V	
									Report					
12	Electrical components													
a)	Motors (=< 50 KW)		make , type , rating, Routine test	Major	Review mfr's TC	100%	IS:325	IS 325/Mfr's T.C.	Mfr's T.C.	✓	P	V	V	
														For Motor above 50kW separate QP shall be folowed
b)	Brakes		Make , t ype , rating , dia , IR, HV , Functional test /Routine test	Major	Review mfr's TC	100%	Appd drgs	Appd drgs	Mfr's T.C.	✓	P	V	V	

दीपक एन BHEL		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN		PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI											
						PACKAGE : DOUBLE GIRDER CRANES (225/45T)											
						ITEM:		QP NO : PE-TS-412-501-A001		CONTRACT NO :							
								REV : 0		CONTRACTOR :							
						DATE : 02.11.16		VENDOR' S QAP No :									
SL. NO.	COMPONENTS & OPERATION		CHARACTERISTCS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY			REMARKS			
										M	C	N					
1	4		3	4	5	6	7	8	9	D*	**	10	11				
c)	Control panel		Interlocking fuctional, IR,	CR	Test for HV	100%	Relevant drg &	Relevant drg. & IS : 3177 /	Vendrs insp	√	P	W	W	Refer Note No.3			
			HV, Sheet thickness, cable laying, dressing , ferulling		functional &		Generally confirm to	App. Panle Drg. & BOM	Report					VFD Test Certificate to be			
			Overall diemsnions , painting		routine check		IS : 3177 / App. Panle Drg. & BOM							submitted from app. Vendor			
			shade, Panel surface finish, Thickness, adhesive test, Component fixing, Degree of protection by paper inserting method											for verification.			
d)	Radio remote, Master controllers		HV, IR,Functional	Major	Verfication	100%	BOM/ Mfr. Catalog	BOM/ Mfr. Catalog	Mfr's T.C.	√	P	V	V	Refer Note No.3			
	Pendent , switches																
e)	Limit switches		HV, IR & Functional	Major	Verfication	100%	Approved drawings	Approved drawings	Mfr's T.C.	√	P	V	V				
f)	Trailing cable, Power		Make , type , rating ,Routine & acceptance test	Major	Verfication	100%	,IS: 9968	,IS: 9968	Mfr's T.C.	√	P	V	V				
	Control Cable & DSL		insulation resistance values			100%	IS 1554-Part-1	IS 1554-Part-1									
g)	Transformer		make rating , routine test	Major	visual	100%	Appd drg	Appd drg	IR		P	V	V				
h)	SFU, MCCB,MCB, Contactors, DSL, relays, fuses, resitance bank		make, t ype , rating size, functional, continuity check	Major	visual	100%	Appd drg	Appd drg	IR		P	V	V				
i)	VVVF drives		make , type , rating, routine test	Major	visual	100%	Appd drg	Appd drg	IR		P	V	V				
j)	Anti collision devices , cable gland , ,lugs ,r ectifier, indicating lamps, terminal blocks, load cell.		make , type	Major	visual	100%	Appd drg	Appd drg	IR		P	V	V				
13	Bought our items																
a)	Wire rope		Visual , tensile	Major	Type, grade, dia	100%	IS:2266	IS:2266	T.C.	√	P	V	V				
					breaking strenth												
b)	Other Items		Dimensional conformity	Major	Review TC	100%	Relevant Drg.	Relevant Drg.	Vendor Confirmation		P	V	V				
c)	Bearing		Type & Size	Major	Verfication		Appd drg/Mfr'scatalogue	Appd drg/Mfr's catalogue		√	P	V	V				
14	Assembly of cranes																
a)	Bridge with LT		Dimesions, wheel level alignment	Major	Measurement	100%	GA drg/IS:3177	GA drg/IS:3177	Vendor insp. report	√	P	W	V				
b)	Crab assembly		Dimesions, wheel level alignment	Major	Measurement/ Visual	100%	GA drg/IS:3177	GA drg/IS:3177	Vendor insp. report	√	P	W	V				
c)	Final Inspection (at works)		Overall dimension: Span, Diagonal dimension	Major	Measurement	100%	Approved drgs./IS :3177	Approved drgs./IS: 3177	Vendor insp.	√	P	W	W				

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI				
				ITEM:		QP NO : PE-TS-412-501-A001		PACKAGE : DOUBLE GIRDER CRANES (225/45T)				
						REV : 0		CONTRACT NO :				
				DATE : 02.11.16				CONTRACTOR :				
								VENDOR'S QAP No :				
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS
									M	C	N	
1	4	3	4	5	6	7	8	9	D*	**	10	11
	with actual panel, RRC and pendent	check, headroom, lift , Eqp. Layout on bridge platform, No Load running of LT machinery for direction and speed with VFD, elevations /levels etc						report				
		No Load & Load Tests										
		a) No load: Hoists,CT,LT speed & current measurement..	Major	Measurement	100%	Approved drgs	Approved drgs	Vendor insp. report	√	P	W	W
		b) SWL: Hoists, CT speed, current & Deflection measurement	Major		100%	GA drg/IS:3177	GA drg/IS:3177	Vendor crane test report		P	W	W
		c) Overload: Hoisting, CT movement & current measurment (at 125% SWL)	Major	Operational		GA drg/IS:3177	GA drg/IS:3177	Vendor crane test	√	P	W	W
		d) Operation check of brakes and limit switches .		Check		Tech. Specification	Tech. Specification	report				
d)	Lifting beam (for tandem operation) at works	Dimension, Visual and load test	Major	measurement, check	100%	Approved drgs/doc	Approved drgs/doc	IR	√	P	W	W
15	Review of QA documentation						As per approved QAP			V	V	V
16	Cleaning and Painting	Surface preparation & Painting	Major	Visual		Approved drgs/doc	Approved drgs/doc	Vendor's Report		P	V	
Note 1 : Original TCs / Photocopies certified in original by mill shall be furnished for review. Test In absence of correlated TCs Check test shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used. Note 2 : X-Ray to be taken for thickness upto 19 mm and Gamma Ray for thickness above 19 mm. If Gamma Ray is used for lower thickness slow speed film like D2 or equivalent which gives enough readable and interpretable film quality to be used for clarity. All NDT shall be carried out by Qualified Level II personnel. Note 3 : Performance of electrical & control devices along with the interlocks, protection & sequence to be checked during crane assembly and parked at works. Note 4 Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:/ Vendor's UT Procedure approved by BHEL may also be used. (i) Cracks, flakes, seams and laps (ii) Defects giving indications larger than 6 mm diameter equivalent flaw. (iii) Groups of defects with maximum indication less than that from a 6 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 40%. (iv) Defects giving indications of 3 to 6 mm diameter equivalent flaw separated by a distance less than four time the length of the larger of the adjacent flaws												

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 2X660 MW SEZ ENNORE STPP AT ASH DYKE OF NCTPS, CHENNAI							
								ITEM:		QP NO : PE-TS-412-501-A001		PACKAGE : DOUBLE GIRDER CRANES (225/45T)			
										REV : 0		CONTRACT NO :			
						DATE : 02.11.16		CONTRACTOR :							
								VENDOR'S QAP No :							
SL.	COMPONENTS &	CHARACTERISTCS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY			REMARKS			
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M	C	N				
1	4	3	4	5	6	7	8	9	D*	**	10		11		
Note 5		Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:/ Vendor's UT Procedure approved by BHEL may also be used. (i) Cracks, flakes, seams and laps (ii) Defects giving indications larger than 4 mm diameter equivalent flaw. (iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%. (iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four time the size of the larger of the adjacent flaws For hooks, for carrying out UT on the areas where there is loss of back wall echo due to geometry, the calibration shall be done on blocks of same material of similar thickness having Flat Bottom holes of required size as given above.													
Note 6 :		All material of construction shall be as per approved drg. / data sheet / specifications													
			LEGEND :												
			D * RECORDS INDETIFIED WITH 'TICK'(✓) SHALL BE ESSENTIALLY												
			INCLUDED BY CONTRACTOR IN QA DOCUMENTATION												
			** M : MANUFACTURER/SUBCONTRACTOR												
MANAFACTURER/		CONTRACTOR													
		C: BHEL-CQS/THIRD PARTY INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW													
SUBCONTRACTOR															
SIGNATURE		N : CUSTOMER						REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL						

ULTRASONIC TEST PROCEDURE

1. Specification Applicable : (I) ASTM A – 388
2. Test Purpose : This test conducted on Round Bar, Forging Blank & Hook material (Before Forming) to detect Internal Defect.
3. Condition of material : As rolled/ Normalized Surface shall be prepared as Necessary for conducting the ultrasonic test.
4. Method : Contact method using with pulse-back echo.
5. Equipment details : Modsonic Instrument/ EEC- PX-10
6. Scanning Area : Scanning shall be done in 100% area direction all Along the length and width scanning shall be done at ± 6 db. Evaluation shall be done at reference level.
7. Couplant : Oil/Water
8. Calibration block : The ultrasonic flow detector shall be calibrated by Using standard calibration block IIW V1, V2.
9. Probe used : Probe dia 24mm, 2MHz, 4MHz (NB)
Probe dia 10mm x 4MHz, 24 mm Dia x 2MHz (NB)
(For Hook)
10. Calibration : By choosing proper depth range and gain, the back Wall echo from a defect free area shall be brought To 100 % full screen height (FSH). This shall be The reference level.
11. Acceptance Norms : Loss of back echo: More than 20% not acceptable.
Defect echo more than 20% not acceptable.
Any indication characterized as cracks, lamination, Or any linear defect is not acceptable.
12. Personnel Qualification : The ultrasonic test shall be carried out and results are Evaluated by a person qualified to ISNT/ASNT LEVEL-II.

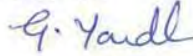
 BHEL PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS BHEL, PS-SR, 690, Anna Salai, Chennai-600035	STANDARD FIELD QUALITY PLAN						
		SYSTEM : EOT Crane 225/45T Cap. AREA : TG HALL				QP NO. : QIP/BOP/001 REV. No. : 00 PAGE No. : 1 of 4		
SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS

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

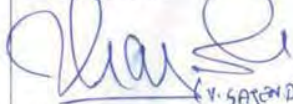
LEGEND : CLASS #: A = CRITICAL, B = MAJOR, C = MINOR
 "A" SHALL BE WITNESSED BY BHEL & CUSTOMER/ CLIENT
 "B" SHALL BE WITNESSED BY BHEL
 "C" SHALL BE WITNESSED BY ERECTION ENGINEER

TYPE @ : V = VISUAL, R = RECORD VERIFICATION,
 M = MEASUREMENT, P = PHYSICAL & T-TEST

FOR BHEL USE


 (NARODHA G)
 PREPARED BY

FOR BHEL USE


 (V. SANKAR)
 REVIEWED AND APPROVED BY

FOR CUSTOMER USE

APPROVED BY

 PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS BHEL, PS-SR, 690, Anna Salai, Chennai-600035	STANDARD FIELD QUALITY PLAN								
		SYSTEM : EOT Crane 225/45T Cap.	QP NO. : QIP/BOP/001 REV. No. : 00 PAGE No. : 2 of 4							
AREA : TG HALL		SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS

3	Check for Alignment of Rails								
	a. Straightness of gantry rails	Measurement	Piano Wire/ Twine	B	100%	Drawings/Erection Manual	Protocol		
	b. Level and Elevation of Gantry rails (top level of girder)	Measurement	Water level/ Measuring Tape	A	100%	Drawings/Erection Manual	Protocol		
	c. Distance between rails(every 5 M) (Tolerance.±. 6mm) including diagonal of gantry rails (Tolerance±. 5 mm)	Measurement	Measuring Tape	A	100%	Drawings/Erection Manual	Protocol		
	d. Bolting of rails and tightening	Measurement	Torque wrench	C	100%	Drawings	Protocol		
4	e. End Stopper Arrangement	Physical	-	A	100%	Drawing	Protocol		
	ERECTION CHECK FOR								
	a. Joining of Girders i.e. splice joints	Physical	-	B	100%	Tech. Spec.	Protocol		
	b. Placement of girder assembly on the gantry.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol		
	c. Movement of wheels	Physical	-	B	100%	Drawings/Tech Spec.	Protocol		
	d. Placement and positioning of electrical panel & trolley.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol		

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 PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS BHEL, PS-SR, 690, Anna Salai, Chennai-600035	STANDARD FIELD QUALITY PLAN						
		SYSTEM : EOT Crane 225/45T Cap.	QP NO. : QIP/BOP/001 REV. No. : 00 PAGE No. : 3 of 4					
AREA : TG HALL								
SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS

5	e. Movement of crab trolley on the crane girder	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	
	f. Deviation in the crane rail level at any point from true level tolerance ± 10 mm	Measurement	Piano Wire / Twince	A	100%	Drawings/ Erection Manual	Protocol	
	D.S.L.							
	a. Fixing arrangement	Visual	-	C	100%	Drawing	Protocol	
	b. Location with respect to gantry rail, spacing & alignment.	Measurement	Measuring Tape	B	100%	Drawing	Protocol	
6	c. Continuity check & insulation Resistance	Measurement	Megger	A	100%	Minimum 5 Mega Ohms	Protocol	
	Cable laying connections	Physical	-	B	100%	Drawing	Protocol	
	Crab Clearances							
7	a. Headroom, end clearance, hook approaches and height of lift and record.	Visual & Measurement	Measuring Tape	B	100%	Drawing	Protocol	
	Gear Box							
8	a. Check oil level	Measurement	Dip stick	B	100%	Drawing	Site log Book	
	LT Machinery, Platform, cabin, Electrical equipment, other structural components, limit switch & Mechanical stopper.							
9	a. Fit up	Visual	-	B	100%		Protocol	
	b. Alignment	Visual	-	B	100%	Drawing	Protocol	
10	Hydraulic rail clamp arrangement	Physical	-	A	100%	Drawing	Protocol	
11	COMMISSIONING CHECKS							

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FOR BHEL USE

G. Yandl

PREPARED BY

FOR BHEL USE

[Signature]

REVIEWED AND APPROVED BY

FOR CUSTOMER USE

[Signature]

APPROVED BY

 PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS BHEL, PS-SR, 690, Anna Salai, Chennai-600035	STANDARD FIELD QUALITY PLAN						
		SYSTEM : EOT Crane 225/45T Cap.				QP NO. : QIP/BOP/001 REV. No. : 00 PAGE No. : 4 of 4		
		AREA : TG HALL						
SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS

	a. Power & control cable connections Insulation Resistance	Visual	Megger	A	100%	Min 5 Mega Ohms	Protocol	
	b. Control panel earthing Insulation resistance	Measurement	Megger	A	100%	Min 5 Mega Ohms	Protocol	
	c. Resistance box earthing	Physical		B				
	IR value	Measurement	-	B	100%	Min 5 Mega Ohms	Protocol	
	Resistance	Measurement		B	100%	Drawing	Protocol	
	d. Operation of Brakes (Hoist motion, L.T. Motion & C.T. motion)	Physical	-	A	100%	O&M Manual	Protocol	
	e. Operation of limit Switch (Hoist & traveling motion brakes)	Physical	-	A	100%	O&M Manual	Protocol	
	f. Motors.		-					
	IR value	Measurement		B	100%	Min 5 Mega Ohms	Protocol	
	Earthing							
	g. At no load check							
	Motor Current	Measurement	-	A	100%	As per procedure	Protocol	
	Crane Speed	Measurement		A	100%			
	(only watching all motion)							
	h. At full load check / Load testing of crane (SWL):							
	Motor Current	Measurement		A	100%	As per procedure	Protocol	
	Crane Speed	Measurement		A	100%			
	Deflection.	Measurement		A	100%			
	i. At 25% Overload		-				Protocol	
	(only watching all motion)	Visual		A	100%	As per procedure		
	j. Hydraulic rail clamp arrangement	Physical	-	A	100%	Drawing	Protocol	
	k. Touch Up Painting.	Visual	-	C		As per approved shade	Records	

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FOR BHEL USE

G. Yandl

PREPARED BY

FOR BHEL USE

[Signature]

REVIEWED AND APPROVED BY

FOR CUSTOMER USE

APPROVED BY



TITLE
2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-412-501-A001
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ANNEXURE-I

MAKES OF SUB-VENDOR ITEMS

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



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



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



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2 x 660 MW ENNORE SEZ STPP
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
21.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
22.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	

	TITLE 2 x 660 MW ENNORE SEZ STPP AT ASH DYKE OF NCTPS, CHENNAI DOUBLE GIRDER EOT CRANE (225/45T) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-412-501-A001	
		VOLUME: II B	
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
23.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
24.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
25.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		

	TITLE 2 x 660 MW ENNORE SEZ STPP AT ASH DYKE OF NCTPS, CHENNAI DOUBLE GIRDER EOT CRANE (225/45T) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-412-501-A001	
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
26.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
27.	MASTER CONTROLLER	SPEED-O-CONTROL		
		ELECTROMAG		
28.	SAFETY SWITCHES	ALSTOM		
		L&T		
		SIEMENS		
29.	PENDENT PUSH BUTTON STATION	OEM		
30.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		
		STANDARD		
31.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
32.	PANELS	SCHNEIDER		
		OEM		
		RITTAL		
33.	RESISTANCE BOXES	PYROTECH		
		ENAPROS		
34.	FIRE EXTINGUISHERS	OEM		
		ASKA EQUIPMENTS LTD.		
		ASHOKA ENGINEERING COMPANY		
		KANADIA FYR FYTER PVT. LTD		
		NITIN FIRE PROTECTION INDUSTRIES LTD		
		NEW ENGINEERING CORPORATION		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		
		MITSUBISHI ELECTRIC		
36.	SHROUDED DSL	SUSHEEL		
		STROMAG		

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

NOTE:

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



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ANNEXURE-II

Mandatory Spares:

(Spares to be provided for each crane)	
Description	Quantity
SPARES FOR LONG TRAVEL UNIT	
SET OF AXLE BEARINGS	1 SET
SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
LONG TRAVEL END SHAFT BEARINGS	1 SET
COUPLING	1 SET
SEALS FOR TRAVEL GEAR BOX	1 SET
LONG TRAVEL BRAKE SHOES	1 SET
LONG TRAVEL BRAKE SPRINGS	1 SET
LONG TRAVEL BRAKE SHOE LINERS	1 SET
SPARES FOR CROSS TRAVEL UNIT	
AXLE BEARINGS	1 SET
SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
SET OF SEALS FOR GEARBOX	1 SET
CROSS TRAVEL END SHAFT BEARING	1 SET
COUPLING	1 SET
CROSS TRAVEL BRAKE SHOES	1 SET
CROSS TRAVEL BRAKE SPRINGS	1 SET
CROSS TRAVEL BRAKE SHOE LINERS	1 SET
SPARES FOR MAIN HOIST	
MAIN HOIST PULLEY BEARINGS	1 SET
SET OF BEARINGS FOR RODE DRUM	1 SET
SET OF BEARINGS FOR GEAR BOX	1 SET
SET OF SEALS FOR MAIN HOIST	1 SET
MAIN HOIST BRAKE SHOES	1 SET
MAIN HOIST BRAKE SPRINGS	1 SET
MAIN HOIST BRAKE SHOE LINERS	1 SET
DISC PAD	1 SET
Description	Quantity
SPARES FOR AUXILIARY HOIST	
AUX HOIST PULLEY BEARINGS	1 SET
SET OF BEARINGS FOR RODE DRUM	
SET OF BEARINGS FOR GEAR BOX	1 SET
SET OF SEALS FOR MAIN HOIST	1 SET
AUX HOIST BRAKE SHOES	1 SET
AUX HOIST BRAKE SPRINGS	1 SET
AUX HOIST BRAKE SHOE LINERS	1 SET
PAIR OF SLINGS	1 SET
DISC PAD	1 SET

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ELECTRICAL: CONTROL PANELS/MOTORS

POWER CONTACTOR OF EACH RATING

2 NOS.

OVER LOAD RELAYS OF EACH RATING

2 NOS.

MCCB/MPCB OF EACH RATING

2 NOS.

PUSH BUTTON OF EACH TYPE

2 NOS.

SPARES FOR VVVF DRIVE OF EACH RATING

1 SET

SET OF BEARINGS FOR MAIN HOIST MOTOR

1 SET

SET OF BEARINGS FOR AUX HOIST MOTOR

1 SET

SET OF BEARINGS FOR CROSS TRAVEL MOTOR

1 SET

SET OF BEARINGS FOR LONG TRAVEL MOTOR

1 SET

Motor of each type & rating

10% of the installed quantity or
minimum 1 number whichever be
higher**NOTE :-**

1) 1 set means 100% requirement.

2) Quantity of spares specified above is for one crane, for two crane the same shall be doubled.

3) All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then suitable applicable alternate spare have been offered / shall be supplied without any financial implication.

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ANNEXURE III - TOOLS & TACKLES

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

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Min. 6 Nos., Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5	Wrench spanner	1 No.
6.	Grease Gun	1 No.
7.	Oil Gun.	1 No.
8.	Hand Lamp.	1 No.
9	Line tester	1 No.
10.	Hydraulic Jack (suitable for removal of LT wheels & other maintenance purpose of crane)	1 No.

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



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ANNEXURE IV

PAINTING SPECIFICATION

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on cranes structures, its mechanical components, motors & panels etc. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

2.0 CODES AND STANDARDS

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

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

- IS:5 : Colours for ready mixed paints and enamels
- IS:1303 : Glossary of terms relating to paints
- IS:2379 : Colour code for identification of pipelines
- IS:1477 : Code of practice for painting of ferrous metals in buildings (Parts I & II)
- IS:2524 : Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
- IS:2395 : Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
- IS:2338 : Code of practice for finishing of wood and wood based materials (Parts I & II)
- IS:158 : Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
- IS:2074 : Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
- IS:104 : Ready mixed paint, brushing, Zinc Chrome, priming
- IS:2932 : Enamel Synthetic exterior
 - (a) Undercoating
 - (b) Finishing
- IS:4682 : Code of practice for lining of vessels & equipment
- SIS 559000 : Swedish standard for blasting
- ISO 8504-2 : Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
- ISO 8501-1 : Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
- SIS 05 5800 : Surface preparation by acid pickling
- SSPC SP08 : Surface preparation by acid pickling
- IS 2629 : Recommended practice for hot dip galvanizing of iron and steel
- ASTM A780 : Standard practice for repair of damaged galvanized coatings
- SSPC : Steel structures painting council
- NACE : National association of Corrosion Engineers
- DIN : Deutsehes Institute for Normung
- BS : British Standard
- ASTM : American Society for Testing material
- AWWA : American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied. Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 110° C. Blasting activity shall be performed at temperatures 30° C above dew point and substrata temperature between 50° C & 500° C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme.



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The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish:-

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting (a) Blasting according to SIS 055900, Grade Sa 2½.

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 60 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

- a) Dust, loose deposits
- c) Adhesive deposits
- d) Oils, greasy impurities
- e) Salt deposits
- f) Markings (e.g., felt tip pen)

Removal

- Vacuum-cleaning, brushing
- Power brushing
- Wet blasting, use of detergent additives by agreement
- Rinsing
- Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

4.1 General

Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spray. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pull off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 Painting System :-

(a) Crane Steel Surfaces /structures

(i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

(ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns. Total primer thickness of two coats total thickness 120 microns.

(iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns, total intermediate coatings thickness shall be 180 Microns. and top polyurethane coating/finish shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.

(iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.



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(v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

b) Painting of Mechanical components, electrical items & motors etc.

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and scarf by pickling, emulsion cleaning, etc. The sheet steel shall be phosphated / oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing synthetic enamel paint shall be applied.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Total DFT -135-155 Microns

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

C) Painting of Control Panel etc.

Surface preparation

: Seven tank process

Primer

: Two coats of zinc rich primer paint, total dry film thickness 75µm.

Finish Coat

: Two coats of finishing epoxy paint shall be applied, 30-40 microns DFT each coat.

Total DFT

: 135-155µm

Or powder coating –

:75 micron (total DFT)

COLOR CODING PROCEDURE / SCHEME

S.No	ITEM DESCRIPTION	REGION	SURFACE PREP.	PAINTING SCHEME							COLOUR SHADE	REMARKS
				PRI MER	MI N D F T µ	INTERME DIATE	MI N D F T µ	FINI SH	MI N D F T µ	TOT AL DFT		
a	Crane structure	As per painting specification outline above.									Golden Yellow Shade 356 as per IS-5	Color band black
b	Bottom block assembly										Crimson shade 540 as per IS-5	
c	Hooks										Crimson shade 540 as per IS-5	
d.	End carriage sweep										Golden Yellow Shade 356 as per IS-5	Color band black
e.	Panels										Light grey 631 as per IS 5/ 7032	
f	Motors										Light grey 631 as per IS 5	



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ANNEXURE-V

DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

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

S.N.	BHEL drawing No.	Title	Approval category	Schedule date of submission from date of LOI.
1	PE-VO-412-501-A001	Manufacturing Quality Plan with sub vendor list For TG Hall Crane	A	7 days
2	PE-VO-412-501-A027	Data sheet for TG Hall Crane with painting details	A	15 days
3	PE-VO-412-501-A003	Data sheet of motors	A	15 days after approval of Mechanism Sizing Calculation in Cat II/Cat I.
4	PE-VO-412-501-A004	Mechanism Sizing Calculation Including storm brake calculation for TG Hall Crane	A	7 days
5	PE-VO-412-501-A005	General arrangement for TG Hall crane with CT DSL details	A	7 days
6	PE-VO-412-501-A006	Crab sub assembly for TG Hall crane with CT wheel assembly	A	7 days
7	PE-VO-412-501-A032	Gantry Rail installation for TG Hall crane	A	7 days
8	PE-VO-412-501-A008	General arrangement for PVC shrouded DSL for TG Hall crane	A	7 days
9	PE-VO-412-501-A009	Main and Auxiliary hook block assembly with details of hook,nut and check plate for TG Hall Crane	I	7 days
10	PE-VO-412-501-A010	Long travel Machinery Assembly with LT wheel assembly for TG Hall Crane	I	15 days
11	PE-VO-412-501-A016	Electrical equipment layout in cabin for TG Hall crane	I	10 days
12	PE-VO-412-501-A017	Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Aux. hoist panel & BOM d) Cross Traverse & BOM e) Long Traverse & BOM Including earthing diagram & write up for TG Hall Crane	A	15 days
13	PE-VO-412-501-A018	General Arrangement of a) Protective panel b) Main hoist panel c) Aux. hoist panel d) Cross Traverse panel e) Long Traverse panel. f) Pendant g) Remote Radio Control for TG Hall Crane	A	15 days
14	PE-VO-412-501-A019	Cable , DSL Sizing and cable schedule for TG hall crane	A	20 days
15	PE-VO-412-501-A050	Crane lubrication drawing TG Hall Crane	I	20 days
16	PE-VO-412-501-A012	Structural calculations for TG Hall Crane	I	7 days
17	PE-VO-412-501-A021	Type test certificate (for motors) TG Hall Crane	I	7 days after approval of Data sheet of motors in Cat II/Cat I.
18	PE-VO-412-501-A025	Erection procedure TG Hall Crane	A	25 days
19	PE-VO-412-501-A023	Mandatory spare parts list TG Hall Crane	A	25 days
20	PE-VO-412-501-A014	O & M manual	I	45 days
21	PE-VO-412-501-A015	Detailed BOM/BOQ for TG Hall Crane	I	30 days
LEGENDS				
A= Approval category				

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I= Information category

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.
5. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-
 - a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.
6. 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.
7. 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.
8. All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
9. 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.
10. Bidder to follow the following the drawing submission schedule:
 - 1st submission of drawings from date of LOI as per the submission schedule.
 - Every revised submission incorporating comments – within 7 days.
 - 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.

DOCUMENT MANAGEMENT SYSTEM

- 1.0 Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.
- 2.0 Internet explorer version – Minimum Internet Explorer 7.
- 3.0 Internet speed – 2 mbps (Minimum preferred).
- 4.0 Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- 5.0 Vendor's Internal proxy setting should not block DMS application's link (<http://dms-server.bhelnem.com/WrenchWeb>).

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ANNEXURE VI – PACKING PROCEDURE

Packing and Marking

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

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

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

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ANNEXURE-VII**Procedure for Load & Overload testing of Double Girder EOT
Cranes at Manufacturer's Works**

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

Basic Assumptions / Inputs for testing at Works:

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

Procedure for Load / Overload testing:

The cranes shall be tested for no load, load test & overload test at works generally in conformance with the IS – 3177 (latest edition). Specifically with respect to the load / overload testing of crane, the following tests as per the outlined procedures shall be done at works.

- Deflection of the girder will be measured at SWL when the trolley with load is at the middle of the girder.
- No load and full load current of the motors will be measured to verify whether it is as per the approved data sheet of the motor. Resistors in the circuit will be checked for any overheating of the element.
- Overload relays will be checked for proper functioning.

Hoisting & Cross Travel motions:

The load will be gradually raised to 125 percent of the rated capacity (SWL) with actual hook. The load will be lifted upward to about 1 meter height above its support and stop again. Check for any undue drift in the load. If load drifts, check the adjustment of brakes and repeat the above procedure. Then lower the load to rest on support/ground.

	TITLE 2 x 660 MW ENNORE SEZ STPP AT ASH DYKE OF NCTPS, CHENNAI DOUBLE GIRDER EOT CRANE (225/45T) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-412-501-A001	
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For checking the cross travel, raise the load up to one (1) meter height above supports and then move the trolley with load about one (1) meter in either direction of the bridge. Then lower the load to rest on support/ ground. Creep speed motions shall be checked over a distance of about 500 mm. Note: Complete No load, load & over load tests in line with IS-3177 (latest edition) shall also be done after erection of EOT crane at site.			



TITLE
2 x 660 MW ENnore SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)
SPECIFIC TECHNICAL REQUIREMENTS

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SUPPLY PRICE PERCENTAGE BREAKUP

S. N.	Details of Works or Equipment/System	Qty. (LOT / Nos.)	Percentage (%) Break up proposed for billing purpose during contract for Supply
1.	Total lumpsum firm price for design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight , unloading, storage and handling at site in line with drawings/ documents/ test procedures approved by BHEL / Customer for Two (2) no. of 225/45 T capacity, Double grider EOT crane with 29M lift of main hook,35.5M lift of auxiliary hook, 27.8 M span, complete with all accessories, isolating switch and power cable from isolating switch to DSL, Erection and commissioning spares for the total scope defined as per technical specification PE-TS-412-501-A001.	2 set.	87.75 %
2.	Total lumpsum firm price for design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight, unloading, storage and handling at site in line with drawings/ documents/ test procedures approved by BHEL / Customer for PVC shrouded bus bar type DSL for 244.5 M bay length complete with all accessories for the total scope defined as per technical specification PE-TS-412-501-A001.	1 set	3.0 %
3.	Total lumpsum firm price for design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight , unloading, storage and handling at site in line with drawings/ documents/ test procedures approved by BHEL / Customer for 244.5 M bay length Gantry rail complete with all accessories for the total scope defined as per technical specification PE-TS-412-501-A001.	1 set	6.0 %
4.	Lump sum price of temporary cable for operation of crane during erection stage of the plant (equal to half the baylength plus 25 M) for the total scope defined as per technical PE-TS-412-501-A001.	2 set	1.5 %
5.	Lump sum price of STORM BRAKE (LT hydraulic rail clamps/parking brakes) as per technical specification PE-TS-412-501-A001.	2 set	0.5 %
6.	Lump sum price of MAIN HOOK AND AUXILLIARY HOOK ASSEMBLY as per technical specification PE-TS-412-501-A001.	2 set	1.0 %
7.	Total lumpsum price for Maintenance tools and Tackles as per technical specification PE-TS-412-501-A001.	1 set	0.25 %

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. The unit rates derived for PVC shrouded DSL, Gantry rail and temporary cable from sl no 2,3 & 4 respectively shall be used for adjustment purpose in case of change in baylength during detail engineering stage.
- 4) Bidder to submit a stamped & signed copy of the above percentage breakup along with their offer.

GENERAL TECHNICAL REQUIREMENTS

1.00.00 INTRODUCTION

This part covers technical requirements, which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical requirements brought out in the Technical Specifications and the Technical Data Sheets.

2.00.00 BRAND NAME

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Owner to determine that the products proposed are equivalent to those named.

3.00.00 BASE OFFER & ALTERNATE PROPOSALS

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice may also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Owner. Sufficient amount of information for justifying such proposals shall be furnished to Owner along with the bid to enable the Owner to determine the acceptability of these proposals.

4.00.00 COMPLETENESS OF FACILITIES

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

4.02.00 All equipment furnished by the Bidder shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

5.00.00 CODES & STANDARDS

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

- (a.) Bureau of Indian Standards (BIS)
- (b.) Indian electricity act
- (c.) Indian electricity rules
- (d.) Indian Explosives Act
- (e.) Indian Factories Act and State Factories Act
- (f.) Indian Boiler Regulations (IBR)
- (g.) Regulations of the Central Pollution Control Board, India
- (h.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- (i.) Pollution Control Regulations of Department of Environment, Government of India
- (j.) State Pollution Control Board.
- (k.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- (l.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

- (a.) Japanese Industrial Standards (JIS)
- (b.) American National Standards Institute (ANSI)
- (c.) American Society of Testing and Materials (ASTM)
- (d.) American Society of Mechanical Engineers (ASME)

- (e.) American Petroleum Institute (API)
- (f.) Standards of the Hydraulic Institute, U.S.A.
- (g.) International Organisation for Standardization (ISO)
- (h.) Tubular Exchanger Manufacturer's Association (TEMA)
- (i.) American Welding Society (AWS)
- (j.) National Electrical Manufacturers Association (NEMA)
- (k.) National Fire Protection Association (NFPA)
- (l.) International Electro-Technical Commission (IEC)
- (m.) Expansion Joint Manufacturers Association (EJMA)
- (n.) Heat Exchange Institute (HEI)

5.03.00 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, alongwith the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned else where in the specification together with the complete word to word translation of the standard that is normally not published in English.

5.04.00 As regards highly standardized equipment such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

5.05.00 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

5.06.00 Two (2) English language copies of all-national and international codes and/or standards used in the design of the plant, equipment, civil and structural works shall be provided by the Bidder to the Owner within two calendar months from the date of the Notification of Award.

5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

6.00.00 EQUIPMENT FUNCTIONAL GUARANTEE

6.01.00 The Equipment and Auxiliaries shall be capable of continuous operation in frequency range of 47.5 to 51.5 Hz.

6.02.00 The functional guarantees of the equipment under the scope of the Contract is given elsewhere in the technical specification. These guarantees shall supplement the general functional guarantee provisions covered under General Conditions of Contract.

6.03.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Bidder as specified elsewhere in this specification.

7.00.00 DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Design of Facilities

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Bidder shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 Maintenance and Availability Considerations

Equipment/facilities offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the Bidder for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the Bidder for lifting the equipment and accessories covered under the specification.

8.00.00 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY BIDDER

8.01.00 Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

The Bidder shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and data sheets.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I attached with Chapter 3.

8.03.00 The documentation that shall be provided by the Bidder is indicated in various sections of specification. The documentation shall include but not be limited to the following:

Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Bidder shall furnish a Plant Definition Manual within 4-6 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

- i. System description of all the mechanical, electrical, control & instrumentation & civil systems.
- ii. Technology scan for each system / sub-system & equipment.
- iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.
- iv. Optimization studies including thermal cycle optimization.
- v. Sizing criteria of all the systems, sub-systems including various piping systems/ equipment/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.
- vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.
- vii. Operation Philosophy and the control philosophy of the Main Plant and other plants.

- viii. General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Owner's scope. This drawing shall also be furnished in the form of floppy discs to the Owner for engineering of areas not included in Bidder's scope.
- ix. Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the Bidder.
- x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xi. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Owner.
- xii. After approval of Plant Definition Manual / Design Basis Report, Bidder shall furnish detailed technical specification of all system / packages of the Plant.
 - i. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.
 - ii. Flow diagrams, Process & Instrumentation Diagrams alongwith write-up and system description.
 - iii. Start-up curves for turbine, boiler and both turbine and boiler combined together as a unit for various start-ups, viz. cold, warm and hot start-up.
 - iv. Piping isometric, composite layout and fabrication drawings.
 - v. Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.
 - vi. Technical data sheets for all bought out and manufactured items. Bidder shall use the specifications as a base for placement of orders on their sub-vendors.
 - vii. Detailed design calculations for components, system/sub-system,, piping etc., wherever applicable including sizing calculations for all auxiliaries as per criteria specified elsewhere in specification.
 - viii. Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.
 - ix. Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.

- x. Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).
- xi. Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.
- xii. Comprehensive list of all terminal points which interface with Owner's facilities giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.
- xiii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
- xiv. Protection system diagrams and relay settings.
- xv. Interconnection diagrams.
- xvi. Cable routing plan.
- xvii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.
- xviii. Alarm and annunciation list and alarms & trip set points.
- xix. Sequence and protection interlock schemes.
- xx. Type test reports and power system stability study report.
- xxi. Control system configuration diagrams and card circuit diagrams and maintenance details.
- xxii. Detailed software manuals & source software listing.
- xxiii. Detailed flow chart for digital control system.
- xxiv. Mimic diagram layout.
- xxv. Civil Task drawings(for the Engineering by Owner),Design and Drawings for the Civil & Structural works in the scope of the Bidder.
- xxvi. Model study reports wherever applicable.
- xxvii. Functional & guarantee test procedures and test reports.

- xxviii. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.
- xxx. The Bidder while submitting the above documents / drawings for approval / reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.01

Instruction Manuals

The Bidder shall submit to the Owner, draft Instruction Manuals for all the equipment covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the Owner the Instruction Manuals shall be submitted as indicated in Annexure-I. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Owner. The Instruction Manuals shall comprise of the following.

Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

- a) Erection strategy.
- b) Sequence of erection.
- c) Erection instructions.
- d) Critical checks and permissible deviation/tolerances.
- e) List of tool, tackles, heavy equipment like cranes, dozers, etc.
- f) Bill of Materials
- g) Procedure for erection.
- h) General safety procedures to followed during erection/installation.
- i) Procedure for initial checking after erection.
- j) Procedure for testing and acceptance norms.
- k) Procedure / Check list for pre-commissioning activities.
- l) Procedure / Check list for commissioning of the system.

- m) Safety precautions to be followed in electrical supply distribution during erection

Operation & Maintenance Manuals

- i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied to the Owner.
- ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Owner for records.
- iii. A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.
- iv. The manuals shall include the following :
 - a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
 - b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
 - c) Where applicable, fault location charts shall be included to facilitate finding the cause of maloperation or break down.
- v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.
- vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the Owner indicating lubrication method for each type/category of bearing.

8.03.02

Plant Handbook

The Bidder shall submit to the Owner a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipment and systems covering the complete project including

1. Design and performance data.
2. Process & Instrumentation diagrams.
3. Single line diagrams.
4. Sequence & Protection Interlock Schemes.
5. Alarm and trip values.
6. Performance Curves.
7. General layout plan and layout of main plant building and auxiliary buildings.
8. Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Owner's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03 **Project Completion Report**

The Bidder shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **Drawings**

- (a.) All documents submitted by the Bidder for Owner's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I. The soft copies to be supplied shall be either in CDs, or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form.
- (b.) Final copies of the approved drawings shall be submitted on CD-ROM along with the requisite number of hard copies as per Annexure-I.
- (c.) The completed plant documentation with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. shall be furnished to Owner.
- (d.) All documents/text information shall be in latest version of MS Office.

- (e.) All drawings submitted by the Bidder including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.
- (f.) Each drawing submitted by the Bidder (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Owner, Consultant, name of the Project, system designation, the specifications title, the specification number, drawing/document number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.
- (g.) The Bidder shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Owner. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".
- (h.) Similarly, all the drawings/ documents submitted by the Bidder during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission.
- (i.) The furnishing of detailed engineering data and drawings by the Bidder shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Owner will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipment provided by others and external connections & dimensions which might affect plant layout. The review by the Owner should not be construed to be a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Owner / Project Manager shall not relieve the Bidder of any of his responsibilities and liabilities under this contract.
- (j.) After the approval of the drawings, further work by the Bidder shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Owner.
- (k.) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Bidder's risk. The Bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Owner. However, if some changes are necessitated in the design of the equipment/system at a later date, the Bidder may do so, but such

changes shall promptly be brought to the notice of the Owner indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

- (l.) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Owner prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/representative of Owner based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.
- (m.) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Bidder well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.
- (n.) As Built Drawings

After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to “as built” conditions.

- (o.) Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Owner. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Owner's scope and submit all necessary drawings/ documents for the same.
- (p.) The Bidder shall submit adequate prints of drawing/data/document for Owner's review and approval. The Owner shall review the drawings and return one (1) copy to the Bidder authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Bidder to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

- (q.) All engineering data submitted by the Bidder after final process including review and approval by the Owner shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Owner in writing.

8.04.00 **Engineering Information Submission Schedule**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Owner. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

- (a.) Information that shall be submitted for the approval of the Owner before proceeding further, and
- (b.) Information that would be submitted for Owner's information only.

The Engineering Information Schedule shall be updated monthwise.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **Engineering Progress and Exception Report**

8.05.01 Report giving the status of each engineering information including

- (a.) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission
- (b.) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the Owner within four (4) weeks of the award of the contract, which shall then be discussed and finalized with the Owner.

8.06.00 **Co-Ordination Meetings**

8.06.01 The Bidder shall be called upon to organize and attend monthly Design/ Co-ordination Meetings with the Owner/Owner's representatives, Project Consultant during the period of contract. The Bidder shall attend such meetings at his own cost at mutually agreed venue as and when required and

- fully co-operate with such persons and agencies involved during the discussions.
- 8.06.02 The Bidder should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Bidder shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Bidder will be reviewed by the Owner as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Owner shall then be discussed across the table during the above co-ordination Meetings wherein best efforts shall be made by both sides to ensure the approval of the drawing.
- 8.06.03 The Bidder shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Bidder shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
- 8.06.04 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.
- 8.06.05 Any delays arising out of failure by the Bidder to incorporate Owner's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Bidder to alter the Contract completion date.
- 8.07.00 **Design Improvements**
- The Owner or the Bidder may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.
- If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Bidder proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
- 8.08.00 **Equipment Bases**
- A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Owner. Each base plate which support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.
- 8.09.00 **Protective Guards**
- Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

8.10.00 Lubricants, Servo Fluids and Chemicals

8.10.01 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

8.10.02 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Owner along with lubrication requirements.

8.11.00 Lubrication

8.11.01 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

8.12.00 Material of Construction

8.12.01 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

8.13.00 Rating Plates, Name Plates & Labels

8.13.01 Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Owner.

8.13.02 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Owner or as detailed in appropriate section of the technical specifications.

8.13.03 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering

engraved on the back. The name plates shall be suitably fixed on both front and rear sides.

- 8.13.04 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with epoxy. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.
- 8.13.05 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.
- 8.13.06 Valves, steam traps and strainers shall be identified by Owner's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.
- 8.13.07 Safety and relief valves shall be provided with the following :
- (a.) Manufacturer's identification.
 - (b.) Nominal inlet and outlet sizes in mm.
 - (c.) Set pressure in Kg/cm² (abs).
 - (d.) Blowdown and accumulation as percentage of set pressure.
 - (e.) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
- 8.13.08 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.
- 8.13.09 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system

8.14.00 **Tools and Tackles**

The Bidder shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Bidder shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Bidder should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Owner.

8.15.00 Welding

8.15.01 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be performed by others the requirements shall be submitted to the Owner in advance of commencement of erection work.

8.16.00 Colour Code for all Equipment/ Pipings/ Pipe Services

8.16.01 All equipment/ piping/ pipe services are to be painted by the Bidder in accordance with Owner's standard colour coding scheme, which will be furnished to the Bidder during detailed engineering stage.

8.17.00 Protection and Preservative Shop Coating

8.17.01 Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.

8.17.02 Preservative Shop Coating

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.

- 8.17.03 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the Owner regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Owner.
- 8.17.04 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.
- 8.17.05 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Owner. Lube oil piping or carbon steel shall be pickled.
- 8.17.06 Painting for Civil structures shall be done as per relevant part of technical specification.

9.00.00 QUALITY ASSURANCE PROGRAMME

- 9.01.00 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his sub-Bidder's premises or at the Owner's site or at any other place of work are in accordance with the specifications. Such programs shall be outlined by the Bidder and shall be finally accepted by the Owner/authorized representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001. A quality assurance programme of the Bidder shall generally cover the following:

- (a.) His organization structure for the management and implementation of the proposed quality assurance programme
- (b.) Quality System Manual
- (c.) Design Control System
- (d.) Documentation and Data Control System
- (e.) Qualification data for bidder's key personnel.
- (f.) The procedure for purchase of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- (g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.
- (h.) Control of non-conforming items and system for corrective actions and resolution of deviations.
- (i.) Inspection and test procedure both for manufacture and field activities.

- (j.) Control of calibration and testing of measuring testing equipment.
- (k.) System for Quality Audits.
- (l.) System for identification and appraisal of inspection status.
- (m.) System for authorising release of manufactured product to the Owner.
- (n.) System for handling, storage and delivery.
- (o.) System for maintenance of records, and
- (p.) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

9.02.00 General Requirements - Quality Assurance

- 9.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme duly approved by the Owner. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Owner for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished.
- 9.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-Bidder's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. Compact Disc or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
- 9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
- 9.02.04 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference

documents/standards etc. will be subject to Owner's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Owner shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Owner in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and dispositioning.

- 9.02.05 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Owner's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
- 9.02.06 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 9.02.07 The Bidder shall submit to the Owner Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F3. The field welding schedule shall be submitted to the Owner along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
- 9.02.08 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Owner.
- All welding/brazing procedures shall be submitted to the Owner or its authorised representative for approval prior to carrying out the welding/brazing.
- 9.02.09 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/sub-Bidder's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Owner.
- 9.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorised representative.
- 9.02.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the

equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

9.02.12 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

9.02.13 No welding shall be carried out on cast iron components for repair.

9.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

9.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

9.02.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

9.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications,

quality plans and delivery conditions shall be furnished to the Owner on the monthly basis by the Bidder along with a report of the Purchase Order placed so far for the contract.

9.02.18 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-Bidder's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

9.02.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Bidder's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

9.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

9.02.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

9.02.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/ authorised representative.

9.02.23 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment

All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and

inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Bidder/ sub-Bidder is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Bidder/ sub- Bidder along with the statistical figures to validate the alternate procedure to be forwarded.

The Bidder/Sub-Bidder shall carry out routine test on 100% item at Bidder/sub-Bidder's works. The quantum of check/test for routine & acceptance test by Owner shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

9.03.00 QA Documentation Package

The Bidder shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (?) mark.

9.03.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.

9.03.02 Typical contents of QA Documentation is as below:-

- (a.) Quality Plan
- (b.) Material mill test reports on components as specified by the specification and approved Quality Plans.

- (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- (e.) Heat Treatment Certificate/Record (Time- temperature Chart)
- (f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- (g.) CHP / Inspection reports duly signed by the Inspector of the Owner and Bidder for the agreed Customer Hold Points.
- (h.) Certificate of Conformance (COC) wherever applicable.
- (i.) MDCC

9.03.03 Similarly, the Bidder shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

9.03.04 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- (c.) If a decision is made despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of

QA documentation package shall not be later than 3 weeks after the despatch of equipment.

9.03.05 Transmission Of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Owner.

For the particular case of phased deliveries, the complete quality document to the Owner shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 Project Manager's Supervision

9.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section General Conditions of Contract, the Bidder shall proceed to comply with the Project Manager's decision.

9.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

- (a.) Interpretation of all the terms and conditions of these documents and specifications:
- (b.) Review and interpretation of all the Bidder's drawing, engineering data, etc:
- (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :
- (d.) Inspect, accept or reject any equipment, material and work under the contract.
- (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates
- (f.) Review and suggest modifications and improvement in completion schedules from time to time, and
- (g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 Inspection, Testing And Inspection Certificates

9.05.01 The word 'Inspector' shall mean the Project Manager and/or his authorized representative and/or an outside inspection agency acting on behalf of the

Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.

- 9.05.02 The Project Manager or his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.
- 9.05.03 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 9.05.04 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 9.05.05 When the factory tests have been completed at the Bidder's or sub-Bidder's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 9.05.06 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-Bidder, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorized representative to accomplish testing.

- 9.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 9.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 9.05.09 All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.
- 9.06.00 **Associated document for quality assurance programme:**
- 9.06.01 List of items requiring quality plan and sub supplier approval. (Annexure-III).
- 9.06.02 Status of items requiring Quality Plan and sub supplier approval. (Annexure-IV).
- 9.06.03 Field Welding Schedule (Annexure-V).
- 9.06.04 Manufacturing Quality Plan (Annexure-VI).
- 9.06.05 Field Quality Plan (Annexure-VII).

10.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

- (a.) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Owner and the Bidder for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Bidder's quality assurance programme as well as those included elsewhere in the Technical Specifications.
- (b.) The Bidder's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall

be commenced during which period the complete facilities, equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

It will be the responsibility of the Bidder to assess and furnish a list of all commissioning spares required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Bidder within 12 months from the date of LOA, separately for each equipment and shall be reviewed by the Owner and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the trial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Bidder of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Bidder as a part of the respective equipment package at no extra cost to the Owner.

- (c.) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Owner six months prior to the respective implementations. The Owner will approve final verification of cleanliness.
- (d.) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- (e.) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owner's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Owner.
- (f.) The Bidder during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.
- (g.) Bidder shall furnish the commissioning organization chart for review & acceptance of Owner at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain :
 - (1.) Biodata including experience of the Commissioning Engineers.
 - (2.) Role and responsibilities of the Commissioning Organisation members.

- (3.) Expected duration of posting of the above Commissioning Engineers at site.

10.02.00 Initial Operation

- a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.
- b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.
- c) The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.
- d) The Bidder shall intimate the Owner about the commencement of initial operation and shall furnish adequate notice to the Owner in this respect.
- e) Any loss of generation due to constraints attributable to the Owner shall be construed as Deemed Generation.
- f) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Bidder. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Bidder to the full satisfaction of the Owner to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

10.03.00 Guarantee Tests

- a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Bidder in presence of the Owner. The Bidder's Commissioning, Start-up Purchaser shall make the unit ready to conduct such test. Such test will be commenced and completed as per schedule indicated in Vol I GCC
- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

- c) For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Owner shall be used. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Owner's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.
- d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Bidder, free of cost.
- e) The Guarantee tests and specific tests to be conducted on equipment have been brought out in detail elsewhere in the specification.

11.00.00 TAKING OVER

Upon successful completion of Initial Operations and all the tests other than guarantee tests conducted to the Owner's satisfaction, the Owner shall issue to the Bidder a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Owner delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Bidder of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

12.00.00 TRAINING OF OWNER'S PERSONNEL

12.01.00 The scope of service under training of Owner shall include a training module in the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Owner:

- (a.) Training for Steam Generator Equipment
- (b.) Training for TG and related equipment.
- (c.) DDCMIS
- (d.) Training for Electric Power Supply systems
- (e.) Training for HT motor
- (f.) Training for power cycle piping/critical piping.

The above training shall be provided taken by the EPC Bidder in one of the reference power plant.

12.02.00 The scope of services under training shall also necessarily include training of Owner's Engineering personnel covering a training module of upto 52 man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares 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. An indicative module of the training requirement of Owner's Engineering personnel is attached as Annexure-II.

Four (4) man month and two (2) man month training for Purchasers Engineering Personnel on the offered CFD modelling code for SG & ESP including alternative geometry modelling technique to be provided.

12.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Owner's approval. Consolidated training period included above (i.e. 35 and 52 man months respectively for O&M and Engineering) is indicative only. Owner reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.

12.04.00 Clause 12.02.00 & 12.03.00 shall be applicable for domestic bidders. For foreign bidders refer Vol I GCC.

12.05.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.

12.06.00 In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

12.07.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Owner reserves the right to include or exclude these item(s) during place of Award. All expenses except travelling expenses shall be borne by the contractor.

13.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

- (a.) Working platforms should be fenced and shall have means of access.
- (b.) Ladders in accordance with Owner's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

14.00.00 NOISE LEVEL

The equivalent 'A' weighted sound pressure level measured at a height of 1.0 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

- (a.) Safety valves and associated vent pipes for which it shall not exceed 105 dBA.
- (b.) Regulating drain valves in which case it shall be limited to 90 dBA.
- (c.) TG unit in which case it shall not exceed 90 dBA.
- (d.) For HP-LP bypass valves and other intermittently operating control valves, the noise level shall be within the limit of 85 dBA.

15.00.00 PACKAGING AND TRANSPORTATION

All the equipment & spares 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. Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

16.00.00 ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

17.00.00 INSTRUMENTATION AND CONTROL

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

17.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimeter (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
c)	Draught	-	Millimeters of water column (mm wc).
d)	Vacuum	-	Millimeters of mercury column (mm Hg) or water column (mm Wcl).
e)	Flow (Gas)	-	Tonnes/ hour
f)	Flow (Steam)	-	Tonnes/ hour
g)	Flow (Liquid)	-	Tonnes / hour
h)	Flow base	-	760 mm Hg. 15 deg.C
i)	Density		Grams per cubic centimeter.

17.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

17.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

18.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment, which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

19.00.00 INSTRUMENT AIR SYSTEM

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. shall be as per the details furnished elsewhere.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

20.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

- (a.) Temperature test pockets with stub and thermowell
- (b.) Pressure test pockets

21.00.00 ELECTRONIC MODULE/COMPONENT DETAILS

The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

22.00.00 ENVIRONMENTAL MONITORING & CONTROL MEASURES

Bidder to note that MOEF has declared Manali area as critically polluted area and also imposed certain restrictions on consideration of developmental projects.

Concerned authorities have been addressed to have self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF and also to furnish the action plan ie., for the establishment of self monitoring system. It is also directed to undertake Environmental Audit (EA) to ascertain the compliance level of standards notified by MOEF.

In this context it is to be noted that our proposed project is also located in the said critically polluted cluster. Though environmental clearance for the said project has been obtained the Controlling Authorities will be highly keen and keep a tight vigil on the availability/provision of self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF.

Environmental Clearance:

The environmental appraisal minutes are indicated below.

“Expert Appraisal Committee/MoEF has considered the project on 25th June 2012 and recommended issue of EC subject to TANGEDCO furnishing the cumulative impact on air, water and soil considering the Industries located 15km radius from the Ennore SEZ Project Site. The same is being furnished. Copy of Minutes of EAC is enclosed. Final Environmental Clearance yet to be received. For Compliance of conditions stipulated by TNPCB under section 21 of the Air (Prevention and control of Pollution) Act 1981 as amended in 1987, the following are included in the specification:

- a) RCC chimney with designed height of 275mtrs included in the specification.
- b) High efficiency ESPs (99.9% efficiency) have been proposed to ensure emission of particulate matter within 50 mg/Nm³.
- c) Bag filters have been proposed for the coal crushers to collect suspended particulate emission.
- d) Dust suppression system has been proposed for the coal yard.
- e) Equipment for continuous monitoring of Ambient Air Quality has been proposed.
- f) On line / automatic continuous stack monitor has been proposed.
- g) Port holes in the chimney and sampling facilities for the stack for the proposed Boiler, as per the Central Pollution Control Board guide lines.
- h) The unit shall have suitable sufficient acoustic measures for Generator, Turbine, Coal crusher and other sources including special anti vibration Foundation for which all the heavy rotating equipments / machines shall be erected over the Anti vibration foundations to reduce noise, vibration etc.,
- i) The unit shall have separate energy meter for the operation of the Electro Static Precipitator, the Air pollution control equipment for the proposed Boiler.

- j) Alternate power source will come into effect in case of power failure for the operation of Air Pollution Control measures
- k) laboratory for analysis of gaseous / particulate emissions
- l) The coal shall be stored in a completely paved area with the provisions for leach ate collection. The coal storage yard shall be provided with wind barriers of sufficient height. The height of the coal piles shall be lower than that of the wind barrier.
- m) The location of wind barriers shall be based on the predominant wind direction and shall be in consultation with TNPCB so as to avoid fugitive dust emission.
- n) Closed conveyors for coal transport and Bag filters in all the transfer points to control dust emission have been proposed
- o) Dust suppression system / water sprinklers to keep the stock pile sufficiently wet all the time to avoid carryover of dust.
- p) All the internal roads shall be well paved and be provided with water sprinkling arrangement to avoid fugitive dust emission during vehicle movement. The unit shall limit the speed of the vehicle to 10KM/hr. for heavy vehicles within the plant premises to prevent the road dust emission.
- q) Burners have been designed for low NOx.
- r) Space provision made for installation of FGD of requisite efficiency of removal of SO₂, if required at a later stage for which adequate space is provided near the chimney.
- s) The unit shall ensure that the velocity of the exit gas from the stack shall be greater than 25 m/sec and the ratio of the exit gas to wind velocity shall not be less than 1.5 to eliminate or reduce pollutant down wash.
- t) The unit shall have on line/automatic continuous stack monitors with computer recording arrangement for monitoring SPM, Sox and Nox in the boiler emission.
- u) Sewage Treatment Plant & Effluent Treatment Plant has been proposed.
- v) Natural draft cooling tower has been included in the specification.
- w) 100% Dry fly ash collection system and conventional wet bottom ash disposal is included. However ash water recovery system is included in this scope if ash slurry is disposed in the ash pond in emergencies.

- x) Ash slurry pipe lines and ash water recovery pipe lines of adequate capacity and strength are proposed to be provided. However these pipe lines will be used only during emergency, since 100% dry fly ash collection is proposed.

Hence, it is stated that the implementation of Environmental measures including self monitoring system (for air, Water and land) as per the EC granted, especially in the following areas have to be ensured by the bidder without any exception:

Continuous Air quality monitoring stations
Online monitoring system
Effluent Treatment plant
Sewage treatment plant
Optimum use of land area
100% Ash collection & utilisation
Green Belt Development.

ANNEXURE-I

S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD- ROMs (sets)
1.	PLANT DEFINITION MANUAL-	-	3 CD-ROMs
2.	Drawings "FOR APPROVAL"	10	Soft Copy
3.	Drawings "FOR INFORMATION"	10	Soft Copy
4.	Drawings "FINAL APPROVED DRAWING"	8	Soft Copy
5.	Drawings "AS BUILT "	8	3 CD-ROMs
6	DATASHEETS,DESIGNCALCULATIONS,PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i) For Approval	10	SOFT COPY
	ii) FINAL	8	3 CD-ROMs -
	iii) Analysis reports of equipment/ piping/ structures components/ systems employing software packages as detailed in the specifications		
	a) Input	10	SOFT COPY
	b) Output	10	SOFT COPY
	c) Drawings/ Sketches	10	SOFT COPY
7	Erection manual "FINAL"	8	3CD ROMS
8	Operation & Maintenance manual	10	3CD ROMS
9	Plant Hand Book "DRAFT"	6	SOFT COPY
10	Plant Hand Book "FINAL"	15	3CD ROMS
11	Commissioning and Performance Procedure manual	10	3CD ROMS
12	Performance and Functional Guarantees test report	6	3CD ROMS
13	Progress Reports	6	3CD ROMS
14	Project completion report	10	3CD ROMS
15	QA programme including	1	

S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD- ROMs (sets)
	Organization for implementation and QA system manual (with revision-servicing)		
16	Vendor details in respect of proposed vendors including Bidder's evaluation report.	1	
17	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, POR etc.		
	(i) For review/comment	3	
	(ii) For final approval	4	1 set CD ROMS
18	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals	4	
	Final	4	2 CD ROMS
19	Monthly Vendor Approval and QP approval status	2	1 CD ROM
20	QA Documentation Package for items / equipment manufactured and dispatched to site	2	2 CD ROMS
21	QA Documentation Package for field activities on equipment/systems at site	2	2 CD ROMS

ANNEXURE-III

		Project :		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL					DOC. NO.:	
		Stage :							REV. NO.:	
		Package :		SUB-SYSTEM:					DATE :	
		Supplier :							PAGE : OF	
Bidder No. :										

S. N.	Item	QP/ Cat.	Insp.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status/ category	Sub-supplier Details submission schedule	Remarks

LEGENDS

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY the Owner)

A – For these items proposed vendor is acceptable to the Owner. To be indicated with letter “A” in the list alongwith the condition of approval, if any.

DR – For these items “Detailed required” for the Owner review. To be identified with letter “DR” in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by the Owner without specific vendor approval from the Owner. To be identified with “NOTED.”

2. QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by the Owner and the final acceptance will be on physical inspection witness by the Owner.

CAT-II : For these items the Quality Plans approved by the Owner. However no physical inspection shall be done by the Owner. The final acceptance by the Owner shall be on the basis review of documents as per approved QP.

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by the Owner shall be on the basis certificate of conformance by the main supplier.

UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

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ANNEXURE-IV

		Project : \$				STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL				DOC. NO.:	
		Package :								REV. NO.:	
		Bidder :								DATE :	
		Bidder No. :								PAGE : OF	
S. N.	Item/ Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturi ng works	Appro val Status	Sub-supplier detail submission schedule	Remarks

ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE							DOC. NO.:			
		Bidder :				(To be raised by the Bidder)							REV. NO.:			
		Bidder No. :				Welding Code:							DATE :			
		System :											PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																

ANNEXURE-VI

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN					PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:					
			ITEM :		QP NO.: REV.NO.: DATE: PAGE: OF....								
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTIC S	CLA SS	TYPE OF CHEC K	QUANT UM OF CHECK	REFERENC E DOCUMENT	ACCEPTAN CE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D *	**	10.		11.
				LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: SUPPLIER/NOMINATED INSPECTION AGENCY, N: THE OWNER						DOC. NO.: REV..... CAT.....			
MANUFACTURER/ SUB-SUPPLIER		MAIN- SUPPLIER						FOR THE					

SIGNATURE	P: PERFORM VERIFICATION. W: WITNESS AND AS APPROPRIATE, CHP: THE OWNER SHALL IDENTIFIED IN COLUMN "N"	V:	OWNER USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL
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ANNEXURE-VII

MFGR.'s LOGO		SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:		
				ITEM :		QP NO.:				
				SUB-SYSTEM :		REV.NO.:				
				DATE:		PAGE: OF....				
SL NO	ACTIVITY AND OPERATION	CHARACTERISTICS INSTRUMENTS	/ CLASS# OF CHECK	TYPE OF CHECK	QUANT UM OF CHECK	REFEREN CE DOCUMEN T	ACCEPTANCE NORMS	FORMAT OF RECORD		REMAR KS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.
			LEGEND: * RECORDS , INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS #: A = CRITICAL, B=MAJOR, C=MINOR;					DOC. NO.: REV.....		
MANUFACTURER/ SUB-SUPPLIER		MAIN- SUPPLIER					FOR THE			

SIGNATURE	‘A’ SHALL BE WITNESSED BY THE OWNER FQA, ‘B’ SHALL BE WITNESSED BY OWNER’S ERECTION / CONSTRUCTION DEPTT. AND ‘C’ SHALL BE WITNESSED BY ERECTION SUPPLIER (A & B CHECK SHALL BE OWNER CHP STAGE)	OWNE R USE	REVIEWED BY	APPROVE D BY	APPROV AL SEAL
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13.0 QUALITY PLAN FOR MANUFACTURE OF EQUIPMENT:

- 13.1 The Quality plan for manufacture is a document, which presents in a tabular form. The Quality Control checks to be exercised by the Contractor during the various stages of manufacture and despatch in order to meet the requirements of this Contract. This plan shall detail the components manufactured, characteristics being controlled and acceptance norms for this characteristic and the agency responsible for performance and witnessing the checks.
- 13.2 After issuance of Letter of Intent (LOI), the contractor shall submit to the Owner, the detailed quality plans to be followed during manufacture of all major equipments. These quality plans shall be discussed mutually and updated by the Contractor taking into consideration the requirement of the Owner. The quality plan when approved shall form a part of the contract. This document shall be followed for inspection of the concerned equipment.
- 13.3 The details of the quality assurance / quality checks envisaged by the Contractor during manufacturing of the equipment supplied by him or procured through his sub-vendors / sub-contractors shall be detailed out in the quality plans to be submitted by the Contractor. The contractor may also furnish any additional information regarding quality assurance / quality checks in the additional sheets, if required. Quality plans for major equipments manufactured by the Contractor or procured through his sub-vendors / sub-contractors shall be submitted during engineering. After approval of the Owner is accorded various quality plans shall be bound as a booklet and shall be submitted to the Owner as soon as possible. The contractor shall ensure that the approved quality plans are followed scrupulously by him and by his sub-vendors / sub-contractors and manufacturing of the items covered under the quality plans shall be taken up only after Owner has approved the quality plan.

14.0 OWNER'S REPRESENTATIVE AT SITE:

- 14.1 SE/ Projects, "2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS" shall be the Owner's representative at site and shall act as an In-charge for all the site works. The contractor's Resident Engineer shall report to him for all the day to day works.

15.0 CONSIGNEE:

All materials shall be consigned to:
SE/ Projects
Tamil Nadu Generation and Distribution Corporation
Ennore SEZ Supercritical TPP

16.0 PAINTS, CONSUMABLES:

- 16.1 Pursuant to the Clause No. 25.0 of Section 3, Volume I, it shall be the responsibility of the contractor to supply all the paints as required.
- 16.2 It shall be the responsibility of The Contractor to supply all consumables like, grease, lubricating oils, all chemicals, ink & graphs for recorders etc., up to satisfactory completion of trial operation and three months thereafter. The Contractor shall also arrange any additional quantities required specifically for the Performance Guarantee Test. Contractor shall furnish specifications of all such consumables to enable the Owner to purchase his future requirements well in advance.

17.0 THIRD PARTY INSPECTION:

- a) Indigenous supplies: - The equipment to be supplied under this Contract shall be inspected during manufacturing as per the quality plan to be finalized. Material verification and stage inspection at all important stages as well as final testing and inspection fall within this scope. The inspection shall be carried out by a third party inspection agency to be appointed by the Owner for

indigenous supplies. The cost towards this inspection shall be borne by the Contractor.

- b) In the case of imported supplies: - For imported materials or non- indigenous supplies, the inspection shall be carried out by a foreign agency of repute to be appointed by the contractor as approved by the Owner. The cost of such inspection shall be borne by the Contractor.

18.0 OPERATION AND MAINTENANCE MANUALS:

- 18.1 For all the equipments supplied by the Contractor, he shall submit to the Owner ten sets of the O&M manuals. The manual shall contain the operational features of the equipment, DOs & DON'Ts, trouble shooting, maintenance schedules for preventive maintenance, detail dimensional drawings, cross sectional drawings, method of assembly etc. to make the Owner's staff acquainted with the equipment as well as to enable them to operate and maintain the same in prescribed manner. Manuals shall contain all information for ordering of the spares, like part name, part no., Drawing/material Specifications, address of the supplier with phone no. & fax no. etc. Contractor shall ensure that these O&M manuals are made available to the Owner well before starting of initial trials of equipment.

18.2 ERECTION MANUALS:

- 18.2.1 In order to enable the engineers of the Owner to supervise the works properly, Contractor shall furnish five copies of erection manuals depicting therein the erection procedure, special precautions to be taken, various clearance to be maintained, erection checks and tests to be carried out before the equipment is put to initial trials.

19.0 SUBMISSION AND APPROVAL OF DRAWINGS:

- 19.1 The contractor shall submit the drawings in sequential order to match with completion of milestone activity. The contractor shall submit all the G.A. drawings, mechanical, electrical and

civil drawings, data sheets etc. for approval of the Owner along with the design calculations and general write up wherever involved. The drawings for all the systems shall be properly coordinated. While scrutinizing the drawings, the Owner shall indicate the corrections to be made in these drawings and documents, which the contractor shall incorporate or justify its correctness. The Contractor then shall submit the revised drawings for approval of the Owner. On approval of the same, Contractor shall furnish six copies and soft copy on CD of these approved drawings to the Owner as per the distribution to be intimated. Any delay in approval of drawings by Owner, due to submission of incorrect data, non-submission of data, non-updating the drawings in line with the corrections indicated shall be to the Contractor's account. During the currency of the contract, if any approved drawings are required to be modified, such details of the modifications required to be carried out shall be separately maintained. On completion of all the works, the Contractor shall incorporate all the changes necessitated in the drawings and submit 6(six) sets of all the "As built" drawing for the records of the Owner. As the drawings shall be approved based on the basic information furnished by the Contractor, approval by the Owner shall not absolve the Contractor of his responsibilities towards correctness of design & performance of the equipment.

20.0 TEST REPORTS:

- 20.1 On completion of tests of equipment at manufacturer's works, the Contractor shall furnish 4 copies of test certificates to the Owner for approval and subsequent despatch clearance. The test report shall invariably indicate identification data, including model no., sl. no. etc. of the equipment, method of application and duration of test along with test results. Only on approval of these test results by the Owner or Owner's representative, dispatch clearance will be issued for dispatch of material to site.

21.0 FIELD QUALITY PLAN:

21.1 Erection shall be carried out as per ECC, manufacturer's manual, approved quality plan & best practices of the industry. After completing erection of individual equipment, the equipment shall be tested for starting up. The list of all the inspections, tests to be carried out before starting up of the equipment shall be mutually decided. Subsequent to these tests, the equipment shall be tried as a sub system and further as a system as a whole. All the inspections and tests to be carried during these stages shall be mutually decided and as per the best practices. This schedule of inspections and the tests shall be called as field quality plan and Contractor shall follow the same during various stages of erection, testing and operations.

22.0 COMMISSIONING AND HANDING OVER:

22.1 INITIAL TRIAL:

On completion of erection of equipment, each item of the equipment shall be thoroughly cleaned and inspected jointly by the Owner / Consultant and Contractor for correctness and completeness of installation and acceptability for initial trials of the equipment by the Contractor & Owner. During the above joint walk down, the list of equipment deficiency & defects shall be prepared and for such a punch list, action shall be initiated by the Contractor in agreed time frame. The list of tests to be performed prior to initial trials shall be mutually agreed and included in the Field Quality Plan by Contractor. The purpose of these trials is to ensure integrity of each individual equipment for its operation in the system for initial operation.

22.2 INITIAL OPERATION:

After successful initial trials of all the individual equipment, all equipments shall be operated together as a system. The purpose of this initial operation is to ensure integrity of all the

sub-systems which compose the total system. Based on the observations made during initial operation, necessary corrections shall be effected in the equipment / systems to ensure proper integrated operation of the system. After satisfactory completion of initial operation for each equipment & sub-system, the complete equipment shall be considered ready for trial operation. During initial operation, any adjustments/calibrations to the instruments fitted in the new system shall be done in the presence of testing staff of Owner so as to enable them to familiarize themselves with its adjustments and maintenance. The Contractor has also to ensure that he trains Owner's Engineers at site dealing with this system in proper way.

22.3 TRIAL OPERATION:

22.3.1 After satisfactory initial operation, the plant shall be put on trial operation. The period of trial operation shall be Thirty (30) days of which minimum continuous seventy two (72) hours shall be at full load. During the period of trial operation, all the necessary adjustments in the plant / equipments shall be made by the Contractor to establish that the complete system as a whole with all sub-systems and with all standby equipment is ready for continuous operation. During these trials, all the standby equipments also shall be run alternatively and continuously for 14 days to prove their performance. During this period, the Contractor shall demonstrate capabilities of his supplied equipment as indicated in the specification or in subsequent discussions. Duration of Breakdown due to grid disturbances will not be reckoned as interruption.

22.3.2 A trial operation report comprising of dates and duration of trial, observations and recordings of various parameters to be measured shall be prepared by the Contractor and signed jointly by the Owner and the Contractor. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. If the trial operation is established

to be satisfactory, except for some minor adjustments, if any, the plant shall be taken over by the Owner for day to day operation and maintenance from the date of conclusion of trial operation. If the trial operation is not satisfactory, then based on the observations during trial operation, necessary modification / repairs to the plant / equipment shall be carried out by the Contractor and on completion of such works, the trial operation shall be repeated again on a date and for a period for 28 days as per clause no. 22.3.1 mentioned above.

22.4 After the trial operation is carried out successfully, to declare it as such, a joint protocol should be signed between TANGEDCO and the Contractor.

22.5 The goods supplied under the contract shall be fully insured up to 3 months from the date of taking over of the plant. However in case the trial operation is extended due to reasons attributable to the Owner, then the insurance policy shall be extended by the Contractor till successful completion of trial operation / taking over of the plant and the actual premium charges towards this extension of insurance policy shall be reimbursed by the Owner to the Contractor without any handling charges.

23.0 PERFORMANCE GUARANTEE TEST:

23.1 After satisfactory completion of the trial operation, the performance test shall be conducted at site by the Contractor. Any preparations required for this test shall be carried out by the Contractor for which Owner will provide required shutdown. The duration of the Performance Guarantee Test of the Plant at the rated capacity shall be mutually agreed. However, a stability period of 2 hours before commencement of test and 2 hours test period followed by another 2 hours stable period shall be maintained. The PG test procedure should be submitted to the owner well in advance and got approved before the commencement of PG test. Performance Guarantee Test shall be conducted within 30 days of intimation from the

Contractor about his readiness for conducting Performance Guarantee Test. These tests shall be binding on both the Owner and the Contractor to determine performance of the equipment/system with the performance guarantee data.

- 23.3 The tests shall be conducted at the specified load conditions or as near the specified conditions as practicable. The Owner/Contractor will apply agreed factors to compensate for deviation from the designed parameters. The suitable correction curves mutually agreed by the Owner and the Contractor shall be used.
- 23.4 All test instrumentation as required for the Performance Guarantee Test shall be arranged by the Contractor free of cost. Precision instruments required for Performance Guarantee Test shall, however, be arranged by the contractor. Calibration before and after test and installation of the test instrumentation for the test shall be the Contractor's responsibility. All test instrumentation shall be in accordance with the applicable code. All test instruments and calibration procedures shall be duly approved by the Owner. Batch calibration shall not be accepted. The test shall be commenced only after clearance of owner on the above vital issues.
- 23.5 Any special equipment, tools and tackles required for the successful completion of the performance tests shall be provided by the Contractor free of cost.
- 23.6 The performance guarantee figures of the equipment shall be proved by the Contractor during the Performance Guarantee Test.
- 23.7 Should the results of these tests show any decrease from guaranteed values, the Contractor shall modify the equipment within 90 days from the date of intimation by the owner as required to bring it to meet the guarantees. In such cases, the performance tests shall be repeated within one month from the date on which the equipment is made ready again for tests subject to grid requirements at that time. All

costs of modifications including labour, material and the cost of additional testing to prove that equipment meets the guarantee shall be borne by the Contractor.

- 23.8 The provisions outlined in the ASME performance test code or other International and Indian approved equivalents shall generally be used as a guide for all the above test procedures unless specified otherwise in the specification. The details of all measuring/recording meters, test instrumentation such as class of accuracy, make etc. shall be covered in the trial operation/ performance test reports. All the list of equipments, accuracy class and test certificates to be submitted and got approved by the owner before the commencement of trial operation.

PG test to be witnessed by the consultant and the owner.

- 23.9 The above shall be read in conjunction with Volume – I, Section 1, General Technical Specification on Performance Guarantee Test.

24.0 PERFORMANCE GUARANTEES, PENALTIES & CAPABILITY TESTS:

- 24.1 The Contractor shall meet the Performance Guarantees as have been indicated in the Specifications and Schedule thereof.
- 24.2 The penalty for not meeting the performance guarantees during the Performance Guarantee Test shall be assessed and recovered from the Contractor. Such penalty shall be levied without limitations, in accordance with stipulations made in Technical Specification and shall be without prejudice to all the other conditions of the contract.
- 24.3 If the guarantees specified are not achieved by the Contractor within 90 days of notification by the Owner, he may at his discretion reject the equipment or accept it after levying and recovering suitable penalties.

24.4 In case there is shortfall in capability of equipment while demonstrating capability tests, the Contractor shall forth-with rectify his equipment within 90 days and re-perform the capability tests to Owner's satisfaction.

24.4.1 Any recoveries by the Owner from the Contractor due to shortfall in guaranteed performance shall be independent of provisions of clause no. 6.0 "Liquidated damages of Special Conditions of the Contract. "

25.0 PENALTY FOR POOR PERFORMANCE:

25.1 The contractor shall furnish performance guarantee as have been specified in Guarantee Schedule under Technical Specification Vol-II. This guarantee shall be met by the Contractor.

25.2 The penalty for not meeting the performance guarantees during the Performance Guarantee Tests shall be assessed and recovered from the Contractor as under.

EVALUATION / LOADING CRITERIA & PENALTY TOWARDS SHORTFALL IN PERFORMANCE PARAMETERS:

S. No.	Variation Factor	Loading for evaluation of shortfall in performance	Penalty for shortfall in performance
1	2	3	4
1	HEAT RATE:- Increase in Station heat rate in kCal / kWh under rated steam conditions at 100% TMCR	Rs.428.41 lakhs per kCal / kWh increase in heat rate over lowest quoted Heat Rate as base.	Rs. 428.41 lakhs per kCal / kWh or part thereof increase in heat rate from guaranteed value

S. No.	Variation Factor	Loading for evaluation of shortfall in performance	Penalty for shortfall in performance
1	2	3	4
	after subtracting excitation power with following conditions: 1.Cycle make-up : 0% makeup 2.Cooling water inlet temperature of 33 deg.C 3.TDBFP's in operation 4. Generator power factor of 0.85 (Gross Turbine cycle heat rate at 100% TMCR condition is guaranteed after accounting for pressure drop in main steam piping, Reheater system and all extraction steam piping from steam turbine to feed water heaters & deaerator)		

S. No.	Variation Factor	Loading for evaluation of shortfall in performance	Penalty for shortfall in performance
1	2	3	4
2	Total auxiliary power consumption of all auxiliaries (*) at 660 MW at after subtracting excitation power with following conditions: 1.Cycle make-up : 0% makeup 2.Cooling water inlet temperature of 33 deg.C 3.TDBFP's in operation 4. Generator power factor of 0.85	Rs.4,70,72,094 for every 0.01 % increase (considering 5.5 % lowest quoted Auxiliary Power Consumption as base)	Rs.4,70,72,094 for every 0.01 % increase or part thereof from guaranteed value
3	Capitalization of losses of Transformers Iron losses Copper losses Cooler pump/fan losses (applicable for each transformer separately)	Rs.3,49,880 /kW Rs.2,89,701 /kW Rs.2,79,904 / kW (considering lowest quoted values as base)	Rs.3,49,880 /kW Rs.2,89,701 /kW Rs.2,79,904 / kW Increase per kW or part thereof from guaranteed value

S. No.	Variation Factor	Loading for evaluation of shortfall in performance	Penalty for shortfall in performance
1	2	3	4
4	Deficiency in capacity of TG from 660 MW at Generator terminals with following conditions: 1.Cycle make-up : 0% makeup 2.Cooling water inlet temperature of 33 deg.C 3.TDBFP's in operation 4. Generator power factor of 0.85	--	Rs 10,55,668 for every kW or part thereof by which output determined by the tests fall short of guaranteed figure of 660 MW
5	Steam Generator Efficiency with following conditions: i) 100% TMCR ii) Firing design coal iii) On Gross Calorific value	--	Rs 9,33,52,000/- for every 0.1% (zero point one percent) shortfall in efficiency

S. No.	Variation Factor	Loading for evaluation of shortfall in performance	Penalty for shortfall in performance
1	2	3	4
	(GCV) basis iv) Rated excess air v) At 32 deg C DBT and 65% RH ambient air conditions.		

Note: All above loadings & penalties as mentioned in Col. 3 & 4 shall be calculated on pro-rata basis.
The penalty indicated above is in addition to the liquidated damages as stipulated in clause no.6.0 of this Section.

* The guaranteed auxiliary power consumption shall be furnished as per list enclosed in Schedule 15 A. Bidder shall list out any additional continuous working equipment in addition to the item listed , which are required for the plant to operate at 100% TMCR load.

26.0 FINAL ACCEPTANCE:

26.1 In case Performance Guarantee Test cannot be carried out at specified time due to reasons attributable to Owner, the Plant shall be taken over 180 days after the intimation from the Contractor provided the Owner is satisfied about his readiness for conducting the Performance Guarantee Test. In such case, the Owner shall give an adhoc final acceptance certificate for the purpose of triggering the Guarantee/Defect Liability period which will be subject to revision based on actual PG test results. In such an eventuality, the Owner shall give a notice to the Contractor of

his readiness to give necessary inputs to enable the Contractor to do the Performance Guarantee Test, in which case the Contractor shall arrange the Performance Guarantee Test within 30 days on receipt of such notice without any additional financial implication to the Owner.

- 26.2 On conducting the Performance Guarantee Test, if it is established to the satisfaction of the Owner that the equipment is performing as specified in the Technical Specifications, the Owner shall issue to the Contractor a final acceptance certificate indicating the date from which the equipment has been taken over.
- 26.3 Such a certificate shall be given within 30 days after satisfactory completion of the performance guarantee test and PG test results are furnished by the Contractor to prove the achievement of the assured PG values. Owner shall not delay the issuance thereof on account of minor omissions or defects which do not affect the safe and reliable operation and/or cause any risk to the equipment. Such certificate shall, however, not relieve the Contractor of any of his obligations which otherwise survive by the terms and conditions of the contract.



**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)**

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-412-501-A001

VOLUME: II B

SECTION-I

REV. 00

DATE: 02.11.16

SHEET :

SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

SUB-SECTION IB

SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)

2.00.00 ELECTRICAL SYSTEM DESIGN**2.01.00 Standards**

The design, manufacture, assembly and testing as well as performance of the equipment and system shall conform to the relevant IS specifications (latest revision). In case the Contractor is not in a position to comply fully with certain IS specifications, or in respect of certain items for which there are no IS specifications, the Contractor may base his proposals on IEC/BS/VDE/DIN recommendations or other reputed national or international standards subject to the approval of the owner.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the codes & standards and statutory requirements of the Government of India, the Government of Tamil Nadu and with the Indian Electricity Rules & Acts. Statutory Guidelines notified by Central Electricity Authority (CEA), India and Central Board of Irrigation & Power (CBIP).

2.02.00 General

2.02.01 The electrical systems and equipments shall cover all items related to Main plant, Balance of Plant and 400 kV GIS. The proposed electrical system for the complete plant is shown in proposed key SLD. However the final SLD shall be finalized during detailed engineering taking care of all the required loads.

2.02.02 The system will consist of required Generator Transformers, Unit Transformers, Station Transformer, Unit Auxiliary Transformers, Service transformers and associated 33kV/11 kV/3.3 kV/ 415 V switchgears as shown in the SLD to cater to unit and station auxiliary loads. The feeders shown in the SLD are minimum required and arrangement shown is for the guidance of the bidder/contractor. The bidder/contractor shall mark out his own design as per the system requirement and the actual distribution shall be arranged by him as per load centre to be approved by the owner. Any additional feeder required for reliable trouble free operation during detailed engineering shall be arranged by the bidder/contractor without any price implication.

2.02.03 Each switchgear/MCC/distribution board shall be fed by 2 x 100 %

transformers/feeders and these shall be rated to carry the maximum load expected to be imposed. Each of the above boards shall be sectionalized.

2.02.04 All 33 kV, 11 kV, 3.3 kV buses shall have facility for auto/manual live changeover facility. All 415 V switchgears fed from transformers shall be provided with live manual changeover. Auto changeover to the reserve supply source shall be arranged for critical 415 V switchgears/MCCs to prevent the loss of unit or to ensure the equipment safety.

2.02.05 33 kV, 11 kV, 3.3 kV and 415 V switchgears, MCCs and DBs shall be provided with interlock to ensure that the different supplies and transformers are never operated in parallel and to avoid the fault level to exceed the switchgear capability, except during momentary paralleling in case of on-load changeover.

2.02.06 The bidder/contractor shall carry out all required system studies using internationally recognized software to determine system parameters like fault levels. All equipments will be designed based upon the calculated and accepted system parameters. The results shall be submitted along with back up of detailed manual calculation.

2.03.00 Climatic Conditions

Electrical Equipment selection and derating shall generally be based on ambient temperature of 50 deg. C. For specific hot areas like boiler, etc. the ambient temperature conditions shall be taken into consideration and equipment suitably derated where necessary. In areas of higher temperature conditions, the equipment shall be adequately protected against damage from radiant heat and hot air. The equipment offered shall be suitable for smooth efficient and trouble free service in the climate of coastal areas of Tamil Nadu.

2.04.00 Make and Interchangeability

All equipment offered and supplied shall be new and type tested.

The makes of major equipment shall be limited to preferred makes indicated under the 'List of preferred makes' or reputed make from reputed firms. If the Contractor prefers to supply other than from the Preferred Makes list, it shall be with the approval of the Owner.

Makes of all equipments and accessories other than 'List of preferred make' are subject to prior approval by the owner during detail engineering.

Similar equipment and components shall be of same make. Equipments of same type and rating shall be interchangeable.

The owner has the option of selecting the manufacturers of electrical equipment, instruments and controls and any other specialized items in the interest of standardization and the contractor shall have to supply equipment of the particular make, if so required.

3.00.00 ELECTRICAL SYSTEM PARTICULARS

3.01.00 Standard voltage levels

The standardized voltage levels as shall be adopted as specified elsewhere in this specification.

3.02.00 Permissible variations:

The system unit/plant equipment shall be designed suitable for continuous operation with variation in voltage and frequency as indicated below:

Variation in voltage and frequency

	Voltage	Frequency
Permissible variation for power supply with rated Performance /rated current and control effectiveness maintained	+/- 10%	-5% to +3%
Permissible variation for control and regulation equipment with rated Performance and control quality maintained		

3.03.00 Basic insulation levels

Equipment shall be designed suitable for basic insulation levels as given below:

Nominal Voltage (kV)

BIL kV (peak)

400 kV	1425
33 kV	170
11 kV	75
3.3 kV	40

3.04.00 Symmetrical short circuit ratings

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels shall be as indicated in the Table below:

S. No.	Voltage level	Symmetrical Breaking Capacity	Making Capacity
1.	400 kV	63 kA for 1 sec	163 kA
2.	33 kV	25 kA for 3 sec	62.5 kA
3.	11 kV	50 kA for 3 sec	125 kA
4.	3.3 kV	40 kA for 3 sec	100 kA
5.	415 V	50 kA for 1 sec	125 kA
6.	220 V DC	25 kA for 1 sec	-
7.	48 V DC	10 kA for 1 sec	

3.05.00 Criteria for selection of voltage levels for motors

Sr. No	Rating	Voltage Level
1	LV Motors- Up to 160 kW	415 V, 3 phase, 50 Hz
2	MV Motors- More than 160 kW and up to 1500 kW	3.3 kV, 3 phase, 50 Hz
3	HV Motors- Above 1500 kW	11 kV, 3 phase, 50 Hz

3.06.00 System Earthing

- i. 33kV/11 kV and 3.3 kV : Resistance grounded.
- ii. 415 V : Solidly grounded.

3.07.00 Degree of Protection:

Degree of protection for various electrical equipments shall be as follows:

S.No.	Equipment	Degree of Protection
1.	Marshalling Boxes, Panels, Motors located outdoor	IP55
2.	Electrical Equipment of CH System	IP55 with dust proof enclosure
3.	HV Switchgear	IP-4X for bus bar chamber, IP-6X for other compartments
4.	LV Switchgear	IP52 up to 1600 A and IP42 above 1600 A

4.00.00 LAYOUT ASPECTS

- 4.00.01 Generator Transformers, Unit Transformers, Unit Auxiliary Transformers, Station Transformers, Startup transformer and the 11/33 kV ICHS Transformers will be installed in the transformer yard.
- 4.00.02 A separate oil pit shall be provided for the Bus reactor, CHP, AHP and the other 33/11/3.6 kV transformers situated at offsite locations.
- 4.00.03 Flexibility shall be kept for removal of any transformers on rail track without affecting other transformer/ equipment/structure.
- 4.00.04 GT and UT Centre line will be fixed duly matching with generator busduct centerline, keeping reasonable spacing in between the transformer and from Power House wall that will be convenient for easy handling.
- 4.00.05 Fire wall in between GT, SUT and UT's and between UATs shall be provided as per applicable codes like TAC recommendations.
- 4.00.06 For oil filled transformer, oil soak pit under the transformer and a common oil pit outside the building at a distance not less than 2.5 meters
- 4.00.07 Drain pipes of Generator transformers, start up transformer, Station and Unit transformers in the transformer yard shall be extended up to burnt oil pit and shall be provided with additional isolation valve, in addition to the drain valve provided at

- transformer end. Drain valve at transformer end shall normally be open and isolation valve at burnt oil pit shall remain closed. In case of any major fault in the transformer, oil can be drained to the pit by opening valve at burnt oil pit along with valve room
- 4.00.08 Gravel filled open oil pit will be provided under each transformer and its cooler bank. The pit shall be such that it can take oil/water surge or 1/3rd of the volume of the transformer oil when filled with gravel of size 60 mm.
- 4.00.09 Each pit will be connected to the drain line with atleast 150 mm diameter pipe with a minimum slope of 1:96 as per TAC regulation. Level of the pit under the transformer shall be such that there will not be permanent accumulation of oil/water.
- 4.00.10 A common oil pit shall be provided for all the transformers in transformer yard. The volume of oil pit up to the bottom level of the oil pit shall be calculated based on the following:
- a. Oil quantity of the largest transformer.
 - b. Quantity of the water for sprinkler system based on 10.2 litres/min/sq.m of the largest transformer surface area (Ref: TAC Manual for water spray system) and 10 minutes operation of spray water system (Ref: NFPA 850).
 - c. Quantity of rain water collected from all associated pits.
- 4.00.10 Pit will be provided with two (2) sump-pumps such that discharge rate of each pump shall be atleast equal to the discharge rate of high velocity water spray system provided for firefighting of the transformer.
- 4.00.11 Gantries shall be provided on either side of the GT & SUT for facilitating stringing to A row of Power House
- 4.00.12 Fencing shall be provided around outdoor switch yard, transformer yard. Auxiliary transformers and service transformers in off-site areas shall also have suitable fence as per IE rules
- 4.00.13 For power transformers, at least 1500 mm spacing shall be provided around the equipment. For service transformers, at least 800 mm spacing shall be provided to nearby wall/fence.
- 4.00.14 All the electrical rooms shall be provided with 3 metre X 3 metre (minimum) size rolling shutter. Electrical equipment layout in the room shall enable replacement of

indoor transformer at a later date, without obstructing structures/equipment. Suitable clear corridor for equipment movement shall be envisaged.

- 4.00.15 In each electrical room of main plant building, operator cubicle with fan and furniture shall be provided.
- 4.00.16 Cable trench shall be allowed only between transformer yard & switchyard
- 4.00.17 All electrical rooms and cable spreader rooms shall have minimum of two doors and the doors shall be fire rated for 2 hours. Cable spreader room height shall be at least 3.5 metre
- 4.00.18 Cables shall not be routed in coal conveyor gallery, a separate cable gallery shall be provided
- 4.00.19 The following minimum clearance shall be maintained for various switchgear installed in a room:

S.No.	Description	Clearance in mm
1)	Between HV switchgear front face and any other panel front face	3000
2)	Between HV switchgear front face and wall/structure	2000
3)	Between HV switchgear rear face and wall/structure/obstacle	1000
4)	Between LV switchgear (drawout type) front face and any other LV panel front face	3000
5)	Between LV switchgear (drawout type) front face and wall/structure	1500
6)	Between LV panel (fixed type)/ control panel front face and any other panel front face	1500
7)	Between LV panel (fixed type) front face and wall/structure	1000
8)	Side spacing between HV switchgear and other panel	2500
9)	Side spacing between HV switchgear and wall	2000 + 1 future panel space
10)	Side spacing between LV switchgear / panels	1000
11)	Side spacing between LV switchgear / panels and wall	1000+ 1 future panel space
12)	Clearance between rows of batteries	800
13)	Space in front of Dry type transformer	3000
14)	Between Dry type transformer rear face and wall/structure	1500

S.No.	Description	Clearance in mm
15)	Space on sides of Dry type transformer	1000
16)	Space around GIS equipment	5000

4.00.20 Cable spreader room shall be provided for the following buildings and areas:

- Main plant turbine building
- Main plant control building
- Switchyard control building
- ESP building
- Ash handling plant
- Coal handling plant
- Water treatment plant
- Desalination plant
- Sea water Intake water pump house
- Any other area not mentioned herein but necessary.

5.00.00 **Fabrication of Structural Steel**

All structural steel shall be supplied by contractor for fabrication work. The fabrication of structural steel shall be welded, bolted or of composite construction as per the approved drawings/requirements. The contractor shall supply welding electrodes, and all other consumable. The steel work shall be wire brushed and cleaned after welding and the weld slag shall be removed appropriately after which two coats of primer shall be applied. Fabricated structure shall be painted with approved type & shade of paint only after the work has been completed in all respects.

6.00.00 **TESTING**

6.01.00 **Routine / Special Tests**

The contractor shall carry out the routine/special tests as listed in the "LIST OF TESTS TO BE CONDUCTED" on the equipment mentioned therein, included in each subsequent chapter.

6.02.00 **Type Tests**

- 6.02.01 The Contractor shall submit the type tests reports for the tests conducted on the equipment similar to those to be supplied under this contract and the test(s) should have been conducted at an independent laboratory not earlier than five (5) years prior to supply under this contract.
- 6.02.02 In case the contractor is not able to submit valid report of the type test(s) or in case type test report(s) are not found to be meeting the specification requirements, or not including all specified tests the contractor shall conduct all such tests under this contract. The cost of such test shall be deemed to be included in the price. The owner shall have right to witness the type tests. Waiver of type tests will not be entertained in normal circumstances.
- 6.02.03 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- 6.02.04 The Contractor shall submit the type tests reports for the tests conducted on the following equipments. However, test reports for any other equipment not mentioned but required during detailed engineering shall also be submitted. The type tests are discussed in the respective chapters.
- 1) Generator
 - 2) Brushless Excitation system
 - 3) Generator control & relay panels
 - 4) Generator Circuit Breaker
 - 5) Generator Transformer
 - 6) Power Transformer (UTs, SUT, UATs and all other power transformers)
 - 7) LV Transformers (Service Transformers)
 - 8) All control and relay panels of transformers
 - 9) Neutral grounding transformers/Neutral grounding resistors
 - 10) 400 kV Gas Insulated Switchgear
 - 11) Outdoor Switchyard equipment
 - 12) HV Switchgear
 - 13) LV Switchgear
 - 14) IPBD/SPBD/NSPBD
 - 15) Motors (HV & LV)
 - 16) Cables (HV & LV)

- 17) IED/Numerical relays/ Energy meters, DR/ Event logger, etc
- 18) Surge arrestors/ Lightning arrestors
- 19) Battery & Battery Chargers
- 20) Cable trays support system
- 21) DG Set
- 22) Earthing and lightning conductors

7.00.00 ENERGY MANAGEMENT SYSTEM

7.00.01 Energy accounting and audit meters shall be installed at such locations so as to facilitate to account for the energy generated as per CEA regulations, 2006 and its amendments as on 4th June 2010 as under:

- 1. At the stator terminal of the generator and before the tap off to the unit auxiliary transformer.
- 2. On the HV and LV sides of the station and the Unit transformers
- 3. On LV side incoming transformer feeders of 415 V buses.
- 4. On all high voltage motor feeders.

7.00.02 All outgoing feeders shall have main and check meters while HV side of GT and ST shall have stand by meters.

7.00.03 The accuracy class of meters shall not be inferior to that of 0.2s accuracy class for meters installed at 11 kV and above and 1.0s for meters installed below 11 kV. In case, numerical relays having built in features of energy measurement of requisite accuracy are provided in switchgear, separate energy meter is not necessary. The accuracy class of CTs and VTs shall not be inferior to that of associated meters.

7.00.04 The energy accounting and audit meters shall be suitable for measurement, recording and display of cumulative active energy with date and time.

7.00.05 The energy accounting and audit meters may also have the facility to measure, record and display one or more of the following parameters depending upon the energy accounting and audit requirement. All parameters excluding instantaneous electrical parameters shall also be stored in memory.

- a) Apparent power

- b) Phase wise kilowatt at peak kVA
- c) Phase wise kVA (reactive) at peak kVA
- d) Phase wise voltage at peak kVA
- e) Power down time
- f) Average power factor
- g) Line currents
- h) Phase voltages
- i) Date and time
- j) Tamper events

7.00.06 The energy accounting and audit meter shall have storage capacity for at least 35 days in a non-volatile memory. Energy accounting and audit meters shall have facility to download the parameters through meter reading instruments as well as remote transmission of data over communication network.

CHAPTER - 11**LV SWITCHGEAR****1.00.00 CODES AND STANDARDS**

IEC: 60947 - Low-Voltage Switchgear and Control gear

IS: 13947 (parts 1 TO 5) - General Requirements of Switchgear and Control gear For Voltage Not Exceeding 1000 V AC.

2.00.00 DESIGN CRITERIA

2.01.00 Power from Unit / Station LV service transformers will be supplied to 415 V switchgears. Power from 415 switchgears to the various PMCCs, ACBDs, MCCs, Emergency MCCs, etc. shall be supplied from redundant incomers. These switchgears will distribute power to LV auxiliary motors and also to other auxiliary loads viz. MCCs / ACDBs, etc. LV switchgears will be of metal enclosed indoor type. Incomers / bus-couplers, outgoing tie feeders rated above 400 amps and motor feeders rated 90 kW and higher, will be equipped with air circuit breakers of fault interrupting capacity of 50 KA rms. Lower rated feeders will be equipped with fully-rated MCCBs.

2.02.00 System Parameters

1)	Nominal system voltage	415 V AC	220 V DC
2)	Highest system Voltage	433 V	240 V DC
3)	Voltage variation	±10%	190 - 240
4)	Rated frequency	50 HZ	-
5)	Frequency variation	+3% to (-)5%	-
6)	One minute Power frequency withstand voltage Main circuit Auxiliary Circuit	2.5 kV 2.0 KV	2.5 kV 2.0 KV
6)	System Earthing	Solidly Grounded	Unearthed

7)	Maximum system fault level	50 KA for 3 secs	25 KA for 1 sec
4.	Molded Case Circuit Breaker		
a)	No. of poles	TPN/TP	
b)	Short time current for 1 sec.	50 kA rms	
c)	Rated short circuit breaking current	50 kA rms	
d)	Rated short circuit making current	105 kA peak	
e)	Overload release setting	Yes	
f)	Short circuit release setting	Yes	
g)	Undervoltage release	Yes	
h)	Shunt trip	Yes	

2.03.00

Type

Circuit Breakers	Shall be air break, three pole, spring charged, and horizontal draw out type, suitable for electrical operation.
Switchgear	Fully draw out type single front
MCC	Fully draw out type single front/Double front.
ACDB/DCDB	Fixed type single front

2.04.00

List of minimum required LV switchgears**S.No Name of LV Switchboard**

1. UNIT PMCC
2. WT PMCC
3. P.H. ACDB
4. BUNKER FLOOR MCC
5. P.H.B. MLDB
6. VENTILATION MCC
7. AC MCC

8. BOILER MCC
9. SOOT BLOWER MCC
10. BOILER VALVE DAMPER MCC
11. MILL SYSTEM MCC
12. TURBINE AUX. MCC
13. TURBINE VALVE DB
14. BOILER ACDB
15. ESP # 1A PMCC
16. ESP # 1B PMCC
17. ESP # 1C PMCC
18. ESP # 1D PMCC
19. ESP ACDB
20. ASH SILO PMCC
21. HYDROGEN GEN PLANT MCC
22. SEA WATER PUMP HOUSE PMCC
23. WATER TREATMENT MCC
24. SWPH MLDB
25. SERVICE BLDG MCC
26. WORKSHOP ACDB
27. AIR CDM MCC
28. CHLORINATION MCC
29. CHP MCC
30. MLDB CHP
31. AHP PMCC
32. ASH SLURRY MCC
33. AHP WATER SYSTEM MCC
34. AHP MLDB
35. FIRE WATER PMCC
36. MLDB RFWF PHASE
37. DG SWGR1 AMF PANEL
38. UNIT NORMAL EMERGENCY PMCC
39. 415 AC ELDB
40. 415MLDB AWR PMCC
41. ADMIN BLDG. PMCC
42. MLDB ADMIN BLDG AREA
43. FUEL OIL UNLOADING PH PMCC
44. MLDB FOHS AREA

45. WATER SERVICE PMCC
46. DM PLANT MCC
47. ETP MCC
48. PRETREATMENT PLANT MCC
49. MLDB WATER SERVICE S/S
50. INTAKE RAW WATER MCC
51. CLARIFIED WATER PUMP HOUSE MCC
52. FD PRESSURISING AREA MCC
53. ESP STANDBY PMCC
54. RO Plant SWGR
55. ICHS Stage I SWGR
56. PIPE CONVEYOR END SWGR
57. Any other LV Switchgear not mentioned herein but required for safe and reliable functioning of the plant.
- 58.

3.00.00 TEMPERATURE RISE

The temperature rise of the horizontal and vertical busbars and main bus link including all power draw out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg. C with silver plated joints and 40 deg. C with all other types of joints and busbars over an ambient of 50 deg C.

4.00.00 OPERATIONAL REQUIREMENTS

4.01.00 Automatic Reverse Closure

Automatic Reverse Closure (ARC) to the reserve supply source shall be provided for 415V unit essential service and other critical switchgears.

4.02.00 Breakers

4.02.01 Breakers shall have anti-pumping feature.

4.02.02 The incomer and bus coupler breakers for switchgear shall be electrically operated with over current releases or relays.

4.02.03 Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. In case releases are offered, the same shall have contact for energization of lockout relay. All breakers shall have built in interlocks for equipment and personnel safety.

- 4.02.04 Paralleling of two supplies shall be avoided by interlocking except for switchgear where auto-changeover is provided. Breaker contact multiplication, if required, shall be through latch relay.
- 4.02.05 Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.
- 4.02.06 Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.
- 4.02.07 Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.
- 4.02.08 Supervision relay shall be provided for trip coil monitoring.
- 4.02.09 All air circuit breakers (ACBs) and moulded case circuit breakers shall be of short circuit performance category as per IS: 13947.
- 4.02.10 The MCCBs shall be of current limiting type. When MCCBs are used as short circuit protection devices for motor modules they shall provide type 2 coordination with associated contactor and thermal overload relay as per IS: 8544 under all operating conditions for the all currents up to the design fault current. The MCCBs on upstream and downstream shall be coordinated. Test reports to prove the requirements of type-2 coordination shall be obtained.
- 4.02.11 The local start push button shall be connected to the DCS so that the drive can be started on checking the process permissive through DCS.
- First contact of STOP PB shall be hardwired directly to switch gear for tripping the drive. Another contact of local push button (Stop) shall be connected to DCS for alarming LPB latched condition in DCS.

4.03.00 Switches and Contactors

- 4.03.01 Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilization category.
- 4.03.02 MCCBs shall be provided for short circuit protection. Isolating switches shall be of AC 23A category when used in motor circuit, and AC 22A category for other applications.
- 4.03.03 Isolating switches and MCCBs shall have door interlocks and padlocking facility.

4.03.04 Moulded case Circuit Breakers (MCCB) / Motor Protection Circuit Breakers (MPCB)

MCCBs shall be of three / four pole construction for panel mounting. The MCCBs shall be provided with front operating handles and mechanical ON / OFF indicators.

MCCB shall be provided with spring assisted quick-make, quick-break, current limiting type manually operated trip free mechanism, mechanical ON/OFF/TRIP position indicators, thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm contacts. The MCCB module shall be provided with service, test and isolated position. The thermal and short circuit tripping device shall be adjustable type.

The MPCB's shall be in general similar to that of MCCB's in all the features mentioned above.

MCCBs/MPCBs shall be provided with overload thermal release setting range of 50% to 100% of rated current and adjustable short circuit magnetic release of 5 to 10 times rated current.

MCCBs/MPCBs shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stress caused by the peak short circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 20 m.second. When used for motor circuit, shunt trip devices shall be provided and the let through power of controlling MCCB/MPCB shall be lower than the respective contactor, Contactor and overload relays shall be selected so as to withstand the let-through energy of the connected MCCB/MPCB in the feeder and consequent thermal and dynamic effects. All power feeder module MCCBs shall be equipped with earth fault release.

The DC circuits shall be provided with DC rated MCCB / MCBs.

MCCBs/MPCBs shall have following accessories and features:

- a) Shunt trip release
- b) Under voltage release
- c) Auxiliary contact for ON/OFF/ trip position
- d) Fault signaling contact
- e) Insulation shields to isolate the connection between each pole
- f) Finger protection plate to prevent accidental contact

- g) The compartment door shall be interlocked with handle of MCCB/MPCB.

4.04.00 Panels

- 4.04.01 All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates.
- 4.04.02 Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall be of Degree of Protection IP55. Push buttons shall be of latch type with mushroom knobs.
- 4.04.03 Operating height of the panels shall be maximum 1800 mm and minimum 300 mm from finished floor level.
- 4.04.04 Wherever breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.
- 4.04.05 All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galvanized steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.
- 4.04.06 Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.
- 4.04.07 The incoming connection to transformer of more than 1000 KVA and inter-connecting sections between switchboards shall be of busducts. The busduct enclosure shall be made of minimum 3mm thick aluminium alloy. The section of the busduct should have adequate strength to withstand internal and external forces resulting from the various operating conditions. Aluminium sheet hood shall be provided for outdoor busduct enclosure joints to provide additional protection against water ingress. The busduct top shall be sloped to prevent retention of water. The bus duct shall have DOP of IP55.
- 4.04.08 It should be possible to carryout maintenance on a feeder with adjacent feeders alive.

4.05.00 Control, Protection & Metering Requirements

- 4.05.01 Control circuits shall operate at suitable voltage of 110V AC. Necessary control supply transformers of 415/110 volts shall be provided for each module of MCC, with its connection after MCCB. However the breakers shall operate on 220V DC.
- 4.05.02 Contractor shall fully co-ordinate overload and short circuit tripping of breaker with upstream and downstream breakers//MCCBs motor starters. Various equipments shall meet requirement of Type-II class of coordination as per relevant IEC.
- 4.05.03 All relays shall be numerical and timers shall operate on available DC supply and not have any inbuilt batteries. They shall be provided with hand-reset operation indicator (flags) or LEDs with pushbuttons for resetting.

The relays shall have provision of both current and voltage inputs. The current operated relay shall have provision for 5 sets of CT inputs, 3 nos. for phase fault and 1 CT input for earth fault & 1 CT input for CBCT. Relay shall be suitable for both residually connected CT input as well as CBCT input. Relays shall be suitable for CT secondary current of 1 A / 5 A selectable at site. The voltage-operated relay shall have provision for 3 PT inputs. Relays shall be rated for operation on 110 V, VT secondary voltage. Relays used in Incomers and bus couplers shall have provision of two sets of voltage signal inputs for the purpose of synchronization.

All CT and PT terminals shall be provided as fixed type terminals on the relay to avoid any hazard due to loose connection leading to CT opening or any other loose connection. In no circumstances Plug In type connectors shall be used for CT/ PT connections.

All numerical relays shall have key pad / keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote. Relays shall have suitable output contact for breaker failure protection.

Relays shall have self-diagnostic feature with self-check for power failure, programmable routines, memory and main CPU failures.

The numerical relay shall be able to provide supervisory functions such as, circuit breaker state monitoring, PT and CT supervisions and recording facilities with Post fault analysis

The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.

Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping.

Numerical relays shall be capable of storing Minimum of 150 time tagged events/ records with time stamping. The numerical relays shall be able to store last 5 faults including the indication, waveforms, protection operated, fault location relay and operating time, currents, voltage and time. All Setting parameters, Fault data, waveforms & event logs shall be stored in Non-volatile memory only.

Sequence of events shall have 1 ms resolution at device level.

Measurement accuracy shall be 1 % for RMS Current and voltage.

Relay shall be immune to capacitance effect due to long length of connected control cables. Any external hardware, if required for avoiding mal operation of the relay due to cable capacitance shall be included as a standard feature. All IOs shall have optical isolation. Analog inputs shall be protected against switching surges, harmonics etc.

The alarm/status of each individual protection function and trip operation shall be communicated to DCS/Respective control system. The numerical relay system shall have built-in features/hardware interface to provide such inputs to Respective control system for analog/digital values.

Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC/ ANSI programmable characteristics.

Numerical relays shall have two level pass word protections, one for read only and other for authorization for modifying the setting etc.

Timer functions shall be programmable for on/off delays.

The protective relays shall have at least 10 nos. potential free contacts (Programmable) Auxiliary relays shall have contacts as required. Relay output contacts shall be suitable for directly wiring in the breaker closing and trip circuit operating from 220 V DC control voltage.

Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Interrogation voltage for the binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages.

No separate earth bus shall be required for the relays. It shall be possible to connect the relay earth to the common earth bus in the switchgear panel which shall be connected to the plant earth mat.

All protective relays shall be latest numerical type, having following features/functions:

- Protection functions as required
- IEC IDMT characteristics
- Measurements
- Event/fault/disturbance recording
- Binary input/output relays as required
- LEDs to indicate status of the relay
- LCD display for measurements, settings, faults etc.
- Key pad on the front of the relay
- Communication ports for transmitting settings, measurements, alarms, faults, events, disturbance records to DCS/Respective control system/SAS (Substation Automation System)
- Communication port for software setting/access measurements/maintenance/fault analysis
- Self-monitoring

All protective relays shall be latest numerical type with one USB port at the front for connecting to Laptop and one port (RJ45/FO port) at rear suitable for communication on IEC 61850 protocols.

The Numerical relays shall be networked through Ethernet switch, Gateway/Data Concentrators and shall be further integrated with SCADA based electrical monitoring system (for monitoring, measuring, fault data analysis & relay parameterization).

All necessary hardware including Managed Ethernet switches, accessories and licensed software shall be supplied by the vendor.

Ethernet switches shall be 'substation hardened' and shall comply with IEC61850-3 for communications and environment requirements. The Ethernet switches shall be of managed type with two (2) no. of fibre optic cable ports for ring network and Fourteen/Sixteen of Copper ports to achieve the LAN configuration. These switches shall be mounted inside the switchgear Panel.

The switchgear shall be provided with DC fail relay and DC fail indication lamp.

Breaker auxiliary contacts used for interlocking purposes shall be multiplied using electrically latched relay.

4.05.04 All equipments shall have necessary protections. However, following minimum protections shall be provided:

- 1) MCCB controlled motor feeders (all motors up to 90 kW)
 - a) Instantaneous short circuit protection on all phases through MCCBs rated for 80 kA rms (prospective breaking capacity at 415V).
 - b) Thermal overload relay in all the three phases with inbuilt protection against single phasing.
 - c) Instantaneous over current protection on all outgoing feeders.
- 2) ACB controlled motors feeders (motors rated above 90 kW) (protection relays shall be of numerical type)
 - a) Instantaneous short circuit protection on all phases
 - b) Overload protection on two phases
 - c) Over load alarm on third phase
 - d) Earth fault protection (sensitive earth fault detectors shall be provided in DC system to annunciator earth fault)
 - e) Under voltage protection
 - f) hand reset lockout relay
- 3) Incomers/bus coupler/outgoing breaker feeders other than motor feeders.
 - a) Definite time delay short circuit protection
 - b) Hand reset lockout relay

- 4) Incomer From DG Set.
- a) Differential Protection (87) - Three Pole
 - b) Reverse Power Protection.
 - c) Overload Alarm on one phase
 - d) Earth Fault Detection Relay (64) definite time delayed earth fault protection connected to transformer LV neutral CT (for Transformer Incomer feeder).
 - e) Voltage controlled over current relay
 - f) Generator under/over voltage Protection
 - g) Hand Reset Lockout Relay
 - h) 3-phase Digital Multifunction meter.

4.06.00 Meters / instruments

Plant electrical parameters shall be metered to the extent required for proper operation and monitoring of plant conditions. Current, voltage and watt-hours measured on each incomer and for each bus. Currents measured on each feeder. Voltage measured on each bus

All meters/ instrument shall be flush mounted on front panel, at least 96 sq.mm. size with 240 degree scales and accuracy class of 1.0. It shall have cramped scale above 2 times to 8 times the rated current for indicating the starting current.

4.06.01 All motors of 15 kW and above shall have an Ammeter. Bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Ammeters shall also be provided for all critical drives such as AOP, jack oil pump, seal oil pumps etc., irrespective of ratings and can be decided during detailed engineering. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.

4.06.02 Breaker controlled panel shall also be of remote controlled with following features:

Each feeder shall have local/remote selector switch. Closing from local shall be possible only in test position whereas closing from remote shall be possible in either service or test position. Tripping from local shall be possible only when local/remote selector switch is in local position. Tripping from remote shall be either breaker in service position or selector switch being in remote position.

4.06.03 Meters and Transducers for 415 Volts MCCs

For incomers feeders following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- Voltage transducer on 'Y-B' phase
- 1.0 class digital multi-function Meter.

For Bus Coupler following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 1.0 class digital multi-function Meter.

For Bus PT following Meters and transducers shall be provided:

- Digital Voltmeter measuring all three phases
- Voltage transducer on three phases

For contactor motor feeders 15 kW & above following Meters and transducers shall be provided:

- Current transducer on 'Y' phase
- 1.0 class Analog meter on 'Y' phase
- Electronic overload relay with current display in switchgear.

For contactor motor feeders less than 15 kW following Meters and transducers shall be provided:

- Electronic overload relay with current display in switchgear.

Meters and Transducers for 415 Volts DBs

For incomers feeders following Meters shall be provided:

- Digital voltmeter measuring all three phases
- Digital ammeter measuring all three phases

For Bus PT following Meters shall be provided:

- Digital Voltmeter measuring all three phases

Energy accounting and audit meters shall meet CEA regulation. For details refer cl.7.00.00, chapter 1.

Transducers shall be of dual output type, class 0.5, 4-20 mA DC linear output & 750 ohm load.

Transducers shall be provided in all the buses so that algebraic summation in electrical system shall be Zero.

4.07.00 Control from Remote

Closing/ opening of the incomer and bus coupler breakers and starting/ Stopping of all motors/ outgoing feeders shall be from DCS/EDMS based control system through interposing relays only. The status (ON/OFF/TRIP), voltage and current of incomers & bus couplers shall be indicated in DCS/PLC. The required transducers shall be provided.

Necessary hardware shall be provided in the switchgear panel like coupling relays (24V DC, with max. burden of 2.5VA), auxiliary relays, current/voltage transducers (4-20 mA, dual output) etc. to effect interlocks, exchange information / status and exercise control from remote.

4.08.00 Normal/ Emergency (N/E) Switchgear

4.08.01 During auto changeover of the supply, the contactors in the affected bus would have dropped off. The services, which shall be restarted immediately and automatically without time lapse to keep unit running, are considered essential service. (For e.g. seal oil pumps, lube oil pumps, auxiliary cooling water pumps etc.). Such auxiliaries shall restart automatically after an auto changeover. These modules shall have additional hardware like timer, auxiliary contactors & associative circuitry in the module. Such essential services shall be identified during the detailed engineering stage & suitable module/Scheme shall be provided.

The modules of some of the critical application motors like baring gear motor, air heater motor, lube oil pump, jacking oil pump etc irrespective of their KW rating shall be provided with a CT, ammeter & a current transducer with remote metering in DCS.

Normal / emergency switchgear (N/E) shall be normally fed by 415V unit service switchgear & incomer from DG set will remain open. A bus coupler shall be provided in the N/E bus so that either DG set can feed the emergency loads.

The N/E switchgear shall be located adjacent to CCR.

5.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

5.01.00 All 415V switchgear motor control centers (MCCs), ACDB, etc shall have following features:

- 1) Shall be of metal enclosed, fully draw out, indoor, floor mounted and free standing type.
- 2) Incomer modules and bus coupler modules of all the switchgear shall be fully draw out air circuit breaker type, controlled from local/ DCS/EDMS.

- 3) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2 mm.
- 4) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.
- 5) All switchboards/panels shall be of dust and vermin proof. All cutouts shall have synthetic rubber gaskets.
- 6) For motors above 90 kW, remote controlled electrical circuit breakers (ACB), and for smaller motors and all other feeders, MCCBs shall be provided.
- 7) All switchboards, MCCs and DBs shall have following distinct vertical sections.
 - a) Completely enclosed bus bar compartment for horizontal and vertical bus bars.
 - b) Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or MCCB feeders).
 - c) Compartment for cable alley or cable box for power and control cables. In case of cable box, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables.
 - d) For cable connection to circuit breaker, a separately enclosed cable compartment shall also be acceptable.
 - e) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary.
 - f) All 415 V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process. Paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards.
- 8) Busbars shall be of high conductivity aluminium alloy suitable for required current ratings with maximum temperature rise of 40°C over design ambient

temperature for plain joints and 55°C for silver plated joints. The Busbars shall be provided with Double decker Lyra type contacts for better connection.

- 9) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm. Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/ sleeved.
- 10) Busbar insulators shall be of track-resistant high strength non-hydro- scopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted.
- 11) All numerical relays and timer shall be subject to Owner's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, draw out construction for easy replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.
- 12) Maxi terminal /cage clamp type terminal blocks shall be provided for signals to be interfaced with DDCMIS. The details of interfacing with DCS/EDMS shall be referred in Annexure B, Volume V (C&I).
- 13) The switchgears/MCC shall be designed to offer adequate level of safety to operating/ maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Contractor shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room describing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC.
- 14) All current and voltage transformers as required for metering & protection specified shall be completely encapsulated cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. All current and voltage transformers as required for metering and protection specified shall

be completely encapsulated cast resin insulated type. Incomers from transformers shall have CTs for transformer restricted earth fault protection.

The accuracy shall be as follows:

	CTs	PTs
Protection	5P20	3P
Metering	1.0	1.0
REF	PS	

- 15) Indicating lamps shall be cluster LED type.
- 16) 20% spare feeders of each type used in the MCC with a minimum one (1) number on each bus section shall be provided.

5.02.00 **DC Distribution Board (DCDB)**

For feeding the DC loads, following DC switchboards shall be provided.

- a) 220VDC Main plant and Station Switch Board (one for each unit)
- b) 220VDC Coal Handling Plant Switch Board
- c) 220V DC 400 kV Switchyard Switch Board
- d) 220VDC Ash Handling Plant Switch Board
- e) 220VDC Raw water plant and RO Plant Switch Board
- f) 220VDC ECHS Switch Board

The switch board shall be provided with suitably rated incomers & bus couplers, required quantity and type of outgoing feeders for the auxiliaries, control supply to various panels / systems in accordance with the number of 220 VDC supplies enumerated in the respective equipment specification. For Each load and auxiliaries separate feeders shall be provided. In addition, the following feeders shall be provided in each switchboard.

- (a) Minimum of two nos. feeders of each type and rating as spare and the same is the minimum quantity at the time of handing over the plant. Any additional quantity required for increase/adjustment during detailed

engineering stage shall also be duly considered.

- (b) 1 No. switchboard for 230V single phase space heating modules.
- (c) 1 No. alarm module for common alarm of outgoing feeder fault.

05.02.01 Current Rating

The short circuit current rating of the switchboard shall be arrived considering the contribution from charger and battery with 5% margin, with minimum 25 kA

The continuous current rating of the bus bars, incomers, ties for 220V DC switchboards shall be the maximum DC load (excluding the momentary load) on the bus due to any operating condition, when unit system additionally feeds station system or vice-versa plus 20% margin rounded off to the next higher standard rating.

5.02.02 Specific Requirements

The constructional features of all DC switchboards shall comply with the requirements of 415V AC switchgear as applicable. DCDB shall be sectionalized and loads are to be distributed for easy maintenance and isolation during earth leakages.

Positive and negative bus bars in the DC switchgear shall be completely segregated from each other by sheet steel partitions.

5.02.03 Module details

(a) Incomer

The incomer modules shall be breaker controlled. Each incomer shall be provided with:

- Ammeter & voltmeter
- Earth fault relay with contact for remote indication (only for 220V DC switchboards)
- Under voltage relay with timer
- Indicating lamps for ON, OFF, earth fault, under voltage conditions
- One no. each of current and voltage transducers for remote indication
- Necessary hardware and circuitry for fault alarm, lamp test and reset.

(b) Outgoing feeders and tie Feeders/bus coupler

These feeders shall be provided with suitably rated DC MCBs with feeder on and fault indicating lamps.

The feeders rated 200 Amps and above shall be provided with a shunt and ammeter.

(c) Motor modules

(i) The motor starters shall be housed within DC switch boards. Separate DC starter panels are to be provided near the Motors. The starting current of the motor shall be limited to 200 % of full load current.

(ii) The motor modules shall be provided with:

- Switch, fuses, air break contactors
- Thermal overload relays
- Starting resistors with associated timers
- ON, OFF, FAULT indicating lamps.
- Necessary auxiliary contactors for fault alarm circuit
- 230V space heating circuit
- ON, OFF PBs for testing purposes
- One shunt with ammeter and one shunt for remote indication (if required)
- Appropriate circuitry for receiving the ON, OFF commands from remote panels/systems, interlocks, etc.
- MCB for space heating circuit

(d) Space Heating Module

230V, 1 space heating module shall be provided with incoming side switch fuse, suitably rated 415/230V cast resin type transformer (expected heating loads of the switchgear and the connected motors + 30% margin), secondary fuse, supply indicating lamp and connection to space heating buses. The 415V power supply for these modules shall be obtained from the unit service switchgear.

5.02.04 Technical Requirements Table

(a) DCDB Details

- (i) Ref ambient temperature : 50 deg C
- (ii) Degree of protection for enclosure IP54 enclosure
- (iii) Type of construction Indoor, single/ double front, non draw out type

(b) Alarm module

- (i) Alarm module for outgoing feeder faults shall be provided with switch fuse, alarm accept, reset PBs, 'supply ON' lamp, 'fault detected' lamp, hooter, necessary auxiliary contactors, control circuit for detecting, annunciating, accepting, resetting the fault in any module of the particular bus section. Contacts from this module for common feeder fault and its own module supply failure shall be provided and used for annunciation in control desk.
- (ii) Alarm module for incomers/bus coupler faults shall be similar to the above except that it shall work on 230V AC supply.

5.02.05 Control room alarms/indications/SER points

(a) Following indications /alarms shall be available in the control room OWSSs.

- Incomer, bus coupler, ties – ON & OFF
- Incomer current
- Alarm module supply failed
- Outgoing feeder fault
- Incomer alarm supply fail
- Bus under voltage
- Bus earth fault
- Bus voltage

(b) For the annunciation in control desk, alarms of a particular bus shall be grouped as one window. The requirement of contacts to SER shall be duly considered and provided.

5.02.06 Metering

1. All meters / shunts / transducers in DC system shall be class 1.00 only
2. Ammeters shall be provided on all incomer to DCDB with remote indication at UCR / DCS
3. Center Zero Voltmeters with Earth fault detection relay shall be provided in Bus PT of DCDB with remote indication at UCR / DCS.
4. Center zero ammeters shall be provided on bus coupler and ties
5. Charger DC output ammeter and voltmeter shall be provided with remote indication at UCR /DCS.

6.00.00 INSTALLATION

6.01.00 This shall be applicable to all LV switchgear panels, MCCs and other power & lighting distribution boards, DCDB, etc.

6.02.00 Manufacturer's instructions, drawings and instructions of the Site Engineer shall be strictly followed during handling, erection, testing and commissioning of the switchgear. The switchgear shall be handled with care, avoiding impact to the equipment by using experienced riggers under the guidance of a competent supervisor. Dragging of the panels shall be avoided and use of a crane and trailer shall be made for handling purposes while transporting to various sites. The switchboard shall be properly supported on the truck or trailer by means of ropes to avoid any chances of damage or tilting due to heavy vibration. The switchboards should be lifted by making use of lifting eyebolts only, fully tightened after ensuring that panel supports, nuts and bolts are all intact and tightened. When panels are to be lifted in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment. The panels shall preferably be kept inside the packing cases till foundations are ready.

6.03.00 Base channels shall be grouted, leveled, in cement concrete pad for 415 V switchgear panels and other cubicle panels. Pedestal type panels and MCCs shall be erected by grouting base channels by bolts. A proper bonding surface should be made by chipping the floor while making cement concreting. All foundations, grouted bolts shall be cured for a minimum period of 48 hours.

6.04.00 The switchboard panels should be taken out from the packed cases and moved one by one to a proper place. All the panels should be assembled aligned leveled and it

should be ensured that panel to panel coupling bolts, bus bars links fit properly without any strain on any part. It should also be checked up that lowering, lifting, racking in and out operation of the breaker and all other motions are free from any obstruction. The fixing bolts should be grouted only after satisfying all these requirements.

- 6.05.00 LV switchgear panels can be tack welded at suitable intervals for each shipping section.
- 6.06.00 After completion of the panel erection, all the cubicles should be cleaned and checked for tightness of all the components. All loosely supplied items shall be fitted up. All the wiring connections should also be checked with drawings and tightened. Metering and protection C.Ts. alarm, indications and protective relays should be fitted up. Phase sequence & polarity of PTs and CTs should be checked. Contact resistance of all busbar joints should be checked up. Every part or insulator should be checked for any possible damage. All the starters, switches, contacts should be cleaned using carbon tetrachloride. Silver tipped contacts should be checked for easy and free movement. Hinges of panel doors should be lightly lubricated to give free and noiseless movement. All openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.
- 6.07.00 Individual feeder functional scheme verification should be carried out and minor wiring modifications in the panel wirings, as per requirement at site, should be done as per the directions of TANGEDCO Site Engineer.
- 6.08.00 In case the switchgear is wet or having a low IR value due to bad wiring, insulators, bushings or any other insulated parts, the entire switchgear should be dried-up according to the instructions of the Site Engineer and the IR value should improve to a safe level for commissioning the same. Care should be taken to protect the surrounding insulation from direct local heating during the drying up process.
- 6.09.00 All the control wiring, PTs, bushings, busbars, other live parts of switchgear, and incoming and outgoing cables should be meggered with 500/1000V megger.
- 6.10.00 Electrical simulation tests should be carried out for all the protective, alarm and annunciation relays along with the manual operation of the circuit breaker.
- 6.11.00 Panels must be cleaned with vacuum cleaner.
- 6.12.00 All switchgear rooms shall be located on same floor (as far as possible) and shall have epoxy flooring.
- 6.13.00 Provision of store room shall be given in all switchgear rooms.

7.00.00 LIST OF TESTS TO BE CONDUCTED**7.01.00 ROUTINE TESTS**

The switchgear panel shall be subjected to routine tests in accordance with the relevant IS/IEC standards. The tests shall include the following:

- Power frequency voltage dry test on the main circuit
- Voltage test on control and auxiliary circuits
- Measurement of resistance of the main circuit
- Mechanical operating tests

The circuit breakers, contactors, switches, local push buttons, local motor starters, VTs, CTs and control transformers shall be subjected to routine tests in accordance with the relevant IS/IEC standards. Routine test reports shall be furnished by the Vendor for Owner's review.

For circuit breaker, the list of routine tests shall include the following:

- Dielectric tests on the main circuit
- Dielectric tests on the control circuit & auxiliary circuit
- Measurement of the resistance of the main circuit
- Mechanical operating tests
- Design and visual checks

7.02.00 TYPE TESTS

The following type test certificates on each type & rating of L.V. switchgear, MCC panel and distribution boards shall be submitted.

- (a.) Short time withstand test with circuit breaker mounted inside the switchgear panel.
- (b.) Temperature rise test.
- (c.) Type II - Short circuit co-ordination test for any three ratings of MCC module as selected by the Purchaser.
- (d.) Test sequence –1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel.

(e.) Degree of protection tests

7.03.00

Site Tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.

a) General

- Check name plate details according to specification
- Check for physical damage
- Check tightness of all bolts, clamps and connecting terminals
- Check earth connections
- Check cleanliness of insulators and bushings
- Check heaters are provided
- HV test on complete switchgear with CT and breaker/ contactor in position
- Check all moving parts are properly lubricated
- Check for alignment of busbar with the insulators to ensure alignment and fitness of insulators
- Check for interchange ability of breakers/ contactors
- Check continuity and IR value of space heater
- Check earth continuity for the complete switchgear board

b) Circuit Breaker/ Contactors

- Check alignment of trucks for free movement
- Check correct operation of shutters
- Check slow closing operation (if provided)
- Check control wiring for correctness of connections, continuity and IR values
- Manual operation of breakers completely assembled
- Power closing/ opening operation, manually and electrically at extreme condition of control supply voltage
- Closing and tripping time
- Trip free and anti-pumping operation
- IR values, resistance and minimum pick up voltage of coils
- Simultaneous closing of all the three phases
- Check electrical and mechanical interlocks provided

- Checks on spring charging motor, correct operation of limit switches and time of charging
- Check SF6 pressure/ vacuum (as applicable)
- All functional checks

c) Current Transformers

- Insulation resistance between windings and winding terminals to body
- Polarity tests
- Ratio identification checking of all ratios on all cores by primary
- injection of current
- Magnetisation characteristics and secondary winding resistance
- Spare CT cores, if any to be shorted and earthed

d) Voltage Transformers

- Insulation resistance test
- Ratio test on all cores
- Polarity test
- Line connections as per connection diagram

e) Cubicle Wiring

- Check all switch developments
- It should be made sure that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked
- Insulation resistance of all wires with respect to earth
- Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component/ equipment
- Check terminations and connections
- Wire ducting
- Gap sealing and cable bunching

f) Relays

- Check internal wiring
- Insulation resistance between all terminals and body
- Insulation resistance between AC and DC terminals
- Check operating characteristics by secondary injection
- Check minimum pick up voltage of DC coils
- Check operation of electrical/ mechanical targets
- Check CT connections with particular reference to their polarities for differential type relays
- Relay settings

g) Meters

- Insulation resistance of all insulated portions
- Check CT and VT connections with particular reference to their polarities for power type meter

CHAPTER 18**EARTHING AND LIGHTNING PROTECTION****A. EARTHING SYSTEM****1.00.00 SCOPE**

The Contractor shall provide all required material and carry out main earth grid, treated earth pits, raisers and inter connections, equipment earthing etc for the following areas and all areas/buildings/structures in both units including but not limited to:

- a) 400 kV Switchyard (Outdoor and Indoor GIS)
- b) Main Plant Building (TG building)
- c) Boiler area, ESP, Chimney, NDCT & other electrical systems
- d) FOPH
- f) Coal / Ash Handling plant etc.
- g) Sea Water PH, RO-DM Plant
- h) All other miscellaneous buildings not mentioned herein.

For Transformer yard, separate earth grid shall be suitably formed and treated earth pits including raisers shall be provided for transformer neutral & body earthing, bus duct support structures and LAs.

Earthing system shall consist of earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons. The earthing system shall conform to IS 3043 and Indian Electricity Act/rules.

The Contractor shall furnish the detailed design, layout and calculations for Owner's approval. Contractor shall obtain all necessary statutory approvals for the system.

2.00.00 CODES AND STANDARDS

- 2.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening

of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

2.02.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed below. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

1.	IS:513	Cold rolled low carbon steel sheets and strips.
2.	IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
3.	IS:1079	Hot Rolled carbon steel sheet & strips
4.	IS:1239	Mild steel tubes, tubular and other wrought steel fittings
5.	IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
6.	IS:2309	Code of Practice for the protection of building and allied structures against lightning.
7.	IS:2629	Recommended practice for hot dip galvanising of iron & steel
8.	IS:2633	Method for testing uniformity of coating on zinc coated articles.
9.	IS:3043	Code of practice for Earthing
10.	IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.

11.	IS:9595	Metal – arc welding of carbon and carbon manganese steels - recommendations.
12.	IEEE:80	IEEE guide for safety in AC substation grounding
13.	IEEE:142	Grounding of Industrial & commercial power systems
14.		Indian Electricity Act.
15.		Indian Electricity Rules.

3.00.00 DESIGN CRITERIA

3.01.00 Fault Current & Duration

Earthing system network/earth mat shall be interconnected mesh of mild steel rods buried in ground in the plant. For earth mat design, the size of earthing conductor shall be calculated considering maximum fault current 56 kA for duration of 1 second and corrosion factor. The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80.

3.02.00 Conductor Material

3.02.01 The earthing system conductors and accessories as proposed are to be as

- | | |
|--|------------------|
| (a) Conductors above ground level and in trenches: | Galvanized steel |
| (b) Conductors buried in ground or embedded in concrete: | Mild Steel |
| (c) Electrodes: | GS Pipe / Rod |

3.02.02 The contractor shall undertake the soil resistivity measurements at site and shall select suitable type of conductors.

3.02.03 The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.

3.03.00 Size of Conductors**3.03.01 Main Conductors**

The minimum sizes of earthing conductors for various electrical equipments shall be as below:

Equipment		Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches
a)	Main earth grid	40 mm dia.MS rod	65x8mm GS flat
b)	Switchyard	---	75x12 mm GS Flat and 50x6 mm GS flat
b)	11/3.3KV/415V Switchgear/equipment	---	65x8mm GS flat
c)	415 V MCC/ Distribution boards / Transformers	---	50x6mm GS flat
d)	LV Motors above 125 KW	---	50 x 6mm GS flat
	25 KW to 125 KW	---	25 x 6mm GS flat
	1KW to 25 KW	---	25 x 3mm GS flat
	Fractional HP LV Motors	---	8 SWG GS wire
e)	Control panel & control desk	---	25 x 3 mm GS flat
f)	Push button station / Junction Box	---	8 SWG GI wire
g)	Columns, structures, cable trays and busducts enclosures	---	50x6mm GS flat
h)	Crane, rails, rail tracks & other non-current carrying metal parts		25x6mm GS flat

3.03.02 Soil Treatment to Lower Resistivity

The soil resistivity study shall be carried out by the contractor.

In order to reduce the resistivity of the soil the earth pits shall be treated with high purity electrically conductive material having ultra low resistance value (typically, 0.001 ohm-m). The properties of the material shall be such that it does not require periodic re-watering or recharge of salt or earth enhancing compound during the life of the power plant. The material should be such that it does not reach chemicals into the adjacent soil or underground water channels and should be PH neutral. Earth enhancing material should permanently protect the encased metal components of the earthing systems. Earthing electrodes encased in high strength concrete mixed with the conductive material shall be preferred instead of electrode buried directly in the earth.

3.03.03 Rod Electrodes

Galvanized steel rod electrodes of suitable diameter and length shall be used as per the recommendation of IS-3043. For test pits electrodes shall be heavy duty type (Class – C) GI pipe of suitable diameter with perforations. For treated earth pits, GI pipe shall be provided as per IS 3043 including charcoal, salt etc. Necessary number of treated earth pits shall be provided for LAs, GTs, UTs, ST, UATs in the transformer yard and other UATs in coal and ash handling plants, ant UATs at raw water pump house and for all LT transformer Neutral & body earthing. Electrodes installed in the test pits will have disconnecting facilities.

3.03.04 Earthing of Electrical equipment on cranes and travelling machines:

Every electrical equipment shall have double earthing. A ring earthing system shall be provided within the crane/machine to which electrical equipment shall be connected at least at two places. The earth ring on the crane/machine shall be connected to the plant earthing system through gantry rails. Two sets of earth collector brushes shall be provided on each side of crane/machine to connect its earth ring to the gantry rails. Each end of each gantry rail shall be bonded to the plant earthing system. In addition, intermediate earthing bond shall also be provided on the rails at every 60 m in case of longer tracks. Flexible copper bonds shall be provided across any gap in the running

gantry rails. For mobile equipment with flexible cables, one separate copper conductor of adequate size shall be provided for earthing.

3.03.05 Equipment Earthing Leads

The size of the earthing leads shall be decided based on the type of equipment and structure to be earthed and shall be provided generally as per IS-3043.

4.00.00 EARTHING SYSTEM LAYOUT

4.01.00 General

Metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, structures in contact with switchyard earth, lightning protection system conductors and neutral points of various systems shall be connected to a single earthing system.

All the offsite areas shall be interconnected together by minimum two parallel conductors.

Crane rails, tracks, metal pipes and conduits shall be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing lead ensured by bonding the different sections of hand rails and metallic stairs.

For all other equipments, two earthing leads shall be used if rated voltage of equipment is above 250V. In case the rated voltage is 250 V or below, one earth lead can be used. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead.

Earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm.

All cable trays in the plant buildings as well as inside the trenches shall be connected to earth grid at an interval of about 10 m.

Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable

4.02.00 Earthing Conductor Layout in Switchyard

Main earthing conductors shall be laid in the form of a grid. Spacing between conductors, number of parallel conductors, etc., shall be decided such that step and touch potential are within safe limits.

The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80.

Earthing conductors shall be provided around the outside edge of fence at a distance of approximately 6000 mm. This shall be connected to the switchyard earthing grid.

Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post.

An earthing mat comprising closely spaced (about 150 mm) conductors shall be provided below the operating handles of disconnecting switches and breaker operating kiosk for the additional safety of the operating personnel.

Each of the earth leads of transformer neutral, lightning arrester shall be directly connected to two separate electrodes. Neutral points of HV transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors. Lightning protection down conductor shall be directly connected to a separate earth electrode.

All earth electrodes in turn shall be connected to main earthing system. The earth grids of different areas of the plant shall be interconnected through, test pits to enable measurement of earth resistance for each area separately.

Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.

Earth pit shall be constructed as per IS: 3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600 mm.

4.03.00 Earthing Conductors Inside Building

Main earthing conductors shall be buried in earth around the building. Minimum two taps-off from this earthing loop shall be taken inside the building and connected to the earthing grid embedded in the floor slab with approximately 50 mm concrete cover. The requirement of electrodes around the building shall be specified.

In case the building has more than one floor, each floor shall be provided with separate earth grid. These floor earthing grids shall be interconnected.

Each RCC / Steel column of the building shall be interconnected to the floor earthing grid in the ground floor.

Instrumentation system and computer system shall be provided with a dedicated earthing system suitable for the equipment. Separate electronic earthing for the PLC equipments, SAS panels and all other equipments wherever necessary shall also be provided

Earthing grids of all the buildings, outdoor yards shall be interconnected to form a single grid for the plant.

Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.

Suitable earth risers as approved by Owner shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.

5.00.00 EARTHING SYSTEM INSTALLATION

The spacing between two electrodes shall be at least equivalent to twice the length of the electrode.

Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively. 8 SWG earth wire should be run along with lighting conduits and shall be earthed at both ends. The wire should be suitable clamped with conduit at equal interval at not more than 500 mm.

The earthing conductor crossing the road / track shall be laid in hume pipe or laid at a greater depth to avoid damage.

When earth conductor passes through floors, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation.

The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices.

Cable trays, metal pipes / conduits, steel columns, etc., shall not be used as earth continuity conductors.

Street lighting poles, flood light poles & towers, their junction boxes shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points.

Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles, etc.

Equipment bolted connection after being checked and tested shall be painted with anti-corrosive paint / compound be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise instructed by the Owner.

All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.

The contractor shall demonstrate the effectiveness of earthing system by measurement of earth resistance, step and touch potential at different locations. Earth resistance at earth terminations shall be measured in presence of Owner's representatives. All equipment required for testing shall be furnished by contractor.

Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.

Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding. The overlapping of earthing conductor in welded joints should be 6 times diameter. Cleats should be provided at both sides to increase contact area. Angles/ cleats should be welded at the point of crossing of longitudinal and transverse earthing conductors.

Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.

Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Trenches after laying earth rods should be closed with approved filling materials in layers and not with debris.

6.00.00 OTHER REQUIREMENTS OF EARTHING SYSTEM:

Life expectancy	40 Years
System Fault Level	56KA for one second
Min. Steel corrosion	0.12mm/year

Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
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Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.
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Surface resistivity	- Gravel : 3000 ohm-meter
	- Concrete : 500 ohm-meter

B. LIGHTNING PROTECTION SYSTEM

Lightning protection system shall be in strict accordance with IS: 2309 and NFPA 78 as applicable.

7.00.00 CONDUCTOR MATERIALS

- a) Lightning protection air termination, down conductors, test links for buildings: GS flat
- b) Exposed lightning protection air termination on chimney top: lead coated copper
- c) Earth conductors buried in ground/concrete: MS rod

8.00.00 LIGHTNING SYSTEM LAYOUT

8.00.01 Lightning conductors shall be connected through test link with earth electrode/earthing system

8.00.02 Suitable lightning protection shall be provided to protect

- a) Main Power House building and other structure as per IS requirement.
- b) Main transformers and other equipments.
- c) 400 KV GIS switchyard & building
- d) Chimney, Cooling Tower and CHP
- e) Other off site buildings & structures as applicable.

8.01.00 Down Conductors

1. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.
2. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.
3. All joints in the down conductors shall be welded type.
4. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.
5. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor

fixing at an interval of 1500 mm.

6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.
7. Lightning conductors shall not pass through or run inside GI Conduits.
8. Testing link shall be made of galvanized steel of size 25x 6mm.
9. Pulser system for lightning shall not be accepted.
10. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.
11. Lightning protection conductors/ air termination rods and circumferential band provided at the top position of chimney stack shall be lead coated in order to avoid melting by exposure to hot flue gases.
12. For tall buildings and structures, early streamer emission (ESE) type, air terminal system such as marketed by Heary Brothers (USA) or any other reputed make are preferred.
13. Horizontal air termination flats provided on top of boilers, main plant building, pump houses & other buildings shall be laid such that no part of the roof shall be more than 9 metres.
14. Conductors of lightning protection system shall not be connected with conductors of earthing system above ground level
15. Lightning protection shall have as few joint as possible and avoid sharp bends. Down conductors shall have as far as possible, no joint except at test point and end termination.
16. Termination at the metallic equipments on roof should be made by suitable nuts, bolts, pressure washer and bitumen washers with good electrical conductivity.
17. All lightning protection conductors shall be exposed to atmosphere unless specifically mentioned.

9.00.00 QUALITY ASSURANCE PROGRAMME

Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

10.00.00 INSPECTION AND TESTING

- 1) Earth continuity checks.
- 2) Earth resistance of the complete system as well as sub-system.
- 3) The earthing and lightning conductors should be type tested as per IS 2629. Following minimum tests shall be conducted:
 - i. Freedom from defects
 - ii. Uniformity in thickness
 - iii. Mass of coating
 - iv. Adhesion tests

Any other applicable tests not mentioned in the specification but required

CHAPTER 14**VARIABLE SPEED DC/AC DRIVES****1.00.00 INTENT OF SPECIFICATION**

This specification covers requirements for the design; manufacture, testing and supply semiconductor (Thyristor/ Transistor) controlled variable speed DC/AC drives, both analog & digital type.

2.00.00 CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of AC/DC Drives shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility. Unless otherwise specified, the equipment / system shall conform to the latest applicable standards.

The equipment shall comply with the requirements of latest revision of following standards issued by BIS (Bureau of Indian Standards)/IEC, unless otherwise specified.

IS-3700	Essential ratings and characteristic of semi-conductor devices
IS-3715	Letter symbols for semi-conducting devices
IS-4411	Code of designation of semi-conducting devices
IS-5001	Guide for preparation of drawings for semi-conductor devices
IS-5469	Code of practice for the use of semi-conductor junction devices
IS-6297	Transformers and indicators for electronic equipment
IS-8789	Performance parameters for motors
IS-12729	Switchgear and control gear for voltages exceeding 1000V- General Requirements
IS-13408	Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IEC 60146	Semi Conductor converters
IEC 60297	Dimension of panels and racks
IEC 60326	General requirements and measuring methods for printed wiring boards
IEC 60352	Solder less wrapped connection

IEEE 444	Protection standards for converters
IEEE 519	Harmonic control & reactive compensation of static power converters

3.00.00 **DESIGN CRITERIA**

3.01.00 Power semiconductors of reputed make either in stud mounting form or disc/flat pack type can be offered based on the duty requirements specified in technical specifications and to meet the technical and functional requirements.

3.02.00 The peak reverse voltage rating of each power semiconductor shall be as follows:

3.02.01 **Power Semiconductors Protected by RC Snubber**

The following factors of safety shall be observed:

- a) For converters operating in rectifying mode only : 2.0 times peak of the no load source voltage
- b) For converters operating both in rectifying And inverting modes : 2.5 times peak of the no load source

3.02.02 **Power Semiconductors Protected by Avalanche Diodes**

The contractor shall choose and recommend the factor of safety which however, shall not be less than 1.5.

3.03.00 The current rating of the power semiconductor shall be estimated for the specified duty class of the respective motor. In sizing the power semiconductor both the forward voltage drop and the forward resistance shall be considered.

3.03.01 A derating of approximately 20% shall be made to take into account series operation of devices.

3.04.00 The class of overload shall be one of the following:

Duty Class Rated current values for converter (in percent of rated direct current)

- I 100 % Continuous
- II 100 % Continuous
150 % overload for 1 minute once in period of 24 hours
- III 100% continuous
150 % overload for 2 minute once in period of 24 hours
200 % overload for 10 seconds once in period of 24 Hours

3.05.00 For the cases where the power semiconductor chosen is of inadequate current or voltage capacity the contractor shall conform to the following guidelines:

3.05.01 Inadequate Current Capacity

- a) If the power semiconductor is of stud mounting type, then current sharing reactors shall be provided to prevent current mis-sharing between the power semiconductors connected in parallel.
- b) If the power semiconductors in parallel are of capsule type, then, one of the following options may be exercised:
 - i) Power semiconductors with adequate derating and the layout configured so that current mis-sharing between various power semiconductors in parallel is minimized.
 - ii) Selection of power semiconductors so that their forward voltages are within a tolerance band of 100 mV to 250 mV.

3.05.02 Inadequate Voltage Capacity

In this case the power semiconductors shall be connected in series with adequate protection to prevent irregular voltage grading across each power semiconductor during turn-on.

3.06.00 The converter shall be provided with adequate surge suppression circuitry at the AC input, DC output and across the devices to limit the main voltage surges, transformer switching surges, reverse recovery transients to less than twice the peak value of line working voltage.

3.07.00 Maximum noise level from the drive at 1-meter distance, under rated load with all normal cooling fans operating shall not exceed 85 dBA.

3.08.00 Motor space heater supply for approximate rating of 240 V, 400 Watts is to be provided in VFD Panel interlocked with VFD Run command i.e. when Motor is running, motor space heater shall be OFF and when motor is stopped, motor space heater shall be ON. In case of bypass mode operation of motor, a contact shall be taken from Bypass Mechanism so that logic for Space heater is ensured i.e. heater is ON when motor is stopped and vice-versa.

3.09.00 VFD should have by-pass system for running of motor on DOL in case of outage of VFD. Before changeover to DOL VFD shall give an alarm and VFD fail indication. The contractor shall submit the control/interlock scheme with equipment data sheet for owner's approval.

4.00.00 **DRIVE OPERATION**

The drive should be according to the no. of Quadrants that shall be provided for the respective motors depending on the motor application during detailed engineering.

A. The Quadrant Operation of the Drive will be according to the following criteria.

- a) One Quadrant Operation -> (I): One Quadrant of operation means only Motoring is required & the drive should operate in the 1st Quad.
- b) Two Quadrant Operation -> (II):- Two Quadrant Operation means the drive should be able to control the motoring & Braking of the motor. It can be of two types.
 - i) Voltage Positive & Current can change Polarity i.e. operating in First & Second Quad.
 - ii) Current Positive & Voltage can change Polarity i.e. operating in first & fourth Quad.

- c) Four Quad Operation -> (IV):- The drive should be able to operate in all four Quadrant i.e. the motor requires forward motoring, forward braking, Reverse motoring & reverse braking.

5.00.00 CONTROL FOR DC MOTORS

5.01.00 Armature Voltage Control Converter

5.01.01 This converter shall consist of, unless otherwise stated, a three phase full wave bridge circuit.

5.01.02 Each arm of the bridge can have a number of power semiconductors both in series and/or in parallel. The design basis for such cases shall be in conformity with Clause 3.00.00 of this specification.

5.01.03 If the drive operates in the first quadrant only, a freewheeling diode may be provided for the purpose of allowing decay of energy during the condition of braking of the drive. This diode may be housed within the same cubicle as the bridge converter.

5.01.04 Redundancy shall be provided as follows:

- a) For power semiconductors in parallel one additional parallel three phase full wave bridge arm shall be provided as redundant element.
- b) For power semiconductors in series, at least 2% of the total thyristors in series for each parallel arm shall be provided.

The factors of safety to be observed in such designs shall be in conformity to Clause 3.00.00 of this specification.

5.02.00 Field Excitation Control Converter

5.02.01 Unless otherwise stated, this converter shall be powered from a single phase line-to-line source tapped at the three-phase incomer to the armature voltage control converter with adequate isolation.

5.02.02 Unless otherwise stated, this converter shall be a bridge of diodes of adequate capacity.

5.03.00 Transducers**5.03.01 Armature Circuit**

- a) For drives where accuracy of speed control is better than 0.5%, the actual speed of the drive shall be measured by a tachogenerator of suitable rating, and type (Digital pulse tachometer or analog tachometer).
- b) For drives where accuracy of speed control required can exceed 2% or more, measuring the current by a current transformer on the AC side of the converter can be accepted.
- c) For drives whose accuracy of speed should not exceed 2% it is necessary that a suitable DC shunt of 75 mV and adequate current capacity shall be provided.

5.03.02 Field Circuit

For Drives where there is a possibility of field circuit failing, then in such case transducers should be provided.

6.00.00 FREQUENCY CONVERTERS FOR SQUIRREL CAGE INDUCTION MOTORS**6.01.00 Configuration**

Frequency converters shall have one of the two configurations given below:

- a) Current source inverter.
- b) Voltage source inverter.

6.02.00 DC Link**6.02.01 Current Source Inverter**

- a) The smoothing reactor shall be sized to avoid conditions of discontinuous current operation of the frequency converter at its lowest frequency of operation, which shall not be less than 5 Hz.
- b) The smoothing reactor shall be uniformly insulated and shall be protected for voltage surges occurring during sudden load throw-off.

- c) The smoothing reactor shall be made from electrolytic grade copper/aluminium and shall be epoxy encapsulated with suitable class of resin decided from techno-economic considerations and performance requirements in conformity with IEC-60146.

6.02.02 Voltage Source Inverter

- a) The smoothing reactor shall conform to requirements specified in Clause 6.02.01
- b) The DC capacitor shall be shunt connected at the input to the inverter. It shall be sized so that the reactive power requirements of the motor during its total range of operation are met. Further, the following aspects shall be observed:
 - i) As per standards, the nominal value of capacitance referred to the temperature of 250C shall be within tolerance range of 10%. At the design ambient temperature, the value of capacitance and the tolerance range shall be such as to meet the normal operation/performance requirements of the frequency converter.
 - ii) As per standards, the dissipation factor of each unit of the capacitor shall be less than 1% at 250C. However, the design ambient shall be such as to meet the normal operational/performance requirements of the frequency converter.
 - iii) The impregnation material used for the capacitor shall be noninflammable, non PCB dielectric liquid.
 - iv) The voltage rating of each capacitor shall be selected based on considerations of life expectancy, overvoltage during regeneration of energy, design ambient temperature, ripple voltage etc.

6.03.00 Inverter

- 6.03.01 The inverter system suitable for three phase output shall consist of the following subsystems:

- a) The basic inverter circuit consisting of the switching device say Thyristors/Transistors/IGBT/MOSFET, connected so as to supply three phase power.
- b) The logic network to enable rapid transition of the main inverter switching devices from on-state to off-state.
- c) Suitable feedback system to allow balance of reactive power flow during load power factor fluctuation as well as regeneration.
- d) The filter system of the inverter output to suppress 5th, 7th, 11th, 13th harmonics at the output of the inverter to less than 5% of the fundamental amplitude.
- e) The ripple control system to limit current ripple to 4% at the input terminals of the inverter caused by distorted current output.

6.03.02 The output frequency of inverter shall be controlled to within the limits specified in technical parameters.

6.04.00 Inverter for AC drive

6.04.01 Current Source Inverter

a) Constant Torque Operation

The current output by the DC link shall be accurately monitored so that the ratio of the terminal voltage of the motor and the corresponding frequency remains constant and the duty cycle requirements for the respective motors are met. Necessary protective features for tripping the frequency converter, alarm/annunciation and fault diagnostics shall be provided.

b) Constant Horsepower Operation

In this type of operation, the motor's internal voltage shall be maintained within + 1% while the frequency of the inverter is varied to meet the duty cycle requirements for the respective motors.

Necessary protective features for tripping the frequency converter, alarm/annunciation and fault diagnostics shall be provided.

6.04.02 Voltage source Inverter

a) Constant Torque Operation

The DC voltage input to the inverter shall be accurately monitored to maintain the ratio the terminal voltage of the motor to frequency at the rated/design value so that the duty cycle requirements of respective motors are met. The DC voltage input shall be maintained within + 1% of the required value. Should this fall for any reason, necessary action for tripping the frequency converter and initiation of annunciation/alarm and fault diagnostic shall be provided.

b) Constant Horsepower Operation

In this type of operation, the voltage at the terminals of the motor shall be maintained within +1% of the rated value while the frequency of the inverter is varied to meet the duty cycle requirements for the respective motors. Necessary protective features for tripping the frequency converter, initiation of alarm/annunciation and fault diagnostic shall be provided.

6.05.00 Output Over current Limit

Unless otherwise stated, the inverter shall be capable of being temporarily overloaded to 150% of its full load ampere capacity for sixty (60) seconds beyond which a current limit action shall be initiated and an alarm contact initiated for annunciation.

6.06.00 Control Modules

6.06.01 All elements of the control system shall be mounted on epoxy laminate boards and each board shall be a plug in module mounted on a standard nineteen inch rack which shall be accessible from the front. Each card shall have LED indication on its front plate to indicate normal condition of the card. Readily accessible and clearly marked test pins shall be important points on the cards to enable signal analysis. The contractor/bidder shall furnish the signal input to the card.

6.06.02 The epoxy laminates shall be free from manufacturing errors and shall be designed to prevent incorrect insertion in the card rack. The copper side of the card shall be suitably

lacquered to prevent oxidation. The gap between two cards shall be sufficient to permit adequate ventilation.

6.06.03 Adjustments susceptible to change by accidental contact shall be lockable.

7.00.00 CONTROL REQUIREMENTS

7.01.00 Short time voltage dips up to 80% of nominal (e.g. in case of large motor startup connected to same bus) shall not cause the control system to stop functioning and shall not trip the drive system.

7.02.00 The drive motor shall be speed regulated corresponding to 4-20mA input signal. Upon complete loss of users speed reference signal, the drive shall automatically run at constant speed as determined by the last speed reference available prior to loss of the signal. The required provision for interfacing with DCS, including details of communication module and data transfer facility, I/O details shall be furnished by the contractor. Local / remote selector switch shall be provided.

8.00.00 PROTECTION

8.01.00 Protection of Power Semiconductor

- a) Each power semiconductor shall be protected against short circuit.
The fuse shall be sized so that its I^2t does not exceed the I^2t characteristic of the power semiconductor itself. The voltage and current rating of the fuse shall match the duty on the power semiconductor. The arc voltage, due to melting of the fuse shall not exceed the repetitive peak reverse voltage of the power semiconductor.
- b) All fuses shall have a trip indicator to operate a suitable microswitch with at least 1 NO + 1 NC potential free contacts for annunciation and/or tripping.
- c) A fast tripping feeder circuit breaker shall be used in case fuses for short circuit protection of thyristors are not used.

8.02.00 Protection of Converter System for DC Drive**8.02.01 Armature Circuit**

The basic protections to be provided are as follows:

- a) Earth fault relay
- b) Thermal overload relay

Other optional protections not mentioned herein but are required for safe and reliable functioning of the system shall be considered in scope of supply.

8.02.02 Field Circuit

The basic protections to be provided are as follows:

- a) Minimum excitation limit relay
- b) Thermal overload relay
- c) Earth Fault Relay

Other optional protections not mentioned herein but are required for safe and reliable functioning of the equipment/system shall be considered in scope of supply of contractor.

8.03.00 Protective Systems for AC Inverter Drive

- a) Fuses for all power semiconductors and/or other devices like commutation chokes, capacitors etc. which are not adequately protected against flow of abnormal currents.
- b) Under voltage and over voltage protection on the input side. Loss of input voltage to inverter shall entail tripping of the inverter.
- c) Protection for all control cards, power supply stabilisers, filter circuits etc. Protection shall be provided such that failure of a part does not cause damage elsewhere in the system.

- d) Polarising relay to prevent reversal of polarity on the input side of the inverter.
- e) Protection of inverter thyristor, commutating circuits and other inverter elements during regenerative operation of the inverter and also during sudden load throw-off.
- f) Besides the above, the following protective systems shall also be supplied
 - i) Current limit fuses at the output of the inverter.
 - ii) Commutation circuit under voltage
 - iii) Inverter over frequency.
 - iv) Programmable over current
 - v) Phase sequence/loss of phase protection.
 - vi) Earth fault protection
 - vii) DC link overvoltage protection
 - viii) Specific motor protection
 - ix) Incoming line surge protection
 - x) Ventilation Loss
 - xi) Over temperature

8.04.00 All controls, indication, Metering, Annunciation required on the Drive Panel shall be duly provided. Diagnostics shall be interfaced to DDCMIS.

9.00.00 **COOLING OF POWER CONVERTERS**

9.01.00 Power semiconductors shall be mounted on heat sink which can be individual or common to a number of devices. Adequate provision for clamping and mounting the power semiconductors shall be available.

9.02.00 Cooling of power semiconductors can either be natural air cooled or forced air cooled. The contractor shall recommend the type of cooling. However, for power converters which exceed capacities of 2 kA continuous load, alternative cooling methods as oil or water cooling shall be considered. The power semiconductors shall preferably be double side cooled.

9.03.00 All equipment required for safe and correct operation as drive motor, blower/pump, cooling water/oil header, water/oil distribution piping, de-ioniser system, flow monitors etc. as applicable shall be considered in the contractor's scope of supply.

10.00.00 SWITCHING DEVICES

10.01.00 Switching devices as circuit breakers, isolators, contactors; switch-fuse units etc. shall be supplied as required for safe and reliable working of the system.

10.02.00 The switching devices shall be enclosed in a separate enclosure forming the set of panels for the power converters. They shall have adequate clearance both with adjacent devices and metalwork at earth potential. Connection between devices shall be by adequate size of electrolytic grade of copper/aluminium strips. These connections shall be adequately braced and insulated.

11.00.00 CONSTRUCTIONAL FEATURES

The controller should have modular construction to facilitate maintenance.

11.01.00 Busbars

11.01.01 Power connections shall be of the bolted type and mating surfaces shall be tinned.

11.01.02 The bus bars running to various converters shall be suitably designed to ensure equal sharing between the parallel strings and prevent mechanical stress on the fuse.

11.01.03 All bus bars shall be adequately insulated for full circuit voltage by insulating tapes and similar insulating material.

11.01.04 In case aluminium bus bars are specified, care shall be taken to ensure that bimetallic connections are provided wherever necessary.

11.01.05 All cubicles shall have copper earth buses of adequate size running in the entire cubicle height along the sides with provision for connection to plant earth grid. All the non-metallic components / parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system shall be provided.

11.02.00 Cubicle

- 11.02.01 Cubicles housing the power semiconductors and drive level control system shall conform to IP 42 degree of protection to enclosures.
- 11.02.02 Panels shall be free standing, floor mounting type and shall comprise rigid welded structural frames enclosed completely with cold rolled sheet steel of thickness no less than 2.5 mm for front and rear portions and 2.0 mm for sides, top and bottom portions. There shall be sufficient re-inforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.
- 11.02.03 All doors, removable covers and panels shall be gasketed all round with neoprene gaskets. Ventilating louvers shall have screens and filters. The screens shall be made of either brass or GI wire mesh.
- 11.02.04 Design, material selection and workmanship shall be such as to result in a neat appearance inside and outside with no welds, rivets or bolt heads apparent from outside, with all exterior surfaces true and smooth.
- 11.02.05 All the control wiring shall be enclosed in plastic / metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, copper conductor wire 1.5 mm² size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5 mm² size for control fuse rating 16 A & above for electrical circuits and 0.5 mm² for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminal shall be provided

11.03.00 Painting

- 11.03.01 All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS: 6005 "Code of Practice for Phosphating Iron and Steel".
- 11.03.02 Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
- 11.03.03 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

- 11.03.04 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and even drying.
- 11.03.05 The phosphate coating shall be followed by the application of two coats of ready mixed stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.
- 11.03.06 After application of the two coats of primer finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests.
- 11.03.07 The final finished thickness of paint film on steel shall not be less than 100 microns and shall not be more than 150 microns.
- 11.03.08 Finished painted surface of panels shall present an aesthetically pleasing appearance free from dents and uneven surface.
- 11.03.09 A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.
- 11.04.00 Bins and Printed Circuit Cards**
- 11.04.01 Individual bins shall be mounted on a swingable frame so that the connections at the rear are also accessible.
- 11.04.02 Self retaining thumb head screws shall be needed for holding the bins in position.
- 11.04.03 Adequate number of card/bin extenders for testing of PCBs shall be provided, each with flexible cables at least two metres long. These extenders shall be of a universal type suitable for use with any card / bin as the case may be.
- 11.04.04 All adjustments which are to be made while changing a card shall be outside in a separate module preferably plugged into the regulator bin.
- 11.04.05 Locking of individual cards in a bin shall preferably be through self retaining thumb-head screws.

- 11.04.06 Control modules shall be in the form of plug in packages, plugged into a module bin. Each plug in unit shall consist of a strong frame on which a printed circuit board would be permanently screwed. The plug connections shall only be of the pin type.
- 11.04.07 The printed circuit board (P.C.B.) shall be made of glass fibre filled with epoxy laminates. The plug in unit shall be screwed to the basic socket in the module bin with long through bolts and knurled heads.
- 11.04.08 The front plates of the plug in unit shall have the switches, the potentiometers, miniature monitoring meters, test points etc. Each plug in unit shall have its own identification legend.
- 11.04.09 All plug in units shall be polarized to prevent incorrect insertions into the module bin.
- 11.04.10 The gap between two plug in units inside a bin shall be sufficient to permit adequate ventilation.
- 11.04.11 The copper side of the printed circuit board shall be lacquered to prevent oxidation.
- 11.04.12 Each side of the printed circuit board shall have a shield cover to prevent inter circuit and external interference.
- 11.04.13 The P.C.B. shall be mounted on P.C.B. guides fixed on standard racks and the shield properly grounded.
- 11.04.14 Control circuit test points shall be easily accessible for monitoring and maintenance.
- 11.05.00 Annunciation**
- 11.05.01 The annunciator shall work on 220 V DC power supply.
- 11.05.02 Each annunciator window shall have two lamps connected in parallel which operate at not more than 75% of their rated voltage.
- 11.05.03 Window shall be arranged in a logical group.

- 12.05.04 The annunciator shall have a module construction with glass epoxy plug in cards.
- 11.05.05 Alarm bell/siren shall be continuously rated and shall have a series resistance.
- 11.05.06 The annunciator shall have the following facilities.
- a) First in sequence, memory reset.
 - b) Fleeting faults shall be memorised.
 - c) Test Feature.
- 11.05.07 There shall be a three tier system of protection and annunciation:
- a) Alarm both audible and visual.
 - b) Warning with delayed shut down –time delay through a timer of range 0-60 sec.
 - c) Disturbance associated with failures of systems elsewhere.
- 11.06.00 Meters**
- 11.06.01 Individual meters shall be provided for speed reference, speed feedback, current reference, current feedback, pulse output, and regulated power supply voltages.
- 11.06.02 All meters shall be identical and fed through individual buffer I.C. amplifiers.
- 11.06.03 All meters shall be the circular scale type having a full scale deflection of 2700.
- 11.06.04 All meters shall conform to at least accuracy class 1.0
- 11.06.05 All meters with their individual buffer amplifier cards shall be housed in separate bin. It is recommended that the buffer amplifiers all be housed on a single/two card/s and this card/s be itself/themselves housed in the regulator bin. Sensitive signal leads in that case will not have to traverse from one bin to another, only noise insensitive buffer amplifier output leads will need to go to the meter bin.
- 11.06.06 Selector switches if used with any meters shall have pistol grip handles.

11.07.00 Wiring

- 11.07.01 Stranded, flexible copper cables of 2.5 sq.mm shall be used for C.T. circuits and 1.5 sq.mm for other control circuits. However for PCB terminals 0.75 sq.mm may be accepted.
- 11.07.02 Ultra flexible cables shall be used for all connections from a fixed part to a movable member. In addition, a hanging loop of sufficient length shall be provided to avoid any cable stressing.
- 11.07.03 All terminal boards for outgoing connections shall be at a height of at least 250 mm from the cubicle floor, and preferably tilted at an angle of 45° to the horizontal for ease of connections. Similarly, connection of the incoming power cables to the bus bars shall be done at a height of at least 250 mm from the cubicle floor.
- 11.07.04 Item designation and location marking shall be in line with IEC recommendations.
- 11.07.05 Device labeling shall be on its fixed mounting and not on the device itself such that labeling remains even when the device is replaced. Metallic labels/paper labels or sticker shall be accepted.

12.00.00 LIST OF TESTS TO BE CONDUCTED**12.01.00 Tests on Power Semiconductors**

All power semiconductors selected shall be subject to quality assurance tests to check on the characteristics submitted by the successful bidder on samples. The contractor and/or his sub-vendor shall allow Owner's authorised representative to witness the tests. Details of the test are to be agreed between the Owner and the Contractor. The broad outlines of the tests to be conducted are as follows:

- a) Off state voltage and reverse voltage
- b) Critical rate of rise of off state voltage
- c) On state voltage
- d) Thermal resistance
- e) Surge on-state current

- f) Triggering data
- g) Recovery charge and recovery time
- h) Critical rate of rise of on-state current
- i) Switching losses
- j) Environmental Tests

12.02.00 Tests on Converters

Converter with its enclosure and cooling system shall be connected to a dummy load. A variable voltage source on the source side shall be adjusted so that the specified current rating of the converter at no-delay of the firing angle (in case thyristors) shall be passed. At the end of stipulated period of test a timer shall cut-off the source. The load side and source side current shall be measured/recorded during the testing phase. The temperature of the case and the heat sink and wound components like chokes shall be suitably recorded. The temperature decay measurement/recording shall continue for the off-duty cycle at agreed intervals. During the course of test the cooling system shall be operative.

The following tests shall be conducted: (IEC 61800-2)

- a) Checking of the setting of the protection devices and their functioning.
- b) Checking of the auxiliary devices and their functioning.
- c) Speed regulation of the drive shall be observed at different output voltage and frequency settings (for AC drives).
- d) Determination of the power losses at specified loads (By Calculation).(Type Test)
- e) Load test or rated current test for large converters (above 1 MW).
- f) Insulation test
- g) Temperature rise (Type Test).
- h) Light load & Functional Test.
- i) Observation of various wave forms i.e. current and voltage.

12.03.00 Other Composite Test at No-load

- a) Environmental tests on printed circuit boards, pulse transformers etc.
- b) Other tests as may be agreed on various converter subsystems.

12.04.00 Acceptance Test

These shall be conducted at the works of the Manufacturer's and/or his subvendor to ascertain that performance stipulated in this specification has been honoured (e.g. overcurrent capability, measurement of ripple voltage & current, P.F. measurement, Audible noise, etc). Dummy loads as required for the purpose of simulating the operation conditions at the manufacturer's works shall be considered in scope of this specification. However, should this not be possible, testing at site with the actual load shall be conducted to prove the performance of the power converters.

12.05.00 All the meter, instruments, devices used for the testing purpose shall be properly calibrated by standard authorised agencies which shall be traceable to National Standards. For each such instrument proper validity of calibration shall be documented by Contractor/sub contractor.

13.00.00 HARMONICS LIMITATIONS

The harmonics generated on source (Input) side (Both AC/DC drive) and output side (For AC drive only) shall be restricted to the following limits: (IEEE-519 for source side and IEC-61800 for load side)

- a) Voltage Harmonics Source side Load side Maximum 5% Maximum 5%(THD)
- b) Current Harmonics Source side
 - i. 5th Maximum 30%
 - ii. 7th Maximum 20%
 - iii. 11th Maximum 10%

Bidder shall indicate clearly the method of achieving above requirement.

14.00.00 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR and/or SUB CONTRACTOR

1. General arrangement drawings showing outline dimensions, cable entry openings, fixing/foundation details, weights and door openings.
2. Front & cross section views showing arrangement details of equipment and terminals and with a Bill of Material for all equipment.
3. Schematic diagram indicating terminal number for external connections &

block diagram of control system.

4. MANUFACTURER'S technical literature on various equipments supplied. Wiring diagram of complete inverter. This shall be based on approved schematic drawing. The correctness of this drawing shall be the responsibility of the manufacturer.
5. Test certificates for the cabinet and all individual equipments and performance load tests shall be submitted atleast 2 weeks before dispatch of equipment.
6. Operation and maintenance manuals shall be furnished with the equipment.
7. Detailed drawing of converter showing layout of power semiconductors, fuses, heat sinks, cooling system etc.
8. Details of testing procedures for power semiconductors and power converters as per Standards/Code of Practice for approval.
9. Shipping details of the equipment.

For AC Drives

Sr.no	Particulars	Rating
1	Type of frequency converter	Voltage Source Inverter/ Current Source Inverter
2	Type of application	Conveyors, pumps, compressors, fans etc.
3	Type of converter cooling	Natural air/ forced cooled
4	Rated Input Voltage a. up to 160 kW b. above 160 up to 1500 kW c. above 1500 kW	415 V 3.3 kV 11 kV
5	Rated Output Voltage	0-100% of supply Voltage
6	Type of motor	Squirrel cage Induction Motors
7	Type of Inverter	Voltage Source Inverter/ Current Source Inverter with constant torque/constant horsepower operation as required by the application.



**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)**

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-412-501-A001

VOLUME: II B

SECTION-I

REV. 00

DATE: 02.11.16

SHEET :

SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

SUB-SECTION IC

DATA SHEET A



TITLE
2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)
DATA SHEET-A OF CRANE

SPECIFICATION NO. PE-TS-412-501-A001
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DATA SHEET FOR DOUBLE GIRDER EOT CRANE

**** marked information are to be furnished by bidder during detail engineering stage only**

Sl.No	Description	Technical Particulars
1.0	Design, fabrication and testing of the crane confirm to standard / code number	Mechanical and Electrical as per IS: 3177-1999 (Reaffirmed 2006) & Structure design in accordance to IS 807:2006.
2.0	Number of crane/s	Two (2) nos. for TG Hall ,
3.0	Crane classification	M5 (Mechanical and Electrical)
4.0	Suitable for outdoor or indoor duty	Indoor
5.0	Capacity (T)	TG HALL CRANE
5.1	Main hoist	
	Rated SWL – tones	225
	Test load SWL – tones	(125% of SWL)
5.2	Aux. Hoists	
	Rated SWL – tones	45
	Test load SWL – tones	(125% of SWL)
6.0	Span	As per attached crane clearance diagram
7.0	Operation from	Operator's Cabin+ Pendent push button
8.0	CRANE PERFORMANCE	
8.1	Crane speed with full load (MPM)	TG HALL CRANE
	Main Hoist	1.5
	Aux. Hoist	6
	Crab travelling speed (CT motion)	15
	Crane travelling speed (LT motion)	30
	Creep speed M/Min	@ 10% of main speed for all the motions through VVVF drive
8.2	Acceleration values	LT motion (bridge travel) CT motion (trolley travel)



TITLE
2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)
DATA SHEET-A OF CRANE

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		As per IS: 3177	As per IS: 3177
8.3	Lift in Meters	The lifting rope shall be of sufficient length to permit the main hook to reach the zero level and auxiliary hook below zero level as applicable.	
	Main Hoist	As per Crane clearance diagram	
	Aux Hoist	As per Crane clearance diagram	
8.4	Hook Approaches	As per Crane clearance diagram	
8.5	Hand rail pipes	32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1050 mm and 600 mm and vertical post spacing not exceeding 1750 mm with provision of kick plate (100 mm high and 6mm thick)	
9.0	COMPONENT DETAILS		
9.1	Trolley		
	Type	Fabricated	
	Method of fabrication	Fusion welded	
	Material conforming to IS:	IS: 2062 Gr. A or B	
	Whether jacking pads for lifting trolley provided or not	Yes	
9.2	Rope drums	Main hoist	Aux. Hoist
	Material (Indicate IS)	Seamless pipe ASTM -106 or fabricated Fe410w IS: 2062 Gr A/B & stress relieved	
	Numbers provided	One for each hoist	
	Type of grooves	Identical Right hand and Left hand	
	Flange /Flangeless	Flanged	
9.3	Rope details		
	Standard	IS:2266	
	Construction	Extra flexible plough steel / 6 x 36 or 6x37 construction	
	Factor of safety	5.25 as per IS	5.25 as per IS
	Type of core	Steel	Steel



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9.4	Sheaves details	Main hoist	Aux. Hoist		
	Material	Fe 410 WA IS: 2062 Gr. A or B / CS Gr. 280-520 IS: 1030 Design as per IS: 3177- 1999			
	Diameter of Equivalent sheaves in mm on Root	Should not be less than 62% of calculated main sheave diameter.			
	Type of guards provided	Fabricated from rolled steel plate			
9.5	Coupling & Shafting				
9.5.1	Coupling details (between motor and gear box)	Main Hoist	Aux. Hoist	Cross Travel	Long Travel
	Type	Flexible shock absorbing coupling excepting pin bush type			
	Guards and Enclosures	Provided			
9.5.2	Coupling details (gear box and wheels)	Cross Travel	Long Travel		
	Type	Flexible geared type			
	Guards and Enclosures	Provided			
9.5.3	Coupling details (gear box and rope drum)	Main Hoist	Aux. Hoist		
	Type	One of the following arrangements will be adopted for connecting the rope drum with the gear- box. 1. Flexible joint, incorporating flexible geared coupling housed within the drum. 2. Fully flexible geared coupling between the drum & gearbox.			
	Guards and Enclosures	Provided			
9.5.4	Shafting (Output)				
	Factor of Safety	As per IS : 3177 (latest edition)			
	Arrangement of Lubrication	Grease cups/ Nipples			
	Type of Lubricant	Grease			
9.6	Gear box details	Fabricated steel gear boxes which shall be dust proof and firmly sealed to prevent oil leakages. Gearboxes shall have covers split horizontally and arranged such that top half can be removed for inspection. The gear boxes shall be fitted with bolted type machined inspection covers.			
A.0	Hoist Motions	MH	MH Micro	AH TG (for Hall	AH micro



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				Crane)	
	Type of mounting of gear box	Horizontal / Vertical			
	Classification	Suitable for M5 duty			
	Type of gears	Helical / Spur	Through VVVF drive	Helical / Spur	Through VVVF drive
	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	Hardness (BHN) – gear	As Per IS 3177 (latest edition)			
	Hardness (BHN) – pinion	As Per IS 3177 (latest edition)			
	Difference in Gear and pinion hardness	Min 20 BHN			
	Material (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/ EN 24. Hardness conforming to IS: 3177 (latest edition) (All gears shall be suitably heat treated. Gears and pinions shall be hardened ,ground finished, machine cut and profile ground. Gears to be hardened, tempered & heat treated as per IS 4460)			
	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved(Fabricated steel gear boxes which shall be dust proof and firmly sealed to prevent oil leakages. Gearboxes shall have covers split horizontally and arranged such that top half can be removed for inspection. The gear boxes shall be fitted with bolted type machined inspection covers).			
	Noise level	85 db			
B.0	Travel Motions	CT	CT micro	LT	LT micro
	Type of mounting gear box	Vertical / Horizontal	Through VVVF drive	Vertical / Horizontal	Through VVVF drive
	Classification	M5 duty			
	Type of gears	Helical/Spur	Through VVVF drive	Helical/Spur	Through VVVF drive
	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	Hardness (BHN) – gear	As Per IS 3177 (latest edition)			
	Hardness (BHN) – pinion	As Per IS 3177 (latest edition)			



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	Difference in Gear and pinion hardness	Min 20 BHN	
	Materials (gear / pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/ EN 24. Hardness conforming to IS: 3177 (latest edition) All gears shall be suitably heat treated. Gears and pinions shall be hardened ,ground finished, machine cut and profile ground.	
	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved (Fabricated steel gear boxes which shall be dust proof and firmly sealed to prevent oil leakages. Gearboxes shall have covers split horizontally and arranged such that top half can be removed for inspection. The gear boxes shall be fitted with bolted type machined inspection covers).	
9.7	Wheels details	Cross travel	Long travel
	Material	forged rolled / cast steel	
	Hardness	300 – 350 BHN	
	Type	Double flanged	
	Specification conforming to	IS: 3177 (latest edition)	
	Arrangement of lubrication	Grease	
9.8	Lifting hooks	MH	AH
	Type	Ramshorn, shank with safety latch swiveling type as per latest edition of IS: 5749	Plain with safety latch swiveling type as per latest edition of IS: 15560
	Material	➤ Class 2 as per IS 1875:1992 (re affirmed 2004) for hooks conforming to IS : 5749 ➤ Class 1A & 3 for hook of grades L & M respectively as per IS 1875:1992 for hooks conforming to IS : 15560	
	Hook can swivel	Yes	
	Safety latch on hook provided	Yes	
	Locking device on swivelling hook	Provided	
9.9	Buffer s	Cross travel	Long travel
	Type	Spring or rubber buffers shall be provided on the trolley & end carriage	
	Numbers provided	4	4
	Details of end stop	Suitable end stops welded to the bridge girder shall be provided to contact the buffers.	



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10.0	Brakes	All brakes shall have weatherproof enclosures				
A.0	Hoist Motions	MH		AH		
	Type of brake	AC Electro-Hydraulic Thruster operated +DCEM				
	Number	1+1 (per motor)		1+1 (per motor)		
	Braking capacity	150%				
B.0	Travel Motions					
		CT		LT		
	Type of brake	AC Electro-Hydraulic Thruster operated + DCEM		AC Electro-Hydraulic Thruster operated + DCEM + Hydraulic Thruster (foot operated)		
	Number provided	1+1 (per motor)		1+1 (per motor) and two nos. hydraulic thruster (foot operated) brakes for LT motion		
	Additional Hydraulic rail clamps,two nos. per cranes to be provided (to be designed with wind speed of 50 m/second)					
	Braking capacity	125%				
11.0	Drive system for hoisting					
	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box				
12.0	Bearings	Crane hook	Trolley wheels	Rope drum	Gear box	Any other assembly
	Type	Antifriction ball / roller bearings				
	Method of lubrication	Grease lubrication				
	Bearing life	10,000 working hours				
13.0	Bridge girder					
	Type & Quantity	Box type – 2 nos. Material: Mild steel, grade A/B of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate.				
	Vertical Deflection	Span / 900				
	Type of connection to end carriage	By fitted bolts				



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14.0	Rails				
	Type / section	Rails sections as per IS: 3443 Grade 55 C 11/ 50 C 12. Rail to rail jointing shall be by end clamping arrangement.			
	Standard conforming to	IS: 3443			
	Material	50C12 or 55C11			
15.0	End carriage span material	Structural steel.			
16.0	Motors	Suitable for ambient temperature of 50° C			
16.1	Hoist Motions	MH	MH micro	AH	AH micro
	Type	SC, suitable for Inverter duty Three phase squirrel cage induction motors operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits.	Through VVVF drive	SC, suitable for Inverter duty Three phase squirrel cage induction motors operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits.	Through VVVF drive
	Enclosure	TEFC	Through VVVF drive	TEFC	Through VVVF drive
	Numbers furnished	1	Through VVVF drive	1	Through VVVF drive
	Voltage, phase and frequency	3 Ph., 4 wire, 415V $\pm$ 10%, 50 Hz $\pm$ 5% Combined voltage & frequency variation = 10% absolute			
	Class of protection	IP – 55			
	Rated capacity (KW)	Motor nameplate rating at 50° C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement in the duty condition specified. Further, the hoist motors will be rated to lift 125% of the design load on the hook at the rated speed.			
	Rating	S4, 40/60 % CDF			



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	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B			
	Number of starts/ hour	300 starts / hr			
	Pull out torque	The pull out torque of the motor will not be less than 275 % of the full load torque.			
	Overload protection for motors provided	In built feature of VVVF drives.			
	Space heater requirements	For motors of rating 30 KW and above			
16.2	Travel Motions	CT	CT micro	LT	LT micro
	Type	SC, suitable for Inverter duty Three phase squirrel cage induction motors operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits.	Through VVVF drive	SC, suitable for Inverter duty Three phase squirrel cage induction motors operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits.	Through VVVF drive
	Enclosure	TEFC	Through VVVF drive	TEFC	Through VVVF drive
	Numbers furnished	2 nos. for TG hall Crane	Through VVVF drive	4 nos. for TG hall Crane	Through VVVF drive
	Voltage, phase and frequency	3 Ph, 4 wire, 415V $\pm$ 10%, 50 Hz $\pm$ 5% Combined voltage & frequency variation = 10% absolute			
	Class of protection	IP – 55			
	Rated capacity (KW)	Motor nameplate rating at 50° C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement in the duty condition specified.			
	Rating	S4, 40/60 % CDF			
	Class of insulation	Class 'F' for sq. cage motors with temperature rise limited to that of class B			



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	Number of starts/ hour	300 starts / hr			
	Space heater requirement	For motors above 30 KW rating			
	Pull out torque	The pull out torque of the motor will not be less than 275 % of the full load torque.			
	Overload protection for motors provided	In built feature of VVVF drives.			
	Space heater requirements	For motors of rating 30 KW and above			
17.0	<u>Limit switches</u>	Main hoist	Aux. Hoist (for TG Hall Crane)	Cross Travel	Long Travel
	Type	Rotary gear (screw type) + Gravity	Rotary gear (screw type) + Gravity	Lever type (one way/ two way)	Lever type (one way/ two way)
	Number provided	1 + 1	1 + 1	2/1	2/1
	Control voltage/ Enclosure	110 V/ IP 55			
18.0	<u>Power conductors (DSL)</u>				
	Type	LT: PVC shrouded conductor (Cu) bus bar. CT: Flexible trailing cable ERP insulated Cu conductor as per IS: 9968			
	Size	Shall be sized with a margin of 20% over load requirement. Voltage drop at motor terminal shall be limited to 3% at extreme positions of cranes. Protective cover over DSL shall be provided.			
19.0	Length	Suitable for entire bay length			
	Protective Panel	Shall be provided with isolating switch, power contactor control and indication to switch ON/OFF power to starter panels, control and lighting transformer.			
	Material & size	Cold Rolled sheet steel , not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick			
	DOP	IP 54			
20.0	<u>Control panel</u>	Separate VVVF system panels to be provided for CT, LT and both hoist motions			
	Material	Sheet steel 2 mm size			
	Numbers and location	One each for MH, AH, CT and LT located on bridge platform			
	Degree of Protection	IP 54			



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	Illumination	Internal illumination with florescent lamp			
21.0	<u>Master</u> <u>Controllers</u>	Main Hoist	Aux Hoist	Cross Travel	Long Travel
	Number of steps	5	5	4	4
	Voltage & current rating	415 V/10 A			
	Location	In Cabin			
	Type	Controller contact shall have ample current capacity for the duty cycle, type and number of auxiliary contacts for required electrical interlocks.			
	Numbers	Independent controllers shall be provided to control each crane motion.			
22.0	Earthing	Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be effectively earthed.			
	Material of earthing	G.I / Copper			
23.0	<u>Cable</u>	Power (fixed type cable)		Control	
	Material	Aluminium		Copper	
	Size	Min. 3Cx10 mm ² for Aluminium		Min. 1.5 mm ²	
	Type	XLPE insulated (except trailing cable)		PVC insulated	
	Voltage grade	1100 V			
	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage.			
24.0	Contactors	AC 4 duty for reversing application. AC 3 duty for non - reversing application.			
25.0	Switches	AC 23 for motor application, AC 22 for other application.			
26.0	Fuses	HRC			
27.0	Overload relays	Overload protection inbuilt in VVVF drives.			
28.0	Fire Extinguisher				
	Type and size	4.5 kg , CO ₂ type			
	Numbers & Location	One no. in Cabin and Three on bridge			
29.0	Power Supply	415 V, 3 phase, 4 wire supply at operating floor at centre of bay length.			



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30.0	Transformer	Dry type, with insulation class B or better.
	Quantity	2 X 100 % for control, 2 nos for lighting & 1 no for hand lamp.
	Voltage Rating	Control 415/240V , Lighting 415/240V and hand lamp 415/24V.
	KVA rating	20% over loading to be considered while sizing the rating
31.0	Illumination	
	In Cabin	Two 10W CFL fixture, 2nos. 24V – 5A – 3 pin industrial socket. 15A/20A socket outlet shall be provided for A/C
	Over Bridge	4 nos. 60 W Bulk-head fittings with incandescent lamps and 4 nos. 24V – 5A – 3 pin industrial socket.
	Under bridge	4 nos. 250 W HBSV lamps
	For inspection of crane components	One (1) portable 40W hand lamp with min. half span length flexible cable for inspection of crane components
	Hand lamp socket and hand tool sockets	Hand lamp socket outlets (2 pin, 10A, 24V) and power socket outlets (3 pin, 20A, 240V) shall be provided for use of hand tools along with switches.
32.0	Type of platform required on the bridge.	Chequered plate platform 6 mm thick as per IS :3502
	Length	Full span length
	Type of access from gantry girder level to crane bridge	Rung ladder at ends from gantry girder level walkway to crane bridges walkway
	Type of access to maintenance cage from crane bridges walkway	Rung ladder
	Type of access to Cabin from crane bridges walkway	By Staircase
	Provided at both ends	Yes
	Width of platform	Access walkway of not less than 500mm clear with hand railing of height of 1100mm along both sides of bridge girder and cross over walkways.
33.0	Operators Cabin	
	Type of construction	Fixed , closed , air conditioned type, for indoor operation provided with non-slip surface. Window AC shall be provided for the same.
	Area and minimum clear height	2500x1800 mm with a head room of 2000 mm
	Operator's seat	Revolving type



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	Warning horn & light	- An electrical horn shall be provided and mounted on under side of the cabin operated by foot switches as and when required by the driver. Horn shall be heavy-duty howler to produce 95 dB at 3.5 M, double bell projector suitable for 240 V AC operation. - The cabin shall be fitted with a 300 mm diameter hand operated brass gong. The gong shall be securely suspended outside the cabin and operated by the cabin driver through a hammer tied by a flexible steel wire. - A distinct type alarm with conspicuous warning lights on either side of the crane bridge to indicate overloading of crane.
	Position of controllers	In front/ side of operator's chair
	Ventilation	One (1) no. fan + Air conditioner (1.5 T min.) (BEE Rating five star)
	Siren	One (1) heavy duty type industrial siren shall be provided with each crane. The siren shall be operated from foot-switch in the operator's cabin.
34.0	Type of control for Hoists/ CT/LT operation	Through VVVF drive
	Speed control	Thru' VVVF with minimum 6 pulse design
	Starting torque of VVVF	Up to 400% typical with encoder.
	Starting current	Less than 150 % of rated torque.
	Temperature	VVVF system shall be capable of withstanding upto 50 o C without derating.
35.0	Sweep	Sweep shall be attached to the end carriages and to the trolley to remove foreign materials from the rails.
36.0	Painting & Color Coding	As per Annexure I below
37.0	Main Isolating switch / Change over type	Main isolating switch / change over type at Middle of the bay length
38.0	Isolating switch / Change over type	Two nos. isolating switch over shall be provided at extreme ends of the bay length, at a distance of approximately 20 mtrs. From the center line of first & last column for maintenance of the cranes.
39.0	Whether tandem operation required	Not required.
40	Mechanical overload protection	Mechanical overload protection to be provided (Load cell to be provided for same).

NOTE : Other requirements of the system-

- for Storm brake calculation, Basic wind speed to be considered as 50 m/sec as per IS:875 -1987 Part-3 .Probability factor,(k1 risk coefficient), terrain, height and structure size factor, k2 and



TITLE

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- topography factor, k3 shall be as per IS:875.
- All Crane motors shall be capable of the following :
 - Operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
 - Withstand 120% of rated speed for two minutes.
 - Current shall not exceed 6 times full load current for creep speed motor.
 - Withstanding the stresses imposed if started at 110% rated voltage.
 - Start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.
 - The locked rotor motor withstand time under hot condition at 110% rated voltage shall be more than motor starting time at minimum permissible voltage by at least 3 seconds for motors upto 20 seconds starting time.
 - Maximum torque shall not be below 200% of full load torque.
 - The VVF drive control shall be used for control of each motion. The VVVF drive shall be equipped at least with 1024 pulse incard, droop control for synchronization and crane software. The rating of VVVF shall be decided considering 250% of full load current of respective drive motor based on in panel rating with derated at 50 Deg C ambient temperature.
 - The limit switches shall be totally enclosed type IP-55.
 - Each hoist shall be furnished with two (2) limit switches meeting the following requirements:
 - A screw type limit switch with self resetting features which will act in case of over hoisting.
 - A gravity operated hand reset type limit switch as a back up protection against over hoisting.
 - Trailing cable shall be 1100 V grade, tinned copper, heat resistant, with EPR insulation and as per Class – 5 of IS-8130. Also should have inner PCP sheath and outer CSP sheath with nylon chord reinforcement & heat resistant, oil resistant and flame retardant heavy duty FRLS type.
 - Electrical equipment shall be adequately rated to permit simultaneous operation of the combination of motions of the crane for its duty service.
 - Provision of operation of Hydraulic rail clamp operable from operator's cabin shall also be provided.
 - Track type limit switches on the bridge and trolley to prevent over travelling in either direction.
 - Cranes shall be furnished complete with all electrical equipment, accessories, like drives, conductors, insulators, protective & operating devices, Cables, Current collectors, all protective device. Anti collision (type infra red sensing devices) shall be provided. Protection for electrical faults (short circuit, overload, single phase, earth fault) etc. shall be provided.

Fold-2

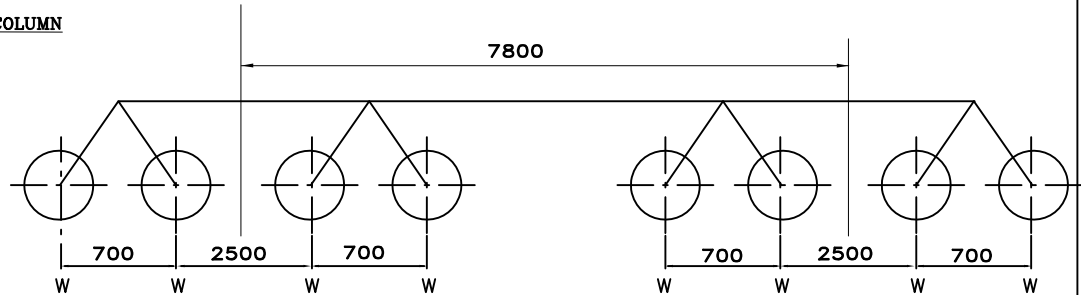
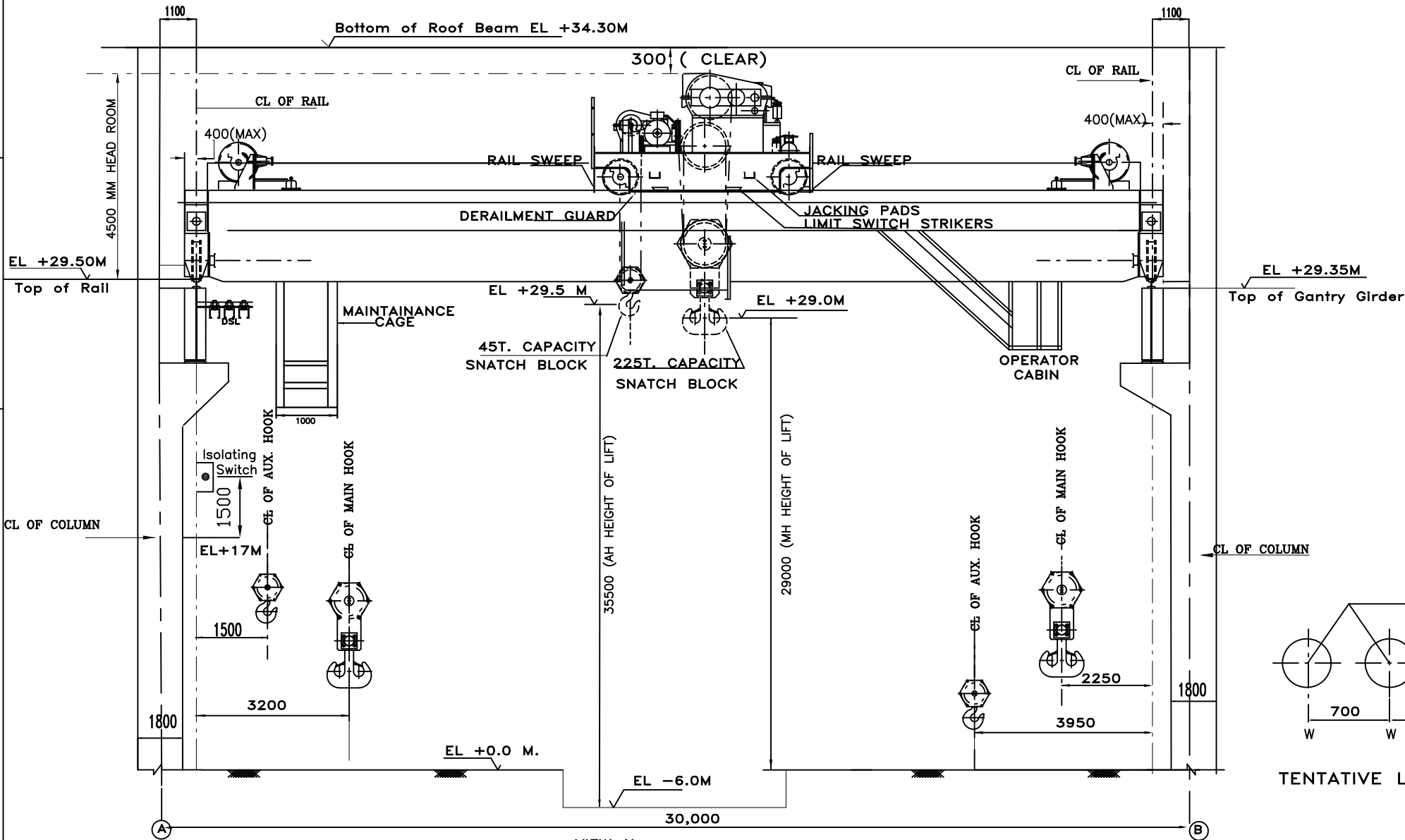
ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

Fold-1

DRAWING No.

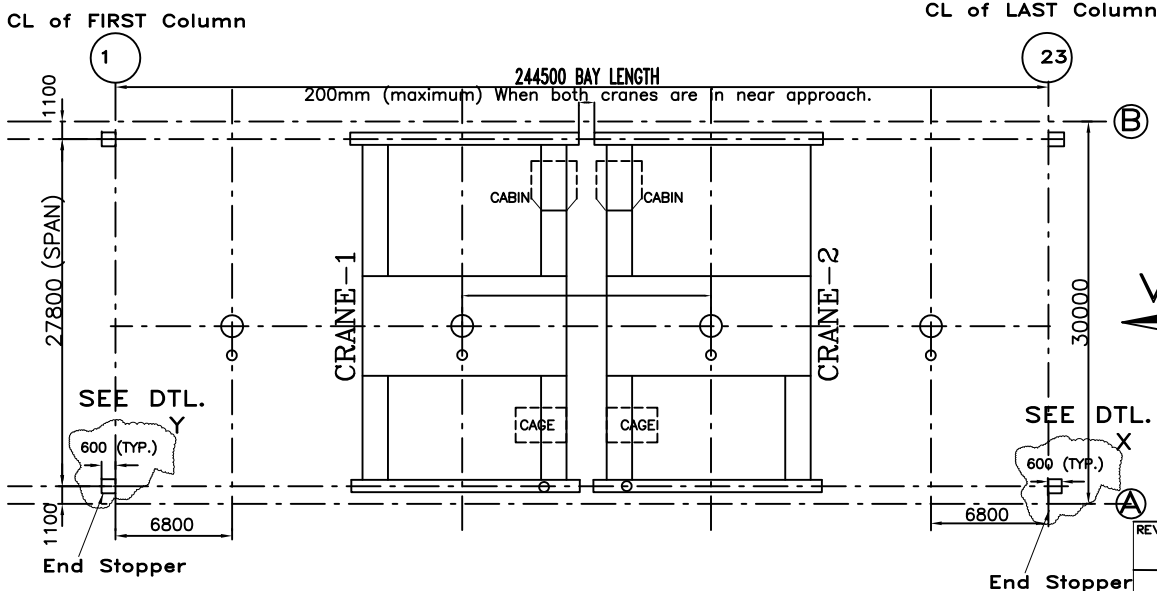
CUSTOMER'S DRAWING No.



TENTATIVE LT WHEEL LOAD DIAGRAM WITHOUT IMPACT W=42T

NOTE

1. THE DESIGN CODE FOR EOT CRANE SHALL BE IS:3177 (latest edition).
2. DRAWING IS NOT TO SCALE.
3. CRAB DESIGN AS SHOWN IN THE DIAGRAM IS INDICATIVE ONLY.
4. All DIMENSIONS ARE IN MM UNLESS SPECIFIED.



KEY PLAN

PROJECT	2x660MW ENnore SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI			
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED			
OWNER'S CONSULTANT:-	DESEIN PRIVATE LIMITED DESEIN HOUSE, NEW DELHI			
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI			
SUB-CONTRACTOR				NAME SIGN DATE
TITLE				DRAWN AK
CRANE CLEARANCE DIAGRAM FOR TG HALL CRANE				DESIGNED LJ
225/45T (DOUBLE GIRDER) E.O.T. CRANES (2 Nos.without tandem)				CHECKED GBC
				DEPT. SCALE
				SIGN
				DATE
				BHEL DRG NO : PE-DG-412-501-A001
SHEET 1 OF 1				REV 00

SIZE-A2



**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)**

STANDARD TECHNICAL REQUIREMENT

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SECTION-II

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SHEET :

SECTION-II

STANDARD TECHNICAL REQUIREMENT

SUB-SECTION IIA
SUB-SECTION IIB

STANDARD TECHNICAL REQUIREMENT (MECHANICAL)
STANDARD TECHNICAL REQUIREMENT (ELECTRICAL)

**TITLE**

**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI**
DOUBLE GIRDER EOT CRANES (225/45T)

STANDARD TECHNICAL SPECIFICATION

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DOUBLE GIRDER EOT CRANE

1.0.0 SCOPE

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

2.0.0 CODES AND STANDARDS

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

- | | | |
|-------|------------------|---|
| i) | IS 807 | Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists |
| ii) | IS: 3177 | Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes. |
| iii) | IS: 2266 | Specification for steel wire ropes for general Engineering purposes. |
| iv) | IS: 4029 | Guide for testing induction motor (for temperature rise). |
| v) | IS: 15560 | Steel hooks for standard shank design. |
| vi) | IS: 3443 | Specification for crane rail section. |
| vii) | IS: 325 | Three phase induction motors. |
| viii) | IS: 900 | Code of practice for installation and maintenance of induction motors. |
| ix) | IS: 4237 | General requirement of switchgear and Control gear for voltage not exceeding 1000V. |
| x) | IS: 434 (Part I) | Copper conductors rubber insulated cables for voltage up to 1000V. |
| xi) | IS 1596 | Polyethylene insulated PVC sheathed cables |
| xii) | IS 3043 | Code of practice Earthing |
| xiii) | IS: 3938 | Electric Wire Rope Hoists. |



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xiv)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
xv)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
xvi)	IS: 691	Flexible trailing cables rubber insulated.
xvii)	IS: 1653	Steel conduits for general engineering purposes.
xviii)	IS: 2509	Rigid non-metallic conduit for electric- Installations
xix)	IS: 2062	Steel for General Engineering purposes.
xx)	IS: 1030	Carbon Steel castings for general engineering purposes.
xxi)	IS: 1570	Schedules for Wrought steels.
xxii)	IS: 1875	Carbon steel billets, blooms, slabs and bars for forgings.
xxiii)	IS: 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
xxiv)	IS: 1852	Rolling and cutting tolerances for Hot rolled steel products.
xxv)	IS: 2291	Tangential Keys and Keyways.
xxvi)	IS: 2292	Taper Keys and Keyways.
xxvii)	IS: 3961	Recommended current rating for cables.
xxviii)	IS: 694	PVC insulated cables for working voltages up to and including 1100V)
xxix)	IS: 1554 (part-I)	PVC insulated (heavy duty) electric cables: Part 1: for working voltages up to and including 1100 volts.
xxx)	IS: 4289	Flexible cables for lifts and other flexible connections: Part 1: Elastomer insulated cables.
xxxi)	BS: 970	Wrought steels in the form of blooms, billets, bars and forgings.
xxxii)	IS: 5749/ BS 3017	Specification for Forged Rams horn Hooks

Indian electricity rules - 1956.

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In the event of any conflict between the specification and standards mentioned above, the more stringent of the two as per interpretation of purchaser shall govern.

3.0.0 DOUBLE GIRDER EOT CRANE**3.1.0 DESIGN REQUIREMENTS**

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

Class of crane mechanism shall correspond to that of the crane requirement and as specified elsewhere.

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

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

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

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

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

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

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

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

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

3.1.5 VOID

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2.0 STRUCTURAL DETAILS

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

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



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- 3.2.1.2 The calculated strength of riveted joint or joints made by friction grip bolts in structure members shall be not less than the calculated net strength of the member.
- 3.2.1.3 Bolts used in shear shall be fitted in to reamed hole.
- 3.2.1.4 Nuts and Bolts will be as per IS:1363, IS: 1364 and IS: 1367
High-tension friction grip bolts as per IS: 3757 and High- tension friction grip nuts as per IS: 6623
- 3.2.1.5 Transverse filled welding on load carrying member shall be avoided.
- 3.2.1.6 All butt welds on structural members subjected to tensile stress shall be of radiographic quality as ASME Sec VIII Div.1 acceptance norms.
- 3.2.1.7 Fillet welding on load carrying members shall be avoided.
- 3.2.1.8 For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8mm thick. For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8mm.
- 3.2.1.9 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness.
- 3.2.1.10 Minimum thickness of chequered plates for platform shall be over 6 mm over plain. Chequered plates shall not be considered for strength calculations of load carrying members.
- 3.2.1.11 Splice shall be designed to resist all the forces and moments to which it is subjected to plus 50% thereof.
- 3.2.1.12 However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splice in line with the gravity axis of the member joined so as to avoid the eccentricity of the loading.
- 3.2.1.13 The material of construction of the major components shall be as specified in the specification/data sheet. Manufacturer are however free to use alternate material material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must.
- 3.2.1.14 Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending. For splicing tension members, the



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net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axes of the splices are in line with the gravity axis of the member to avoid eccentricity.

3.2.2 Bridge Girder

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

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

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

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

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

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

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



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

3.2.2.9 Maximum Span/ Depth ratio for Plate Girder shall be 25 or as per IS 807 latest edition.

3.2.3 End carriage

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

3.2.3.2 The wheel base shall not be less than 1/6th of the span up to 20m, 3.5m for spans above 21m but less than 24.5m & 1/7th of span above 24.5m (as per IS 807 latest edition). End carriage shall be fitted with safety stop to prevent the end carriage falling more than 25 mm in the event of breakage of a track wheel, bogies or axle.

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

3.2.4 Crab (Trolley)

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

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

3.2.4.3 Platforms and Ladders



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a) Safe means of access shall be provided to every place where any person engaged in the examination or maintenance of the crane has to work. Adequate handholds and footholds shall be provided as necessary..

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

c) Safety hand railing of tubular construction 32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1100 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick) shall be provided on bridge walkways and on end carriages, staircases, trolley and at any other place where access is provided. Bends shall be neat and made by machine. The top rail should be so laid that there is no intermediate obstruction and hand need not be lifted from rail while walking

d) In case lattice riveted construction is offered for the bridge girder, full length chequered plate platform with adequate headroom shall also be provided at bottom chord level for periodic checking of all rivets/bolts and other items.

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

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

3.3.0 MECHANICAL

3.3.1 Rope drums

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

The pitch diameter of the drum shall be as per IS - 3177 or as specified elsewhere. The depth of the groove shall not be less than 0.35 times the rope diameter. Each rope



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shall be clamped to drum with two clamp wedges with at least two numbers of bolts on each clamping arrangement.

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

3.3.2 Hoist ropes

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

3.3.3 Rope sheaves

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

3.3.4 Wheels

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

3.3.5 Buffer

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

3.3.6 LT drive

The bridge motion shall be achieved by suitable drive arrangement as specified



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elsewhere. When twin drives are used, these shall be operating in unison to avoid skewing effect. The drives shall be interlocked for simultaneous starting, stopping & speed control.

3.3.7 CT drive

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

3.3.8. Gearing

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

3.3.9 Gear Box

- 3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket. In case of totally enclosed gearboxes, splash or automatic lubrication system shall be used. Covers shall be split horizontally at each shaft centre line, so that top half can be removed for inspection and repair without disturbing the bottom half. Gear shafts shall be supported on ball/roller bearings mounted in gearbox unless specially agreed otherwise. The gear boxes shall be provided with breather, air vent, oil level indicator, dip stick, drain plug and lugs for lifting.

Radial clearance between the gear boxes inner surface and outside diameter of the gears shall be at least 1.25 times the depth of larger gear tooth inside the gear box or 20mm whichever is higher. Facial clearance between inner surface of gearbox and face of gear or pinion shall be at least 20 mm. Gearbox shall be inspected in line with QP and as per PEM (Q)/001 enclosed.



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

3.3.10 Bearing

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

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

3.3.11. Shafts, Couplings and axles

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

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

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

3.3.12 Repair Cage

A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. The repair cage shall be adequately sized to accommodate two



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persons. And guarded for safety and correctly located for the intended service. Suitable access to the cage shall be provided. Repair cage shall be provided at the corner of the crane.

3.3.13 Lifting hook

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

3.3.14 LIFTING HOOK BLOCK ASSY

3.3.14.1 Lifting hook block assembly shall be Ram shorn type or approved for capacity greater than 50 Tonnes and point hook with Shank for capacity below 50 Tonnes and shall be of forged steel construction. Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable. All hooks used shall be in normalized condition only. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely.

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

3.3.15 Brakes

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

i) SERVICE BRAKE

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

ii) HOIST CONTROL

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

3.4.0 ELECTRICAL

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



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- 3.4.1.1 Main Disconnecting/Isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end / at both the ends of bay length or in the middle as specified in the data sheet A. Termination of incoming power supply cable to isolating switch fuse unit and further cable from switch to down shop leads shall be included in the bidder's scope of work. The switch shall be provided with Power ON Red indication lamp.
- 3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipment on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 3% or specified in data sheet "A". It shall be supplied with brackets. Maintenance cage for DSL shall be provided on crane.
- 3.4.1.3 The current collectors shall be with adequate current carrying capacity and shall maintain adequate contact pressure. Spacing between current collectors shall be such as to provide sufficient quenching area for sparks coming out of collectors surface. The collector system per conductor shall spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.
- 3.4.1.4 The cable, supplying power to crane trolley shall be flexible trailing cable as per IS-9968 Part I (latest edition) and mounted on retracting supports (festoon type).
- 3.4.2 DRIVE MOTORS**
- 3.4.2.1 Crane Motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The starting torque of motor shall not be less than 2.25 times the rated torque and pull out torque shall not be less than 275% of the rated full load torque of motor. In case of VVVF drive system, the creep speed will be achieved through VVVF drives and the motors for Main hoists, Auxiliary hoist, CT and LT will be Squirrel cage. Hoisting drive motors shall be provided with antifriction roller / ball bearings on the drive side.
- 3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending up on the ambient temperature and voltage /frequency variation shall be applied to de-rate the motors. The minimum margin of 25 % shall be considered over the calculated rating of the motor. The protection class of the motors shall be as IP-55. Motors shall be tested at manufacturer's works in accordance with IS-325/as per agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325 or as per the motor spec.



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

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

3.4.3 Limit switches

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

3.4.4 Switch

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

3.4.5. Contactors.

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

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



TITLE

**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI**
DOUBLE GIRDER EOT CRANES (225/45T)

STANDARD TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-412-501-A001

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3.4.6 Push button and lamp

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

3.4.7 Protective Panel

3.4.7.1 The electrical protective panel shall be a cubicle fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick with lockable-hinged door. The control cabinet's door shall be interlocked with the operating handles of isolating switches of supply circuits so as to prevent opening of the door when an isolating switch is closed. A device for bypassing the interlock shall also be provided. It shall be dust and vermin proof with degree of protection as IP-54 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipment and devices mounted there on. The following minimum equipment shall be provided.

- a) One triple pole air break type main contactor with thermal overload relay.
- b) One triple pole main line connecting/disconnecting switch.
- c) Emergency push button at convenient height for the operation for interruption of the entire power.
- d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.
- e) Contactors, timer and auxiliary contactors.
- f) Portable Lighting Transformer rated for 415/24V.
- g) Lighting Voltage Transformer with fuse 415/24V.
- h) Control transformer with fuses.
- i) Indicating lamps to indicate the live condition of all three phases.
- j) Main supply ON/OFF lamps on the door of the protective panel.
- k) Electrical interlock shall be provided to prevent the main contactor being closed unless all controllers are in OFF position.
- l) Other equipment as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The main contacts shall have the rating for 5 Amps or as specified in the data sheet A. The contactor drop off voltage shall be between 45-50% of rated voltage.



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- m) All internal wiring shall be identified with numbering rules at both ends as per the relevant wiring diagram.
- n) Each panel shall have internal illumination with fluorescent lamp. The inside of the panel shall be painted white.
- o) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. At least 20% spare terminals for the wire terminations shall be provided in the cabinet.

3.4.8 Starter Panel

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

- a) Contactors : AC4 duty for reversing applications
AC3 duty for non-reversing applications
- b) Switches : AC23 for motor application.
AC22 for other application
- c) Fuses : HRC
- d) Overload relays: Temperature compensated bi-metallic with single phasing preventer.

3.4.9 MOTOR CONTROL PANEL

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

- a) Switch fuse unit with contacts of adequate rating for each motion.
- b) Thermal overload relay for each drive. These shall be ambient temperature compensated adjustable type.
- c) Contactors, timers and auxiliary contactors.
- d) The panel shall be provided with space heater. The space heater with thermostat shall be located at the bottom of the panel and shall have individual ON/OFF switch.
- e) Terminal blocks shall be stud or snap on type. A protective cover shall be fixed on top of terminal blocks to prevent accidental contact. A minimum of 20% spare terminals shall be provided.
- f) Air break contactors shall be provided for main supply as well as for motors. They shall conform to category AC-4 as per IS-1322. These shall have



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three main contacts and 2 No. & 2 NC auxiliary contacts.

- g) The main contacts shall have the ratings as per duty requirement but auxiliary contact shall be rated for 5 amp 240V AC. The contactor drop off voltage shall be between 45-50% of rated voltage. The contactor coil shall be suitable for 240V AC supply.
- h) The auxiliary contactors shall have 4 No. + 4 NC contacts for control and interlocking purposes. The contacts shall be convertible. The contacts rating shall be suitable for 5 amps at 240 Volts AC.
- i) Adequate protection for overload and short circuit shall be provided for all the three phases of each motor.
- j) Double pole switch fuse unit for control circuit of the contractor 'START (push button and a pilot lamp with the red lens for indicating the contactor "CLOSED" shall be furnished.

3.4.11 Illumination

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

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

3.4.13 Grounding



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- 3.4.13.1 The crane structure, motor frame and all other electrical equipment/s shall be grounded in accordance with the Indian Electricity Rules. The connections from Crane Bridge to 4th conductor of down shop leads shall be by means of current collector.
- 3.4.13.2 The equipment fed by flexible cables shall be grounded by means of fourth core provided in the flexible trailing cable. Pendant push button station shall be earthed Separately.
- 3.4.14 Red warning light 3 Nos. shall be provided at both ends of the gantry girder to indicate the aliveness of DSL.
- 3.4.15 **Wiring Systems**
- All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion. All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductor
 - All wiring shall be done with 1100V grade fire resistance PVC insulated wire in conduits or by 1100V grade PVCA PVC cables with extruded inner sheath.
 - For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.
 - Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.
 - Each motor shall be wired independently. Power and control wiring shall be effectively separated.
 - Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.
 - All wire termination to the panels shall be provided with clamp type connections screw. Screw Type terminals with screw directly impinging on conductors are not acceptable.
 - Multi way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring.
 - Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points
 - Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

ANNEXURE - VIII

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

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

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				

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

CONTENT

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

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

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

c) GENERAL INSPECTION REQUIREMENTS

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

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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



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

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





iii Open storage (O)

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

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

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



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

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

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

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

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

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

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

5. CONCLUSION

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

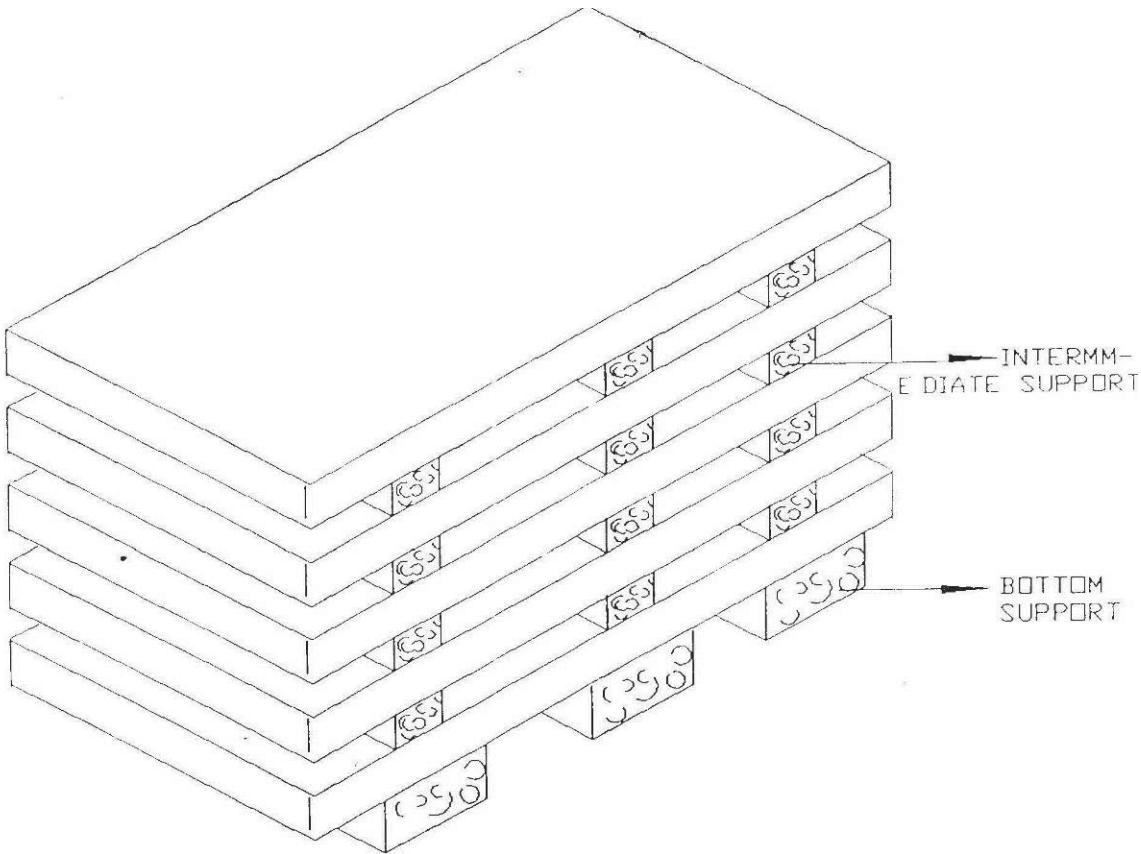


Figure – 1 – PLATE STACKING ARRANGEMENT

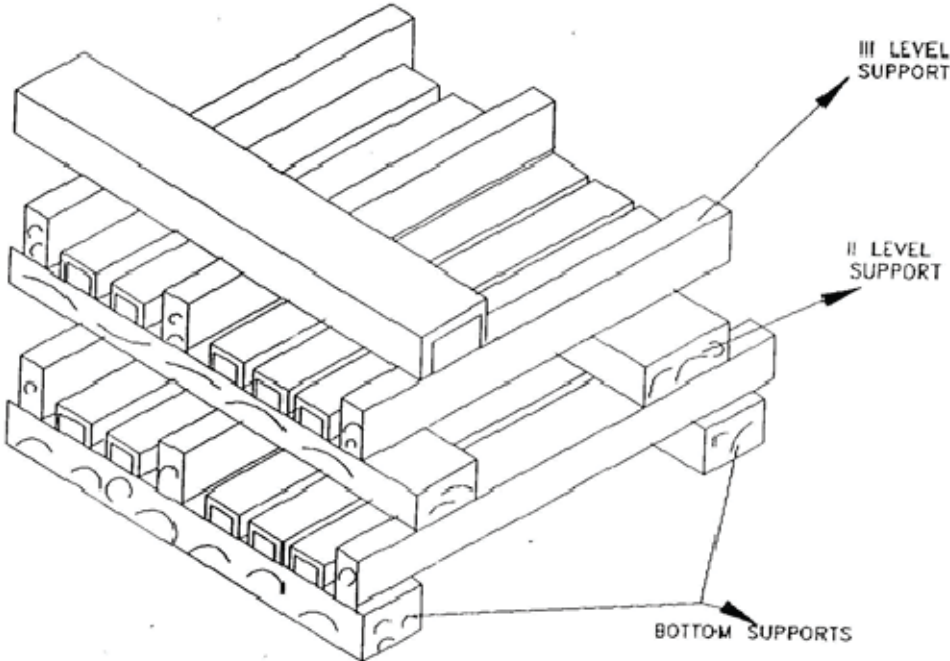


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)**

STANDARD TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-412-501-A001

VOLUME: II B

SECTION-II

REV. 00

DATE: 02.11.16

SHEET :

SECTION-II

STANDARD TECHNICAL REQUIREMENT

SUB-SECTION IIB

STANDARD TECHNICAL REQUIREMENT (ELECTRICAL)

**TAMIL NADU GENERATION & DISTRIBUTION
COROPORATION LTD.**

2X660 MW SEZ ENNORE STPP

**DOUBLE GIRDER/ EOT CRANES
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA
INDIA**

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR DOUBLE GIRDER EOT CRANES 2X660 ENNORE TPS	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 0 DATE:
		SHEET: 1 OF 2

CONTENTS

SECTION	TITLE	NO OF SHEETS
C	Specific technical requirements	2
C	Electrical scope between bhel & vendor	1
C	Electrical load data format	1
C	Technical requirements for motors	10
C	Motor Data sheet-A	1
D	Motor data sheet-C	2
D	Quality plan (for motors 55kw & above 55 kw (lv & mv))	9
D	Quality plan (for motors below 55 kw)	2
D	Basic Technical Particulars of HT/LT motors.	6
D	Technical specification for cables	11
D	Technical specification for cable tray, fittings, accessories, junction box	4

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR EOT CRANES / ELEVATORS / ELECTRIC HOISTS SYSTEM (ELECTRICAL PORTION) 2X660 ENNORE TPS	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 0 DATE:
		SHEET: 1 OF 2
1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:		
The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:		
a) Services and Equipment as per "Electrical Scope between BHEL and Vendor". b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same. c) Supply of mandatory spares as specified in the specifications of mechanical equipments. d) Erection and Commissioning spares. e) Erection & Maintenance tools & tackles. f) Electrical load requirement for EOT CRANES / ELEVATORS / ELECTRIC HOISTS System. g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information. h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer / BHEL approval without any commercial and delivery implications to BHEL. i) Various drawings including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL. j) Motors shall meet minimum requirement of Electric motor specification. k) All routine tests and type tests reports as per applicable standards shall be furnished at contract stage. l) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements. m) LV Power Cables and Control Cables shall be as per cable annexure. n) Cable trays shall be as per attached Cable Tray Annexure. o) Panel shall be as per attached Panel Annexure. p) Technical requirements shall be as per specifications listed in Clause 4.1 to 4.9. In case of any discrepancy between Basic technical Particulars for HT or LT motors and BHEL standard specification, Basic technical particulars for HT or LT motors shall prevail.		
2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS: Refer "Electrical Scope between BHEL and Vendor".		
3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID		
3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.		
3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.		

	TITLE:	SPECIFICATION NO.
	ELECTRICAL EQUIPMENT SPECIFICATION	VOLUME NO. : II-B
	FOR EOT CRANES / ELEVATORS / ELECTRIC HOISTS	SECTION: C
	SYSTEM	REV NO. : 0 DATE:
	(ELECTRICAL PORTION)	SHEET: 1 OF 2
2X660 ENNORE TPS		

4 LIST OF ENCLOSURES

- Electrical scope between BHEL & vendor.
- Technical specification – Specification for Electric Motors/Actuators
- Basic Technical Particulars of HT/LT motors.
- Testing Requirements.
- Quality Plan for LV Motors.
- Load Data Format.
- Cable Annexure.
- Cable Tray Annexure.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: DOUBLE GRIDER EOT CRANES

SCOPE OF VENDOR: SUPPLY , ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT :

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

DESEIN

Technical Requirements for Motors

Tender Specification
Vol-IV : Electrical Works
Motors

CHAPTER – 12

MOTORS

1.00.00 DESIGN CRITERIA

1.00.01 For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 85% shall be considered. The equipment shall operate in a highly polluted environment.

1.00.02 Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

1.00.03 Rating

The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.

All motors shall be continuously rated (S1 duty). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

1.00.04 Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

For Mill Motors:

1. 85 % of rated voltage for motors above 1000 kW
2. 90 % of rated voltage for motors up to 1000 kW

1.00.05 Canopy shall be provided for outdoor motors.

1.01.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services.



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1.02.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.03.00 Voltage and frequency variations:

Frequency: (+) 3% and (-) 5%

Voltage : **i. AC**

a. $\pm 6\%$ for 11 kV/3.3 kV

b. $\pm 10\%$ for 415 V

Combined 10 % (absolute sum)

ii. DC- +10% to -15% for 220 V DC

1.04.00 All LV motors above 10 kW with S1 duty shall be compulsorily of Energy efficient level IE 2 as per IS 12615: 2011.

1.05.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

1.06.00 Type

AC Motors:

- (a.) Squirrel cage induction motor suitable for direct-on-line starting.
- (b.) Crane duty motors shall be slip ring type induction motor

DC Motors

- (a.) Shunt wound.

1.07.00 Temperature Rise

Air cooled motors

70°C by resistance method

Water cooled

80° C over inlet cooling water temperature mentioned elsewhere, by resistance method.

1.08.00 Degree of Protection

Degree of protection for various enclosures shall be as follows :

- i) Indoor motors — IP 54



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- | | | | |
|------|---|---|-------|
| ii) | Outdoor motors | – | IP 55 |
| iii) | CW motors (in case of screen
prot. Drip proof) | – | IP 23 |
| iv) | Cable box – indoor area | – | IP 54 |
| v) | Cable box – outdoor area | – | IP 55 |

2.00.00 CODES AND STANDARDS

2.01.00 All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.

2.02.00 Major Standards, which shall be followed, are listed below. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed

- | | | | |
|-----|---|---|--|
| 1.) | Three phase induction motors | : | IS:325, IEC:60034 |
| 2.) | Single phase AC motors | : | IS:996, IEC:60034 |
| 3.) | Crane duty motors | : | IS:3177, IEC:60034 |
| 4.) | DC motors/generators | : | IS:4722 |
| 5.) | Degree of protection by
enclosures for rotating electrical
machines | : | IS: 4691
IS: 4728
IS: 6362
IS: 2253 |
| 6.) | Noise levels for rotating
electrical machines
Mechanical Vibrations for
rotating electrical machines | : | IS: 12065
IS: 12075 |

3.00.00 OPERATIONAL REQUIREMENTS

3.01.00 Starting Time

3.01.01 For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time .



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- 3.01.02 For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.
- 3.01.03 For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- 3.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- 3.01.05 Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.
- 3.02.00 Torque Requirements
- 3.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- 3.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

- 4.00.01 Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.

- 4.00.02 All motors shall be suitable for direct on line starting through any type of breaker.

L All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below

- (a) Fuel oil area : Group - IIB
- (b) Hydrogen generation plant area : Group - IIC

- 4.00.03 Winding and Insulation

- (a) Type : Non-hygroscopic, oil resistant, flame resistant



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- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature
- (c) 11 kV / 3.3 kV AC motors : Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of 4U+5 KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 3.3 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.
- (d) 415V AC & 220V DC motors : Class 'F' with temperature rise limited to class 'B'
- 4.00.04 Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.
- 4.00.05 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
- 4.00.06 Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
- 4.00.07 In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.
- 4.00.08 MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.
- 4.00.09 Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motor shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor.



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Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.

- 4.00.10 MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs shall be supplied loose by 11/ 3.3 kV switchgear manufacturer.
- 4.00.11 Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
- 4.00.12 HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
- 4.00.13 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
- 4.00.14 The motors shall be suitable for bus transfer schemes provided on the 11 kV, 3.3 kV/415V systems without any injurious effect on its life.
- 4.00.15 All motors below 15 kW shall be provided with sealed ZZ bearings.
- 4.00.16 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
- 4.00.17 All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.
- 4.00.18 The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
- 4.00.19 Neutral in case of HV motors shall be kept accessible.



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- 4.00.20 Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.
- 4.00.21 Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.
- 4.00.22 Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- 4.00.23 For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box..
- 4.00.24 Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.
- 4.00.25 Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors
- 4.00.26 Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
- Hot and cold air temperatures of the closed air circuit for CACA motors.
 - Hot and cold, air and water temperatures for CACW motors.
- The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
- 4.00.27 **Lifting Provisions**
- Motor weighing 25 kg or more shall be provided with eye bolt or other adequate provision for shifting. Electrical hoists shall be provided for motors above 1000 kgs for maintenance of the same.
- 4.00.28 **DC MOTORS**
- DC motors shall be provided where specified/required. DC Motors shall be sized for operation with fixed resistance starting for reliability. DC motors shall be shunt wound type. Motors shall be capable of delivering the rated output at 220 V DC with (+) 10% and (-) 15% variations without exceeding its guaranteed temperature limits. 220 V DC



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system shall be unearthed. Starting current of the DC motors shall be limited to 200% of the full load current of the motor, and is subject to IS tolerance. DC Motors shall be similar to AC Motors with respect to other features like enclosure type, cooling and class of insulation

4.00.30 Painting

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

4.00.31 Local Push Button Stations

The LPBS shall be installed near the motors to be controlled. Individual channel supports shall be used for each LPBS. These shall be installed as per approved erection detail drawing. LPBS for hazardous areas shall be CMRS certified and CCE approved.

All LPBS shall have necessary canopies. Wiring of LPBS shall be checked before giving control supply.

5.00.00 LIST OF TESTS TO BE CONDUCTED FOR HV, MV and LV MOTORS

5.01.00 TYPE TESTS

- (a) No load saturation and loss curves up to approximately 115% of rated voltage
- (b) Momentary overload test
- (c) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
- (d) Surge withstand test on the sample coil after placing it in stator core at $(4U + 5 \text{ KV})$ and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.
- (e) Surge-withstand test with 0.3/3 micro sec. wave on each type of 3.3/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out



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the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

- f) Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only)
- g) Measurement of resistance of windings of stator and wound rotor.
- h) Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only)
- i) Full load test to determine efficiency, power factor and slip.
- j) Insulation resistance test
- k) Test for vibration severity of motor
- l) Test for noise levels of motor
- m) Test for degree of protection by enclosure
- n) Temperature rise test at limiting values of voltage and frequency variations
- o) Over speed test

5.02.00

ROUTINE TESTS

The following shall constitute the routine tests.

- a) Insulation resistance test
- b) Measurement of resistance of windings of stator and wound rotor.
- c) No load test
- d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- e) Reduced voltage running up test (for squirrel cage motor)
- f) Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
- g) High voltage test

6.00.00

INSPECTION AND TESTING AT SITE

6.01.01

Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer:

- (a.) Blowing hot air in case of big motors.
- (b.) Putting the motor in electric oven in case of smaller motors.
- (c.) Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.



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6.01.02 Site Test

- (a.) Measurement of vibration.
- (b.) Measurement of insulation resistance and polarization index.
- (c.) Measurement of full load current.
- (d.) Test running of the motors, checking the temperature rise and identifying the hot spot etc.

6.01.03 3.3 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of $\geq 20 \text{ M}\Omega$ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted:

- a. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.
- b. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.



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MOTOR DATA SHEET-A

SL.NO.	PARAMETERS	UNIT	ENNORE	
	MOTOR			
1	DESIGN AMBIENT TEMP	DEG. C	50	
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, $\pm 10\%$	
3	FREQUENCY WITH VARIATION	Hz	50 (+) 3% to (-) 5%	
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%	
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 kW	
6	SYSTEM FAULT LEVEL AND ITS DURATION	KA	50 KA, 1 Sec	
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec	
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B	
9	MIN. STARTING VOLTAGE		85%	
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		Upto 200W	
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.	
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.0m in line with IS 12065	
13	TYPE OF STARTER PROVIDED IN MCC		N.A.	
14	DOP OF ENCLOSURE		Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.	
15	SPACE HEATER REQUIREMENT		30KW & ABOVE	
16	PAINT SHADE		Shall be confirmed during detailed engineering.	
17	SPECIAL REQUIREMENT		Type test to be conducted on the identical motor in the last 5 years or after the last design change, whichever is earlier. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design. All motors shall be subjected to routine tests as per IS: 325. The motors shall generally conform to IS 325/IEC-60034.	

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

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :		
				BIDDER/ VENDOR		TITLE			NUMBER :		
SHEET 1 OF 9				SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03 ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SPECIFICATION : TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III		
									P	W	V
1	2	3	4	5	6	7	8	9	10		
1.0	RAW MATERIAL & BOUGHT OUT CONTROL										
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2
											PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE								
									BIDDER'S/VENDORS COMPANY SEAL		

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
SHEET 2 OF 9		BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY			VOLUME III REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUF'R'S DRG.	LOG BOOK	3	-	2	
		4. INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUF'R'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, RTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUF'R'S DRG. SPEC.	MANUF'R'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUF'R'S DRG. / SPEC.	MANUF'R'S DRG. / SPEC.	-DO-	3	-	2	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
SHEET 3 OF 9		BIDDER/ VENDOR SYSTEM		QUALITY PLAN NUMBER PED-508-00-Q-007, REV-03		SPECIFICATION : TITLE		SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUF'R'S DRG. .	MANUF'R'S DRG.	-DO-	3	-	2
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		

			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
QUALITY PLAN			BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
SHEET 4 OF 9			SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book,	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC/ BHEL SPEC.	MANUF'S SPEC/ BHEL SPEC.	-DO-	3	-	2	
		4.HVIR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 5 OF 9		CUSTOMER :		PROJECT			SPECIFICATION :			
				TITLE		NUMBER :						
		BIDDER/		QUALITY PLAN			SPECIFICATION :					
		VENDOR		NUMBER PED-506-00-Q-007, REV-03			TITLE					
		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION					
							VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			
									P	W	V	
1	2	3	4	5	6	7	8	9	10			
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :			
				BIDDER/ VENDOR			TITLE			NUMBER :			
SHEET 6 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	P	W	V	11	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN	
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :		
SHEET 7 OF 9		BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-508-00-Q-007, REV-03			SPECIFICATION : TITLE			
SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		
1	2	3	4	5	6	7	8	9	P	W	V
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-
		6. RTD, 8TD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		

			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
QUALITY PLAN			BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
SHEET 8 OF 9			SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS		
1	2	3	4	5	6	7	8	9	P	W	V	
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT. TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1*	1	* NOTE - 2
		3. VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1*	1	* NOTE - 2
		4. OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5. DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1*	1	* NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1*	1	* NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1*	1	* NOTE - 2
		9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1*	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY * NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 9 OF 9		CUSTOMER :		PROJECT		SPECIFICATION :		
				BIDDER/		TITLE		NUMBER :		
		VENDOR		SYSTEM		QUALITY PLAN		SPECIFICATION :		
						NUMBER PED-506-00-Q-007, REV-03		TITLE		
						ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY										
BHEL			PARTICULARS		BIDDER/VENDOR					
			NAME							
			SIGNATURE							
			DATE				BIDDER'S/VENDORS COMPANY SEAL			

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

		QUALITY PLAN SHEET 2 OF 2		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :		
				ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: - ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON - WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. - FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW, ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.												
<u>Legends for Inspection agency</u> - BHEL/CUSTOMER - VENDOR (MOTOR MANUFACTURER) - SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)												
P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

**TAMIL NADU GENERATION & DISTRIBUTION
CORPORATION LIMITED**

2 X 660 MW ENNORE SEZ SUPERCRITICAL TPP

**BASIC TECHNICAL FEATURES
FOR HT/LT MOTORS**

(FOR CRANES)



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

POWER PROJECT ENGINEERING INSTITUTE

NOIDA (U.P), INDIA

	2 x 660 MW ENNORE SEZ STPP BASIC TECHNICAL FEATURES FOR HT / LT MOTORS (FOR CRANES)	Doc. No.	PE-DC-412-565-E003
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1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in 2 x 660 MW ENNORE SEZ STPP.

2.0 CODES AND STANDARDS

The motors shall generally conform to IS 325/IEC-60034. LT motors above 10 kW with continuous duty (S1) shall be energy efficient IE2 conforming to IS-12615: 2011.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 1500 kW	11 KV	11 KV
Above 160 kW up to & including 1500 kW	3.3 KV	3.3 KV
From 200W up to & including 160 kW	415 V	415 V
Below 200W	240V	240V

3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (AC Supply) (+/-) 10%
Frequency variation (+) 3% to (-) 5%
Combined V & F variation 10% (sum of absolute values)

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 10% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% of the motor's full load torque.

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3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

Minimum Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

3.4.3 The locked rotor current of the HV (11 kV) motors (except MDBFP motors) shall not exceed 650% of full load current inclusive of tolerance as per IS: 325 and for MV (3.3 kV) motors locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.

3.4.4 The following frequency of starts shall apply

- i) Two nos. consecutive cold starts in quick succession with third start after 5 minutes in cold condition.
- ii) Two nos. consecutive hot starts in the interval of 15 minutes in hot condition.

3.4.5 Locked motor withstand time of motors under hot condition at highest voltage limit shall be as follows:

- a) For motors with starting time up to 20 sec.
 - at least 2.5 sec. more than starting time.
- b) For motor with starting time above 20 secs but not exceeding 45 secs.
 - at least 5.0 sec. more than starting time.
- c) For motors with starting time above 45 secs.
 - at least 10% more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. For motors and in cases where the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.

3.5 Running Requirements

3.5.1 Motors shall run satisfactorily at a supply voltage of 80% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

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3.6 Stress during bus Transfer

- 3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vect or difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.
- 3.6.2 Motor windings shall be adequately braced to satis factorily withstand the mech. Stresses during above condition.
- 3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.
- 3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Noise level

The maximum noise level for motors shall be in line with IS 12065.

3.8 Vibration

The maximum vibration for motors shall be in line with IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

- 4.1.1 Indoor m otors shall conform to degree of protec tion IP: 54 as per IS: 4691. Outdoor m otors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. CW motors (in case of screen prot. Drip proof) shall conform to degree of protection IP: 23 as per IS: 4691. The degree of protection for term inal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.
- 4.1.2 The stator lam inations shall m ade from suitable silicon steel/m agnetic steel sheet varnished on both sides and pressed to form a rigid core.
- 4.1.3 The rotor shall be of rigid cage construction with die cast aluminium / copper alloy / copper bars firmly wedged in bar slots and brazed to the end rings. The rotor cage shall be designed to operate satisfactorily under respective starting and load duty cycle.

4.2 Enclosure and Cooling

- 4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) enclosures or Closed Air circuit Air (CACA), the method of cooling conforming to IC-0141 or IC-0151 or IC-0161 of IS: 6362 up to 3000 kW motor. CW Motors may be screen protected drip proof (SPDP).

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4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.3 Class of Insulation

HT/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

4.4 Bearings

4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For HV/MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.

4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.

4.4.3 After taking all motor driven equipment loads and thrust (if any) into account, the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.

4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.

4.4.5 For motors up to 2 kW, double sealed type bearings shall be provided.

4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.

4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker with numerical protection. For all motors of rating up to 90kW shall be provided with MCCBs. The terminal box of motors shall be designed for the maximum fault current for a duration of at least 0.25 secs.

4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.5.3 For HV/MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.

4.5.4 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A,C,B or V, W & U respectively.

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4.5.5 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.5.6 Motor terminals and terminal leads shall be fully insulated with no bare live parts.

4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression tinned brass glands shall be provided in terminal boxes.

4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.

4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.

4.6 Grounding

Two separate earthing terminals suitable for connecting G.I. strip grounding conductor shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.7 General

4.7.1 Motors provided for similar drives shall be interchangeable.

4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.

4.7.3 Motors for Fuel oil unloading and drain oil pumps located in hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079.

a) Fuel oil area: Group - IIB.

b) Hydrogen generation plant area: Group - IIC

5.0 ACCESSORIES

5.1 SPACE HEATERS

All motors rated 30KW and above shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

The leads from space heaters of each motor shall be brought out to a separate terminal Box. Space heaters shall be mounted inside the motor in accessible places so that their removal and replacement is simple.

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5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

- 5.2.1 HV/MV motors stator windings shall be provided with 12 nos. Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.
- 5.2.2 For HV/MV motors, each bearing shall be provided with 1 no. Duplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of bearing temperature. The leads from these RTDs shall be brought out to a separate terminal Box or the terminal box same as for winding RTDs.

5.3 DIAL TYPE TEMP. INDICATORS

- 5.3.1 For HV/MV motors, each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

5.4 Vibration monitoring pads

- 5.4.1 Provision shall be made in all HV/MV motors for mounting vibration detectors.

6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition bearing identification number and type of lubricant is to be indicated.

7.0 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

8.0 TESTING

8.1 Type Tests

For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

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Technical specification
Cables

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CHAPTER - 16

LV CABLES

1.00.00 CODES AND STANDARD

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
IEC-60754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEEE-383	Standard for type test of Class IE Electric Cables.
IEC -60332	Tests on Electric cables under fire conditions.



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	Part-3 : Tests on bunched wires or cables (category -B)
SS-4241475 classF3	Swedish Chimney test
NES-715-1	Temperature index

2.00.00 TECHNICAL REQUIREMENTS

- 2.01.01 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.
- 2.01.02 Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.
- 2.01.03 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.
- 2.01.04 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250°C.
- 2.01.05 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.
- 2.01.06 For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables armouring shall be of galvanised steel as follows :-

Calculated nominal dia of cable under armour	Size and Type of armour
i) Up to 13 mm	1.4mm dia GS wire
ii) Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
iii) Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
iv) Above 40 & upto 55mm	1.4 mm thick GS formed wire / 2.5mm dia GS wire
v) Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
vi) Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire



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2.01.07 The aluminium used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of 0.028264 ohm mm² per meter at 20 deg C. Aluminium armouring shall be same as indicated above for galvanized steel.

2.01.08 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire

2.01.09 Cable Identification

1. Outer sheath shall be of PVC (of suitable grade) & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

- (a.) Oxygen index of min. 21 (As per NES-715-1)
- (b.) Acid gas emission of max. 20% (As per IEC-60754-I).
- (c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM D-2843.

2. Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:

- 1 core - Red, Black, Yellow or Blue
- 2 core - Red & Black
- 3 core - Red, Yellow & Blue
- 4 core - Red, Yellow, Blue and Black

3. For reduced neutral conductors the core shall be black.

4. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

- (a.) Cable size and voltage grade - To be embossed



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(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre-
To be embossed / printed

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

5. Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow, Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

2.01.10 All cables shall meet the fire resistance requirement of IEEE - 383 with cable installations made in accordance with clause "Flammability test" and as per Category-B of IEC 60332 Part -3.

2.01.11 Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.

2.01.12 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc, are not acceptable.

3.00.00 Cable selection & sizing

3.01.00 Cables shall be sized based on the following considerations:

- i. Rated current of equipment.
- ii. Maximum voltage drop limits under steady state and during starting for motor being fed from 415V switchgear restricted to 5% and 15% respectively.

Maximum voltage drop limits under steady state and during starting for motor being fed from 415V MCC restricted to 3% and 15% respectively.



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Maximum voltage drop limits under steady state for feeder (i.e. Outgoing feeders being fed from 415V switchgear) restricted to 3%.

- iii. For cables to motors and feeders protected by MCCBs the cross section will be chosen according to the tripping time of MCCBs.

3.02.00 Derating Factors

Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

- i. Variation in ambient temperature for cables laid in air
- ii. Grouping of cables
- iii. Variation In ground temperature and soil resistivity for buried cables.

3.03.00 Cable lengths shall be considered in such ways that straight through cable joints are avoided.

3.04.00 Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried.

3.05.00 All LV power cables except trailing cables shall be XLPE insulated FRLS.

3.06.00 All control cables shall be 2.5 Sq mm copper cable.

3.07.00 Multicore control cables will generally have spare conductor (s) in accordance with the following chart and cores of a single cable will not be split for different auxiliary/equipment:

Conductors	required Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 or 8	1-10/C
9 or 10	1-12/C
11 or 12	1-16/C
13 or 14	1-18/C
Above 14 core	Two or more of above cables



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4.00.00 CONSTRUCTIONAL FEATURES

04.01.00 1.1 KV Grade Power Cables

(d.) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).

(e.) 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968

4.02.00 1.1 kV Grade Copper Conductor Fire Survival Power Cables

4.02.01 1100 volt grade, 90 Deg.C rating, Power cables with stranded Copper conductor, heat resistance elastomeric insulation generally conforming to Type IE-2 of IS: 6380-1984, extruded Halogen free or very low Halogen elastomeric inner sheath, generally conforming to Type SE-3 of IS-6380-1984, round wire/strip armour and extruded outer sheath of elastomeric material generally conforming to Type SE-3 of IS: 6380-1984.

4.02.02 The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988.

4.02.03 The cables shall be rated for 3 hours fire rating.

4.02.04 Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130.
A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.

4.02.05 The insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.



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4.02.06 The suitable fire retardant material fillers shall be used for filling in the interstices.
Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

4.02.07 Fire Survival Power & Control cables shall be provided for the following services:

- (a.) DC emergency lube oil pump.
- (b.) Turbine lube oil pump/barring gear.
- (c.) Jacking oil pump.
- (d.) Scanner air fan.
- (e.) Incoming & outgoing cables for DC lighting distribution board.
- (f.) Fire /smoke detection system.
- (g.) DC seal oil pump.
- (h.) DC emergency lighting cables for Main Plant Building.
- (i.) Batteries to charger and DC distribution board.
- (j.) Emergency turbine trip by push button in control room.
- (k.) Boiler turbine: Generator inter-trip which includes the interconnecting cables between
 - 1. Boiler master fuel trip and turbine trip relays
 - 2. Generator trip relays and turbine trip relays
 - 3. Generator trip relays and 400 kV circuit breaker
 - 4. Generator trip relays and generator field breaker.
 - 5. Generator trip relays and UAT breaker.

4.03.00 1.1 KV Grade Control Cable

Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.

Voltage Transformer leads shall be checked for voltage drop, which shall be limited to within 1 % for all cases other than tariff metering, for which the voltage drop shall be limited to 0.2 %. In case the voltage drop with 4 sq.mm Cu conductors exceeds this value, higher conductor sizes shall be used.



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**Tender Specification
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LV Cables**

- 4.04.00 1.1 kV Copper Conductor Fire Survival Control Cables**
- 4.04.01 Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS 8130/1984 amended up to date.
- 4.04.02 A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
- 4.04.03 The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.
- 4.04.04 An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores.
- 4.04.05 The armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 3975 amended up to date.
- 4.04.06 The outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.
- 4.04.07 The colour of outer sheath shall be black or any other natural colour agreed mutually between Owner and Contractor.
- 4.04.08 The minimum sizes of L.T. cable to be chosen are as below:
AL-16 mm² (3 core) & Cu – 2.5 mm² (3 core)
- In power cables maximum conductor size to be used will be 300 sq. mm & 630 sq.mm for multi core and single core cables. In case of multi core cables not more than 3 runs to be used or otherwise single core cable to be used.



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4.05.00 Cable Drums

Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

5.00.00 TESTS

5.01.00 Type Tests:

5.01.01 The reports for the following type tests shall be submitted on one size each of LV Power cables :

S.No.	Type Tests	Remarks
a)	For Conductor	
1.	Annealing test	For copper conductor only.
2.	Tensile test	For aluminium conductor only.
3.	Wrapping test	For aluminium conductor only.
4.	Resistance test	
b)	For Armour Wires/ Formed Wires	
1.	Measurement of Dimensions	
2.	Tensile Test	
3.	Elongation test	
4.	Torsion test	For round wires only
5.	Winding test	For Formed wires only
6.	Resistance test	
7(a)	Zinc Coating test	For G.S. Formed wires /wires only.



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7(b)	Wrapping test	For Al. Formed wires /wires
c)	For XLPE insulation & PVC Sheath	
1.	Test for thickness	
2.	Tensile strength & elongation tests before ageing and after ageing	
3.	Ageing in air oven	
4.	Loss of mass test	For PVC sheath only
5.	Hot deformation test	For PVC sheath only
6.	Heat shock test	For PVC sheath only
7.	Shrinkage test	
8.	Thermal stability test	For PVC sheath only
9.	Hot set test	For XLPE insulation only
10.	Water absorption test	For XLPE insulation only
11.	Oxygen index test	For outer sheath only
12.	Smoke density test	For outer sheath only
13.	Acid gas generation test	For outer sheath only
d)	For completed cables	
1.	Insulation resistance test (Volume resistivity method)	
2.	High voltage test	
3.	Flammability test as per clause "Flammability test"	
4.	Flammability test as per IEC - 332 Part-3 (Category -B)	



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5.01.02 Flammability Test

- (f.) This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give atleast 10 kg of organic material per metre run.
- (g.) The following cable installation shall be tested :
 - (1.) Installation with single / multi core cables in touching formation.
- (h.) Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to Owner's approval.
- (i.) The size of the cables selected (measured by total cross sectional area of the conductor) shall have maximum organic material per sq. mm of total cross sectional area of all the conductors.

5.01.03 Acceptance Tests

Acceptance tests shall be carried out on each type and size of the cables on the cable drums selected at random as per following sampling plan:

S. No.	No. of drums in the lot	No. of drums to be taken as sample
1.	Upto 100	10% (Subject to minimum of 1 drum)
2.	101 to 300	13
3.	301 to 500	20
4.	Above 500	32

The following shall constitute acceptance tests :

- 1. Item No. 1 to 14, 16, 19, 20, 22, 23, 24, 25 of list of type tests specified in 9.03.01 of chapter 15.
- 2. Fire resistance test as per SS 4241475 (F3 category)
- 3. One length per size / lot for surface finish and length measurement
- 4. Lay length / sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Band marking.

5.01.04 Routine Tests

Routine tests shall be carried out as per relevant standard for each drum of cables of all types and sizes.



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TECHNICAL SPECIFICATION CABLE
TRAY, FITTINGS, ACCESSORIES, JUNCTION
BOX ANNEXURE

Tender Specification
Vol-IV : Electrical Works
Cabling System

- 4.00.00 EQUIPMENT DESCRIPTION**
- 4.01.00 Cable trays, Fittings & Accessories**
- 4.01.01** Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
- 4.01.02** These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- 4.01.03** Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm.
- 4.01.04** Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.
- 4.01.05** Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. Cable trays shall be suitable for a cable weight of 100 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively. The amount of zinc deposit shall not be less than 610 gm per square meter.
- 4.01.06** Cable trays fabricated from standard rolled sections shall be 50x50x6/75x75x6 sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32x6 mm / 50x6 flat for widths up to 500mm/more than 500mm respectively.
- 4.01.07** Separate coloured paint strips shall be applied for identification of different type of trays depending upon types of usage/applications/area as below:



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High/ medium voltage cables: red strips, 2 inch width each, numbers

11kV/3.3kV

equally spaced at 5 metres interval

1.1kv power cables : yellow strips — do —

1.1kv control cables : blue strips — do —

Instrumentation cables : green strips ----- do -----

4.02.00 Support System for Cable Trays

4.02.01 Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

4.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types: (i) C1:- having provision of supporting cable trays on one side and (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

- a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.
- b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.



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- c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
- e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
- f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
- g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.
- h. FRP Cable trays shall be used for areas like intake raw water pump house, Desalination plant, CHP, Battery room, NDCT and chemical house.

4.02.03

The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any



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additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

4.03.00 Pipes, Fittings & Accessories

4.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

4.03.02 GI Pipes shall be of medium duty as per IS: 1239

4.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

4.04.00 Junction Boxes

4.04.01 Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

4.04.02 Glass Fibre Reinforced Junction Boxes

No. of Ways: 12/24/36/48 with 20% spares terminals.

4.04.03 Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803/16913 type 834, 5 self extinguishing in accordance with ASTM D635/UL 94 VO.

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electro statically power coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.



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AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)**

DOCUMENTS TO BE SUBMITTED BY BIDDER

SPECIFICATION No: PE-TS-412-501-A001

VOLUME: III

SECTION-III

REV. 00

DATE: 02.11.16

SHEET :

SECTION-III

DOCUMENTS TO BE SUBMITTED BY BIDDER

IIIA	LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID
IIIB	COMPLIANCE CUM CONFIRMATION CERTIFICATE
IIIC	ELECTRICAL LOAD DATA
IIID	DEVIATION SCHEDULE
IIIE	PRE BID CLARIFICATION SCHEDULE



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DOUBLE GIRDER EOT CRANE (225/45T)**

**DOCUMENTS TO BE SUBMITTED BY
BIDDER**

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SECTION-III

SUB-SECTION-IIIA

REV 00

DATE 02.11.16

SUB SECTION-IIIA LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID



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DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID:

Bidder shall submit signed and stamped copy of the following drawings / documents along with their bid

a) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format given under Vol-III (if applicable)

Or

No deviation certificate (Vol-III)

b) Copy of pre-bid clarifications (if any). (Vol-III)

c) Compliance cum Confirmation Certificate (Vol-III)

d) Un priced copy of price format indicating **quoted/ not quoted** against each row/column along with cost of withdrawal / price implication format for deviations.

e) Electrical load list. (Vol-III)

f) Supply price percentage breakup (Refer Sub section IA , page 79 of 294)

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



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SUB SECTION-IIIB COMPLIANCE CUM CONFIRMATION CERTIFICATE



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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" in section C and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant /equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price and within purview of the tender specification even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to



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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.
- m) Regarding commercial documents / deviations, BHEL clarified that commercial documents / deviations shall not be considered during technical evaluation. However if any issue in the commercial documents / deviation related to technical requirements needs to be highlighted and resolve in technical evaluation only.
No aspect of commercial issues needs to be highlighted / resolved in technical evaluation and their offer is strictly in compliance with technical specification. BHEL also clarified to the bidder any technical deviations (e.g. related to MDL, required documentation etc. for completion of the project) raised by them in commercial deviation either explicit or implicit shall be considered null and void even if agreed by BHEL during commercial evaluation stage.
Bidder agreed to confirm and compliance with technical specification and subsequent clarification on bids during pre- award discussion.



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SUB-SECTION-IIIC

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SUB SECTION-IIIC ELECTRICAL LOAD DATA

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
TG HALL EOT CRANE NO 1		180kW	S	1	0	D	S	N	I		AB BAY		Cable from isolating switch /change over switch (at 1.5mtr from operating floor level) to DSL / junction box and onwards shall be in bidder's scope.				Feeder/s shall be sized to cater to cumulative requirement for TG hall EOT crane 1 & 2 together.	
TG HALL EOT CRANE NO 2		180kW	S	1	0	D	S	N	I									
NOTE:-Signed and stamped copy of this electrical load data shall be furnished by bidder along with bid. In event of ordering, above load data shall be considered as final and inputs for switchgear sizing shall be furnished to concerned electrical agency based on this electrical load data. Hence, no change in this load data shall be accommodated during detail engineering.																		
NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL) 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)																		
	LOAD DATA (ELECTRICAL)	JOB NO.	412		ORIGINATING AGENCY		PEM (ELECTRICAL)											
		PROJECT TITLE	2 x 660 MW ENnore SEZ STPP AT ASH DYKE OF NCTPS, CHENNAI		NAME		DATA FILLED UP ON											
		SYSTEM	DOUBLE GIRDER EOT CRANE (225/45T)		SIGN.		DATA ENTERED ON											
		DEPTT. / SECTION	ELECTRICAL		SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE											



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SECTION-III

SUB-SECTION-IIID

REV 00

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SUB SECTION-IIID DEVIATION SCHEDULE

		DEVIATION SHEET (COST OF WITHDRAWAL)							
		PROJECT:-2 x 660 MW ENNORE SEZ STPP AT ASH DYKE OF NCTPS, CHENNAI							
		PACKAGE:- DOUBLE GIRDER EOT CRANES							
		TENDER ENQUIRY REFERENCE:-							
SPECIFICATION NO PE-TS-412-501-A001								VOLUME III	
NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION / TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
		In case of no deviation, the same is to be mentioned here. Otherwise, clause wise devaitons along with cost of withdrawal of deviation, if applicable shall be furnished in sealed envelope along with Original price bid.							
		However, the same shall be indicated as 'Quoted' under column 'Cost of Withdrawal of Deviation' along with technical offer/ un-priced bid.							
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				DESIGNATIONS		SIGN & DATE			
NOTES:									
1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of									

5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.



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BIDDER**

SPECIFICATION No: PE-TS-412-501-A001

VOLUME: III

SECTION-III

SUB-SECTION-IIIE

REV 00

DATE 02.11.16

SUB SECTION-IIIE PRE BID CLARIFICATION SCHEDULE



**2 x 660 MW ENNORE SEZ STPP
AT ASH DYKE OF NCTPS, CHENNAI
DOUBLE GIRDER EOT CRANE (225/45T)**

**DOCUMENTS TO BE SUBMITTED BY
BIDDER**

SPECIFICATION No: PE-TS-412-501-A001

VOLUME: III

SECTION-III

SUB-SECTION-IIIE

REV 00

DATE 02.11.16

PRE-BID CLARIFICATION SCHEDULE

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

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

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL