

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

**UPPUR TPP BTG
(2 X 800 MW)**

**TECHNICAL SPECIFICATION FOR D/G EOT CRANES
FOR TG HALL (250/55 T)**

SPECIFICATION NO.: PE-TS-425-501-A001



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA
INDIA**

	TANGEDCO UPPUR TPP BTG (2 X 800 MW) DOUBLE GIRDER EOT CRANES FOR TG HALL (250/55 T)	SPECIFICATION No: PE-TS-425-501-A001	
		SECTION	
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		SHEET :	

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SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA – Specific Technical Requirement (Mechanical)

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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, lubricants & consumables, packing, forwarding and transportation to site, unloading, storage & handling at site, preservation, security / safety at site, erection, commissioning and final load test at site and handing over to BHEL's customer of Two (2) nos. **DOUBLE GIRDER EOT CRANES FOR TG HALL (250/ 55T)** with operator's cabin and necessary accessories including supply of mandatory spares, erection and commissioning spares, maintenance tools and tackles, operation and maintenance of cranes for 16 x 7 hours operation and maintenance of crane for 24 months after load testing at site for **2X800 MW UPPUR TPP BTG**.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. **Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection & commissioning and load testing of the cranes and its accessories.**
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.



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

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

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

1.12 The standard quality plan is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan's minimum requirement during manufacturing and testing.

1.13 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 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.

1.14 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



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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: -

- a. Bridge girders
- b. End carriages with wheels
- c. Crab (trolley)
- d. Cross Travel & Long Travel drive arrangement
- e. Operator's cabin
- f. All electrical equipment including cables, cable tray, junction box, VVVF drive, RRC & pendent and panels etc.
- g. PVC insulated shrouded bus bar conductor type DSL, collector trolleys with all fittings and connection
- h. Earthing arrangement
- i. One (1) no 3.5 Core Power copper flexible cable (length- Half the bay length + 25m) of suitable size as per load calculation for commissioning, testing & operation of EOT Crane till such time the DSL is charged.
- j. Fill of lubricant till commissioning of cranes
- k. Painting of cranes and accessories
- l. Rail including all accessories and end stoppers
- m. Maintenance tools & Tackle
- n. Erection & Commissioning spares
- o. Mandatory Spares
- p. Control from cabin, Pendent push button & Radio Remote control
- q. Main Isolating switch in enclosure at operating floor for disconnecting



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supply to DSL while maintaining the crane.

- r. Two nos. isolating switch 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
- s. Slings and cradle for load testing on returnable basis

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 its use. The items supplied shall be of the best quality. The minimum requirement of mandatory spare parts is listed in Annexure –II section-IA of this specification.

1.1.6 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; oil etc. till commissioning of the cranes shall also be supplied by the bidder.

1.1.7 PACKING AND TRANSPORTATION:

Packing, forwarding and transportation to site.

1.2.0 SCOPE OF SERVICES:

It shall include unloading/ loading at site, site storage and preservation, all consumables like welding electrodes, oil, grease, paints etc, erection, testing and commissioning, field acceptance testing, training of the Employers personnel (if applicable), load testing at site and handing over to Employer of Two (2) nos.



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1.2.1 Unloading, storage and handling at site.

The Bidder shall provide means for all unloading and reloading for all consignments of plant; both during transport to Site and on the Site. Consignments shall be unloaded immediately on arrival at Site. The Bidder is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc. The following parts shall be stored inside enclosed warehouses: Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, electric motors and excitation equipment, instruments, welding material and equipment, all small parts and all parts of the crane which already have been finally painted. If large parts are stored in the open air, they shall be provided with weather resistant and fire & resistant covers. Electrical parts, which are not packed in heavy duty polyethylene foil and those so packed, but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation. All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity. All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers.

1.2.2 Erection, Commissioning, Training & Site tests:

Erection & Commissioning of EOT cranes shall be carried out by the vendor in minimum possible time with the help of his qualified engineers & skilled manpower with his own tools and tackles. Following bare minimum responsibilities are to be taken care of:

1.2.2.1 Erection & commissioning of all the mechanical & electrical equipments and systems. All tools, tackles, winches, mobile crane etc. required for shall be arranged by the vendor at his own cost The Details of the tests are given in attached Quality Assurance Plan of EOT Crane.

1.2.2.2 Tests during installation and pre commissioning



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1.2.2.3 Commissioning Tests: The Details of the tests are given in attached reference Quality Plan of EOT Crane. Bidders' scope of work shall also include, arranging the statutory clearance from the concerned Government body/Authority. 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. The Test Load for the load test at Site shall be provided by BHEL within a radius of 1 KM from BHEL's storage space. Transportation, handling etc. of test loads from their location to the power house and back to their original location shall be done by the bidder. Cradle and slings required for load testing shall be in Bidder's scope on returnable basis.

1.2.2.4 Training to customer's O&M staff

1.3.0. PAINTING & COLOUR SCHEME

As per Annexure IV, section-IA of this specification

1.4.0 Works Excluded

Supply feeders and cable from supply feeder to Changeover isolating switch of cranes.

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

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

1.6.0. 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



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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.

1.7.0. Makes of Sub - Vendor items

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

1.8.0 Parameter and tolerances

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

1.9.0 Performance Test requirement

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

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

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

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

1.10.0 Operation and maintenance services – refer Annexure-A

1.11.0 Quality assurance, Inspection & Testing

1.11.1 Inspection and Testing

Bidder shall submit QAP based on the guidelines given in the Annexure-VIII of the specification



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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
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.'



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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

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:



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- 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.

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. Annexure-VII should be referred for details of Load/ Overload test to be conducted at manufacturer's works and at site.
- iii. All Other tests as per IS-3177.
- iv. Speed test at rated load for hoisting, CT and LT mechanism.
- v. Brake test.
- vi. Any other test as per IS-3177
- vii. The test shall be carried out with actual panel, RRC, Master Controller etc.

Procedure No. PEM (Q)/001 (As mentioned at point no. 1.11.1 (v) above)

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



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	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 as 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 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.



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	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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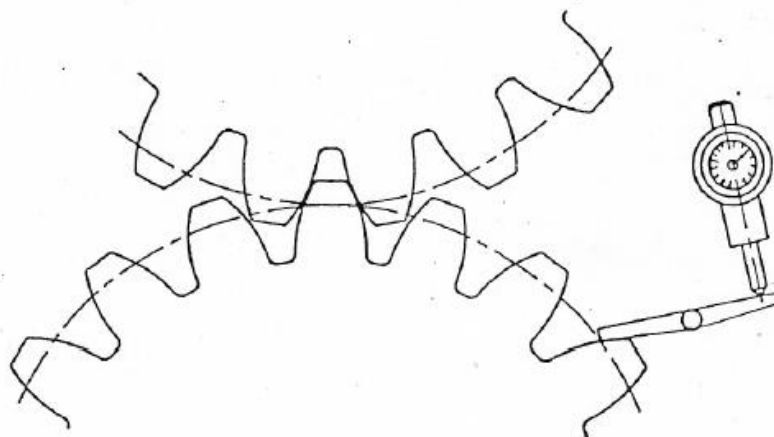


FIG.1 MEASUREMENT OF BACKLASH

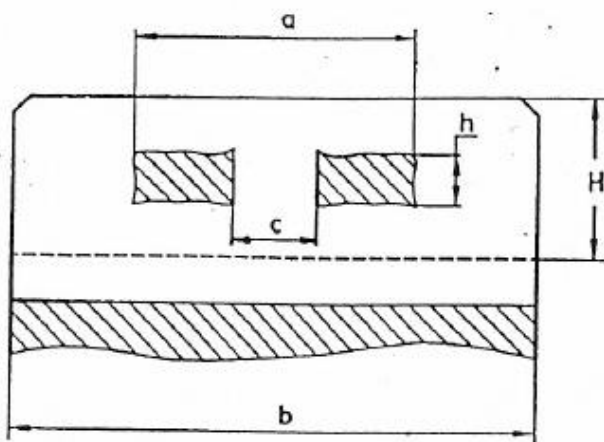


FIG.2 AREA OF CONTACT OF GEAR TEETH

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 all modules 1 to 50
			For Drum gears
			For all modules 2.5 to 50



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-	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



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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 of Two numbers 250 T/55T Double Girder Crane for TG hall EOT cranes for two years after successful erection, commissioning & load testing. 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



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	isolator switch etc.
Lubrication	All gear box and thrusters' oil level will be checked. All bearings, couplings' grease will be checked.
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.

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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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		



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



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		ELLORA		
		BAJAJ		
		PHILIPS		
		APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLINE 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	
19.	PVC POWER CABLES	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	
		ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
20.	PVC CONTROL CABLES	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	



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		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
21.	TRAILING CABLES	UNIVERSAL CABLES LTD	SATNA	
		NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
22.	XLPE POWER CABLES	SUYOG ELECTRICALS LTD	VADODARA	
		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	



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		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
23.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	



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24.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
25.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		
26.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
27.	MASTER CONTROLLER	SPEED-O-CONTROL		
		ELECTROMAG		
28.	SAFETY SWITCHES	ALSTOM		
		L&T		
		SIEMENS		
29.	PENDENT PUSH BUTTON STATION	OEM		
30.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		
		STANDARD		
31.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER		
32.	PANELS	OEM		
		RITTAL		
		PYROTECH		
33.	RESISTANCE BOXES	ENAPROS		
		OEM		
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD.		
		ASHOKA ENGINEERING COMPANY		
		KANADIA FYR FYTER PVT. LTD		
		NITIN FIRE PROTECTION INDUSTRIES LTD		
		NEW ENGINEERING		



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		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		
37.	ANTI COLLISION DEVICE	ELECTRONIC SWITCHES INDIA		
38.	LOAD CELL	IPA		
		SARTORIUS		
39.	RRC	ACROPOLIS ENGINEERING	-	
		SNT CONTROLS	-	
40.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
		BONGFILIOLI*		
41.	RAIL	JSPL		
		SAIL		

NOTE:

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



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ANNEXURE – II (LIST OF MANDATORY SPARES)

(Spares below are listed for one crane, spares are to be provided for two cranes)

Sl. no	Description	Quantity
1	SPARES FOR LONG TRAVEL UNIT	
A	SET OF AXLE BEARINGS	1 SET
B	SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
C	LONG TRAVEL END SHAFT BEARING	1 SET
D	COUPLING	1 SET
E	SEALS FOR TRAVEL GEAR BOX	1 SET
F	LONG TRAVEL BRAKE SHOES	1 SET
G	LONG TRAVEL BRAKE SPRINGS	1 SET
H	LONG TRAVEL BRAKE SHOE LINERS	1 SET
2.	SPARES FOR CROSS TRAVEL UNIT	
A	AXLE BEARINGS	1 SET
B	SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
C	SET OF SEALS FOR GEARBOX	1 SET
D	CROSS TRAVEL END SHAFT BEARING	1 SET
E	COUPLING	1 SET
F	CROSS TRAVEL BRAKE SHOES	1 SET
G	CROSS TRAVEL BRAKE SPRINGS	1 SET
H	CROSS TRAVEL BRAKE SHOE LINERS	1 SET
3.0	SPARES FOR MAIN HOIST	
A	MAIN HOIST PULLEY BEARINGS	1 SET
B	SET OF BEARINGS FOR ROPE DRUM	1 SET
C	SET OF BEARINGS FOR GEAR BOX	1 SET
D	SET OF SEALS FOR MAIN HOIST	1 SET
E	MAIN HOIST BRAKE SHOES	1 SET
F	MAIN HOIST BRAKE SPRINGS	1 SET
G	MAIN HOIST BRAKE SHOE LINERS	1 SET
H	DISC PAD	1 SET
4.0	SPARES FOR AUXILIARY HOIST	
A	AUX HOIST PULLEY BEARINGS	1 SET
B	SET OF BEARINGS FOR ROPE DRUM	1 SET
C	SET OF BEARINGS FOR GEAR BOX	1 SET
D	SET OF SEALS FOR AUX HOIST	1 SET
E	AUX HOIST BRAKE SHOES	1 SET
F	AUX HOIST BRAKE SPRINGS	1 SET
G	AUX HOIST BRAKE SHOE LINERS	1 SET
H	PAIR OF SLINGS	1 SET
I	DISC PAD	1 SET
5.0	ELECTRICAL: CONTROL PANELS/MOTORS	



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A	POWER CONTACTOR OF EACH RATING	2 NOS
B	OVER LOAD RELAYS OF EACH RATING	2 NOS
C	MCCB/MPCB OF EACH RATING	2 NOS
D	PUSH BUTTON OF EACH TYPE	2 NOS
E	SPARES FOR VVVF DRIVE OF EACH RATING	AS REQUIRED
F	SET OF BEARINGS FOR MAIN HOIST MOTOR	1 SET
G	SET OF BEARINGS FOR AUX HOIST MOTOR	1 SET
H	SET OF BEARINGS FOR CROSS TRAVEL MOTOR	1 SET
I	SET OF BEARINGS FOR LONG TRAVEL MOTOR	1 SET

Notes

- a) One (1) set means 100% requirement for one crane.
- b) In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as per the list.
- c) Any item which is quoted as "not applicable" in the above list and is found to be "applicable" at a later date shall be supplied by the Bidder without any commercial implications.
- d) Any change or variation in equipment or systems during detailed engineering stage which would cause changes / variations in the essential spares, shall be supplied by Bidder without any commercial implications.
- e) Mandatory spares shall not be dispatched before dispatch of corresponding main equipment.
- f) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.
- g) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
- h) The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
- i) Each spare part shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.
- j) The Bidder shall note that if there is any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.



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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 : Deutshes 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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(2 X 800 MW)
DOUBLE GIRDER EOT CRANES FOR TG HALL
(250/55 T)

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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

Removal of impurity

a) Dust, loose deposits: Vacuum-cleaning, brushing

c) Adhesive deposits: Power brushing

d) Oils, greasy impurities: Wet blasting, use of detergent additives by agreement

e) Salt deposits: Rinsing

f) Markings (e.g., felt up pen): 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 manufacturer's 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.



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(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.

(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 SHADE

S. N.	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow Shade: 356 as per IS:5	Colour band: Black
2	Bottom block assembly	Crimson shade: 540 as per IS:5	
3	Hooks	Crimson shade: 540 as per IS:5	
4	End carriage sweep	Golden yellow shade: 356 as per IS:5	Colour band: Black
5	Panels	Light grey 631 as per IS:5/ 7032	
6	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-V0-425-501-A301	Manufacturing Quality Plan with sub vendor list For TG Hall Crane	A	3
2	PE-V0-425-501-A303	Data sheet of motors for TG Hall Crane	I	6
3	PE-V0-425-501-A304	Mechanism Sizing Calculation Including storm brake calculation for TG Hall Crane	A	3
4	PE-V0-425-501-A305	General arrangement for TG Hall Crane with CT DSL details	A	3
5	PE-V0-425-501-A306	Crab sub assembly for TG Hall crane with CT wheel assembly	I	4
6	PE-V0-425-501-A308	General arrangement for PVC shrouded DSL for TG Hall crane	I	3
7	PE-V0-425-501-A309	Main and Auxiliary hook block assembly with details of hook, nut and check plate For TG Hall Crane	I	4
8	PE-V0-425-501-A310	Long travel Machinery Assembly with LT wheel assembly For TG Hall Crane	I	4
10	PE-V0-425-501-A312	Structural calculations For TG Hall Crane	A	4
11	PE-V0-425-501-A314	O & M Manual For TG Hall Crane	I	10
12	PE-V0-425-501-A315	Detailed BOM/BOQ for TG Hall Crane	I	8
13	PE-V0-425-501-A316	Electrical equipment layout in cabin for TG Hall crane	I	5
14	PE-V0-425-501-A317	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Aux. hoist panel & BOM d) Cross Traverse & BOM e) Long Traverse & BOM Including earthing diagram For TG Hall Crane"	A	5
15	PE-V0-425-501-A318	"General Arrangement of a) Protective panel b) Main hoist panel c) Aux. hoist panel d) Cross Travel panel e) Long Traverse travel panel. f) Pendent g) Remote Radio Control For TG Hall Crane"	I	5
16	PE-V0-425-501-A319	Cable Sizing and cable schedule For TG Hall Crane	A	6
17	PE-V0-425-501-A320	Crane Operational write up For TG Hall Crane	I	5



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18	PE-V0-425-501-A321	Type test certificate (for motors) For TG Hall Crane	A	8
19	PE-V0-425-501-A323	Mandatory spare parts list For TG Hall Crane	A	8
20	PE-V0-425-501-A325	Erection procedure For TG Hall Crane	I	8
22	PE-V0-425-501-A327	Data sheet of TG Hall Crane with painting details	A	3
23	PE-V0-425-501-A330	Electrical load for TG Hall EOT Crane	I	8
24	PE-V0-425-501-A332	Gantry Rail installation for TG Hall crane	I	3
25	PE-V0-425-501-A350	Crane lubrication drawing For TG Hall Crane	I	6
LEGENDS				
A= Approval category				
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.



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- e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.
- f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
- g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
- h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
- i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- j) Bidder to follow the following the drawing submission schedule:
 - i. 1st submission of drawings from date of LOI as per the submission schedule.
 - ii. Every revised submission incorporating comments – within 7 days.
- k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.



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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. Resisters in the circuit will be checked for any overheating of the element.
- Overload relays will be checked for proper functioning.

Hoisting & Cross Travel motions:

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



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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.

		MANUFACTURER'S NAME & ADDRESS			ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)				PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP					
					ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL				QP NO : PE-TS-424-501-A301 REV : 0 DATE :		PACKAGE : DOUBLE GIRDER CRANES (250/55T) CONTRACT NO : CONTRACTOR : 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	
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		P			
									inspection					
									report					
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	
			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	
									QW-484 ASPER				CUSTOMER APPROVED WPS AND QUALIFIED WELDERS ACCEPTABLE.	
									asme Sec-IX					
b	Back chipping		surface defect	Major	DPT	100%	ASME Sec-VIII,	ASME Sec-VIII,	Vendor insp.		P	V	V	
							Div-I, Appen - 8	Div-I, Appen - 8	Report					

		MANUFACTURER'S NAME & ADDRESS			ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)			PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP							
					ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL		QP NO : PE-TS-424-501-A301 REV : 0 DATE :		PACKAGE : DOUBLE GIRDER CRANES (250/55T)						
								CONTRACT NO : CONTRACTOR : VENDOR' S QAP No :							
SL. NO.	COMPONENTS & OPERATION		CHARACTERISTCS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY M C N			REMARKS	
1	4		3	4	5	6	7	8	9	D*	**	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 flims . Refer note: 2	
					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	DP test of filletweld for ropedrum to be conducted after final machining Random witness by BHEL
										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	100%	ASME Sec-VIII, Div - I	ASME Sec-VIII, Div - I	SR Chart	√	P	V	V	If fabricated from M.S Plate	
					chart										
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	100%	IS:2062	IS:2062							
					in absesnce of T.C. Correlation										

		MANUFACTURER'S NAME & ADDRESS			ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)			PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP					
					ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL			QP NO : PE-TS-424-501-A301 REV : 0 DATE :		PACKAGE : DOUBLE GIRDER CRANES (250/55T) CONTRACT NO : CONTRACTOR : 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
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			ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)			PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP						
					ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL		QP NO : PE-TS-424-501-A301	PACKAGE : DOUBLE GIRDER CRANES (250/55T)						
							REV : 0	CONTRACT NO :						
							DATE :	CONTRACTOR :						
								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
1	4		3	4	5	6	7	8	9	D*	**	10	N	11
	i) raw material		Chemicals composition and	Major	Corelation with	100%	Mfg.drg./IS:1570	Mfg.drg./IS:1570	Test	√	P	V	V	Refer Note:1
			Mechanical Prooporties.		mfr's TC		/ BS - 970	/ BS - 970	Certificate					
	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 ,		i) Chemicals Composition	Major	Correlation with	100%	Component Drawing,	Component Drawing,	Vendor insp.	√	P	V	V	
	Pinions, Shafts,Axles etc		& heat treatment, Physical		mfr's TC		BS : 970 / IS : 1570	BS : 970 / IS : 1570	Report					
			Properties.		Check test in		Approved Data Sheet	Approved Data Sheet						
					absence of TC									
			ii) UT (after proof machining)	Major	check for UT	100%	ASME Sec-V	Refer Note 6	Vendor insp.	√	P	V	V	Hardness witnessing by BHEL before teeth cutting.
					(above 50mm dia)				Report					
			iii) Hardness	Major	check for	100%	Mfg. drg. &	Mfg. drg. &	Vendor insp.	√	P	W	V	
					Hardness		Approved Data	Approved Data	Report					
			iv) Dimensions	Major	Measurement	100%	Component Drawing	Component Drawing	Vendor insp.	√	P	V	V	
									Report					
			V) D.P.Test on teeth	Major	NDT	100%	ASTME-165	No Crack and line of indication	Vendor insp.	√	P	V	V	
									Report					
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	100%	Components Drawing	Components Drawing	Mfr's T.C.	√	P	V	V	
					mfr's TC									
	ii) Machined		a) Dimensions	Major	Measurement	100%	Components Drawing	Components Drawing	Vendor insp		P	V	V	
									report					
			b) DPT after machining.	Major	NDT	100%	ASTM E-165	No. crack /Liner	Vendor insp.	√	P	V	V	
								indication	Report					
C	Gear box assy & idle running		Check for oil leakage,Noise level,vibration , rise in temp. after 2 Hrs. of running.	Major	Visual & Measurement	100%	Vendor standard	Smooth running no oil leakage, Noise	Vendor insp.	√	P	V	V	
								85 db at 1 Mtr.						
			reduction ratio, backlash and contact pattern					Max. Temp. rise						
								40°C above amb						

		MANUFACTURER'S NAME & ADDRESS			ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)				PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP					
					ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL		QP NO : PE-TS-424-501-A301 REV : 0 DATE :	PACKAGE : DOUBLE GIRDER CRANES (250/55T) CONTRACT NO : CONTRACTOR : VENDOR' S QAP No :						
SL. NO.	COMPONENTS & OPERATION		CHARACTERISTCS	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
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 Certifacte , 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	

		MANUFACTURER'S NAME & ADDRESS		ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)				PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP					
								PACKAGE : DOUBLE GIRDER CRANES (250/55T)					
				ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL		QP NO : PE-TS-424-501-A301		CONTRACT NO :					
						REV : 0		CONTRACTOR :					
						DATE :		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
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,											for verification.
		Thickness, adhesive test,											
		Component fixing, Degree of protection by paper inserting method											
d)	Radio remote, Master controller	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	Major	Measurement	100%	GA drg/IS:3177	GA drg/IS:3177	Vendor insp.	√	P	W	V	
		alignment						report					
b)	Crab assembly	Dimesions, wheel level	Major	Measurement/	100%	GA drg/IS:3177	GA drg/IS:3177	Vendor insp.	√	P	W	V	
		alignment		Visual				report					
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	

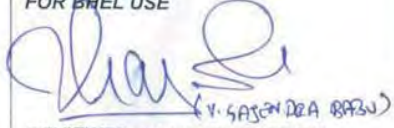
		MANUFACTURER'S NAME & ADDRESS				ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)		PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP						
						ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL		QP NO : PE-TS-424-501-A301 REV : 0 DATE :		PACKAGE : DOUBLE GIRDER CRANES (250/55T)				
								CONTRACT NO :						
								CONTRACTOR :						
								VENDOR' S QAP No :						
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTCS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D*	M	C	N	REMARKS	
1	4	3	4	5	6	7	8	9		**	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 report	√	P	W	W		
		d) Operation check of brakes and limit switches .		Check		Tech. Specification	Tech. Specification	report						
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			ANNEXURE-VIII MANUFACTURING QUALITY PLAN (FOR REFERENCE ONLY, SHALL BE FINALISED AFTER PLACEMENT OF ORDER)				PROJECT : 2X800 MW TANGEDCO UPPUR BTG TPP				
					ITEM: 250/55T DOUBLE GIRDER EOT CRANES FOR TG HALL		QP NO : PE-TS-424-501-A301 REV : 0 DATE :		PACKAGE : DOUBLE GIRDER CRANES (250/55T)				
									CONTRACT NO :				
									CONTRACTOR :				
									VENDOR' S QAP No :				
SL. NO.	COMPONENTS & OPERATION		CHARACTERISTCS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY M C N			REMARKS
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										
MANUFACTURER/		CONTRACTOR	C: BHEL-CQS/THIRD PARTY										
			INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW										
SUBCONTRACTOR													
SIGNATURE			N : TANGEDCO/DESEIN PRIVATE LIMITED					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 | : | Probe dia 24mm, 2MHz, 4MHz (NB)
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. |

 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. : 1 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	
1	RECEIPT & STORAGE EOT Crane after arrival at site. a. Check manufacturers dispatch documents at site, MDCC, CHP etc. for completeness, identification. b. Check for coating condition of rust inhibitor check and any transit damage 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. d. Electrical items like panel, cables, motor, controls & resistance block in closed, covered shed.	Record Verification Visual Physical Physical	Visual Visual Visual Visual	B B B B	100% 100% 100% 100%	Drawings / Tech. Spec. Drawings/Tech. Spec/ No. Damage Storage & Preservation Procedure. Storage & Preservation Manual	Protocol Protocol Protocol Protocol		
2	PRE-ERECTION CHECK a. For Gantry at every 5.0 M i.e. span, level, diagonals before taking over from Client b. Web axes of gantry girders in a row are aligned. c. Center to center distance of gantry girders.	Measurement Measurement Measurement	Tape, Water level Water level Measuring Tape	A B B	100% 100% 100%	Drawings Drawings/ER Manual Drawings/ER Manual	Protocol Protocol 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		
	e. End Stopper Arrangement	Physical	-	A	100%	Drawing	Protocol		
4	ERECTION CHECK FOR								
	a. Joining of Girders i.e. splice joints	Physical	-	B	100%	Tech. Spec.	Protocol		
	b. Placement of girder assembly on the gantry.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol		
	c. Movement of wheels	Physical	-	B	100%	Drawings/Tech Spec.	Protocol		
	d. Placement and positioning of electrical panel & trolley.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol		

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

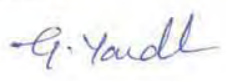
PREPARED BY

FOR BHEL USE

REVIEWED AND APPROVED BY

FOR CUSTOMER USE

APPROVED BY

 PSSR-QUALITY		SUPPLIER'S NAME & ADDRESS		STANDARD FIELD QUALITY PLAN					
		BHEL, PS-SR, 690, Anna Salai, Chennai-600035		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		
7	Crab Clearances								
	a. Headroom, end clearance, hook approaches and height of lift and record.	Visual & Measurement	Measuring Tape	B	100%	Drawing	Protocol		
8	Gear Box								
	a. Check oil level	Measurement	Dip stick	B	100%	Drawing	Site log Book		
9	LT Machinery, Platform, cabin, Electrical equipment, other structural components, limit switch & Mechanical stopper.								
	a. Fit up	Visual	-	B	100%		Protocol		
	b. Alignment	Visual	-	B	100%	Drawing	Protocol		
10	Hydraulic rail clamp arrangement	Physical	-	A	100%	Drawing	Protocol		
11	COMMISSIONING CHECKS								
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  PREPARED BY		FOR BHEL USE  REVIEWED AND APPROVED BY		FOR CUSTOMER USE  APPROVED BY		

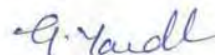
 PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS BHEL, PS-SR, 690, Anna Salai, Chennai-600035	STANDARD FIELD QUALITY PLAN						
		SYSTEM : EOT Crane 225/45T Cap.			QP NO. : QIP/BOP/001 REV. No. : 00 PAGE No. : 4 of 4			
		AREA : TG HALL						
SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / 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		-					
(only watching all motion)	Visual		A	100%	As per procedure	Protocol	
j. Hydraulic rail clamp arrangement	Physical	-	A	100%	Drawing	Protocol	
k. Touch Up Painting.	Visual	-	C		As per approved shade	Records	

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



PREPARED BY

FOR BHEL USE



REVIEWED AND APPROVED BY

FOR CUSTOMER USE

APPROVED BY

CHAPTER – 3

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)



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- (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



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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



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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 at least 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



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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

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- 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



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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



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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



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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



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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 clearance of the project is at an advanced stage

Hence, it is stated that the implementation of Environmental measures including self monitoring system (for air, Water and land) , 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.



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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-II

(Total within 52 man months)

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
STEAM GENERATOR	Thermal design and hydraulic circulation balance	Familiarization with various system and equipment	Manufacturing processes of pressure parts, and equipment	Control philosophy operation, notices, logic & protection schemes, O&M manual familiarization O&M issues
	Combustion and Air & gas weight calculation	Performance data collection analysis and review	Welding process	
	Pressure part calculation	O&M feed back	Testing facilities	Familiarization of special maintenance techniques.
	Pressure part and strength calculation	Operation history of various equipment and system	Product development in process	Special tool and tackles familiarization
	Tube metal temp. calculation and selection.	Failure analysis	Future plan for technology induction	
	Performance calculation		R&D work in progress	
	Duct design.			
	Pressure part			



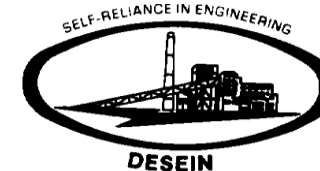
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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Equipment and system sizing and selection of mills, fans, airpreheater, soot blowers, dampers, valves heater, soot blowers, dampers, valves, feeders, burners startup system, fuel firing system, draft plant Flow scheme develop- ment of air & flue gas, fuel oil, auxiliary steam, main and reheat steam feed water.			
	Layout of over all plant, steam generator area, pressure part arrangements, platforms, equipment, piping and duct, coal pipe, flue gas ducts, bunker arrangement, valves and damper, ESP area, cable & piping tressels etc.			
	Erection strategies, erection procedures			
	Performance and demonstration tests.			
MANDAYS	120	20	20	20
CFD model development and validation for Steam Generator	Familiarisation of fundamentals and basis for the development of the CFD models.			
	Solving of set of simple problems by Employer's engineers with the help of trainer.			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Hands on experience on the development of detailed/realistic CFD models for the steam generator and ESP. The Bidder/trainer shall develop CFD models for SG & ESP as per the Contract requirement with complete association of the Owner's engineers.			
	Validation of the above CFD model for SG & ESP by Bidder in association with the Owner's Engineers.			
MANDAYS	120 for SG and 60 for ESP	-	-	-



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
TURBINE GENERATOR AND IT'S INTEGRAL AUXILIARIES	Turbine cycle optimization and turbine performance in off design condition. Rotor design and strength calculation Rotor dynamic behavior studies wrt natural frequency, critical speed, vibration etc. Blade profile/root design and blade strength design, blade vibration analysis Casing & diaphragm design Labyrinth seal selection & design for different turbine configurations Selection of turbine type (i.e. Tandem vs cross compounding, separate HP/IP vs combined HP/IP, material of construction etc.)	Familiarization of power plants of various makes of turbines for super critical units Collection of data for analysis of availability of turbines Comparative studies for integral systems of turbine O&M history/problems related to turbine Failure analysis	Manufacturing processes of turbine Assembly of turbine Testing of turbines Product development in process Future plan for technology induction R&D work in progress	



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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Design principle for Up rating/down rating of existing design/ modules for the specific project.			
	Selection of nos., type and arrangement of bearings, load calculation on bearings, bearing oil flow calculation Selection, design and control principle for Turbine governing system Performance calculation Steam path audit Layout principle of various equipment's of TG and its integral system Latest technological advancements			
MANDAYS	45	10	10	
Boiler Feed Pumps	Techno-economic syudies for Selection of BFP Configuration and its drive Criteria for selection of boiler	Familiarization of power plants of various makes of feed pumps Data collection of BFP	Manufacturing process of various components of BFP Assembly of BFP	



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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Feed Pump parameters Rotor design, strength calculation and rotor dynamic behavior studies wrt critical speed, vibration etc	parameters and configuration Collection of data for analysis of availability of BFP	Testing, capabilities of BFP at works wrt performance, NPSH, thermal shock, dry run, visual cavitation, string test, axial thrust measurement	
	Impeller design and its hydraulic behavior Role of critical parameters such as NPSH(R), Suction specific speed, running clearances, speed etc. in design of feed pumps Material selection of BFP components Guiding factors for selection of BFP seals Computation of axial thrust under various flows Performance calculation Transient analysis in pump	O&M history/problems related to BFP Comparative studies for various types of BFP & its features	Product development in process Future plan for technology induction R&D work in progress	



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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	suction piping wrt NPSH margin Latest technological trends in BFP design			
MANDAYS	20	5	10	
Condenser	Selection of condenser type and its optimization wrt temp rise across condenser, pressure drop in condenser, surface area etc.	Comparative studies of salient features	Manufacturing process of various components of condenser Assembly	
	Techno economic studies for Selection of condenser tube material and other parts depending on water quality Condenser support selection & design Sizing of condenser w.r.t. super critical units Latest technological trends in condenser arrangement and design Condenser vacuum system design	Collection of data for analysis of availability of Condenser O&M history/problems related to condenser	Testing capability at works Product development in process Future plan for technology induction R&D work in progress	



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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	10	5	5	
Feed Regenerative Equipment's	Thermal and mechanical design calculation of heaters Basis of selecting horizontal/vertical heaters Selection of TTD and DCAs for various heaters, and their effect on turbine heat rate Configuration of HP heaters (2x50% v/s100% capacity)	Comparative studies of salient features Analysis of data O&M history/problems related to heaters	Manufacturing process of various components of heaters Assembly Testing capability at works Product development in process	
	Sizing criteria for De-aerator/Heaters Selection of tube & tube sheet material of heaters Latest technological trends in heaters design		Future plan for technology induction R&D work in progress	
MANDAYS	15	10	10	
3-dimensional CFD modeling	CFD model development and validation of design data for steam turbine, BFP, CEP, condenser, heaters etc.			



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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	20			
Compressors	Equipment Theory & Maintenance Practice			
MANDAYS	16	-----	4	
Ash Handling System	Equipment Theory & Maintenance Practice			
MANDAYS	16	4	4	
Coal Handling System	Equipment Theory & Maintenance Practice			
MANDAYS	20	5	5	
H ₂ Plant	Equipment Theory & Maintenance Practice			
MANDAYS	10	3	3	
Condensate Polishing Unit	Equipment Theory & Maintenance Practice			
MANDAYS	15	5	5	



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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
CONTROL & INSTRUMENTATION				
DDCMIS-Man Machine Interface - Hardware & Operating System	Hardware & Software organization of the system Basis of selection of H/W memory sizing Operating system features, interface with other system, openness & inter- operability Upgradability System testing features	Operational feedback		
MANDAYS	24	6		16
DDCMIS-Man Machine Interface System Engineering & Application Software	Specific system customisation	Operation feedback		
	Various system			
	modules & interface with OS			
	Database organization & development			
	Development of mimics			
	Other application like calculations, logs historical storage functionalities & use			
MANDAYS	40	6		8



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
DDCMIS - Control System Hardware	Basic design features for system & its modules System capabilities & system design techniques Communication with MMI & other system	Operation feedback	Manufacturing processes special attention to handling of the modules Maintenance facilities	
MANDAYS	24	5	10	
DDCMIS-Control system Application Software	Database structure Organisation & inter- face between application program & database	Operational feedback	System integration & System capabilities testing	
	Application for implementation of Control functions			
	Study of standard algorithms & development of new algorithms			
MANDAYS	18	4	4	
DDCMIS - Control Loop Study Loop Study	General description of closed loop controls of thermal power plant	Specific operational feedback		
	Critical analysis of few control loops e.g., TSCS Stress Control boiler startup control etc.			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	12	4		
DDCMIS-Burner Management System	Hardware logic, NFPA/ VDE requirements other safety standard Flame scanner location	Operational feedback	Manufacturing procedure & precautions for handling the system System testing facilities	
MANDAYS	16	6	6	12
DDCMIS - EHTC, Turbine stress control system, Turbine protection system & ATRS	Basic design concept & features Logics of turbine stress control system Implementation of failsafe philosophy in turbine protection system	Operational feedback	Manufacturing procedure & precautions for handling for handling the system System testing facilities	
MANDAYS	16	6	6	12
Furnace and Flame Viewing System.	Theory & principle of operation Details of software & methods of modification/ customisation	Operational feedback		
Misc. systems for SG/TG C&I				



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	6	3		
BOP (DDCMIS)	Hardware organization		Manufacturing process of PLC hardware	
	Operating system features		Integration & testing facilities	
	Data base organization			
	Logic/loop algorithm Development of control logic & loop s/w & MMI application development			
MANDAYS	24	-	6	
BOP System Controller				
1) Hard Ware	Equipment Theory & Maintenance Practice			
MANDAYS	30	10	10	
2) Soft Ware	Equipment Theory & Maintenance Practice			
MANDAYS	30	10	10	
VMS				
1) Hardware	Equipment Theory &			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Maintenance Practice			
MANDAYS	12	-	6	
2)Vibration Analysis	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	6	
Analyser				
Water & Gas	Equipment Theory & Maintenance Practice			
MANDAYS	20	-	8	
PADO: System Engineering	Equipment Theory & Maintenance Practice			
MANDAYS	6	3	3	
PADO: Operation & Analysis	Equipment Theory & Maintenance Practice			
MANDAYS	18	6	-	
Actuators	Equipment Theory & Maintenance Practice			
MANDAYS	18	-	6	
Simulator	Equipment Theory &			



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Maintenance Practice			
MANDAYS	16	-	4	
Networking / MIS	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	4	
Electric Power Supply System	Theory & design features		Manufacturing/assembly process	
			Testing methodology	
MANDAYS	5	2		



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
(ELECTRICAL) GENERATOR	(a) Design aspects of the following areas	- Operational feed back - Familiarisation with different sub-systems	(a) Manufacturing process for	
	- Insulation system		- Core	
	- Cooling medium & arrangement		- Winding bars	
	- Winding & core support systems		- Assembly	
	b) Design aspects of other auxiliary systems		(b) Testing facilities	
MANDAYS	30	15	15	
Generator Excitation System including AVR.	Design features of various sub-systems	- Operational feed back - Familiarisation with various equipment functioning at reference plants	- Manufacturing process & testing facilities for various equipment of excitation system	
	Excitor			
	PMG			
	Transformer			
	Controllers & different limiters etc.			
	PSS & associated system studies			
MANDAYS	30	15	15	



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
Boiler Feed pump H.T. Motor	Design Criteria for the Stator core & wdg Rotor core & wdg Insulation system Cooling arrangement	Operational feed back	Manufacturing process & test facilities	
MANDAYS	20		5	
POWER TRANSFORMER	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	4	4
UPS/BATTERY CHARGER	Equipment Theory & Maintenance Practice			
MANDAYS	8	-	4	4
GIS	Equipment Theory & Maintenance Practice			
MANDAYS	24	4	12	24
SAS	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	6	6



PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
CRITICAL PIPING & POWER CYCLE PIPING	Design familiarization for critical piping of supercritical Plant Optimization study for sizing including pressure drop calculation and selection of single or double lead together with Owner's engineers Design and stress analysis of lines with Expansion Joints together with Owner's engineers Design and stress analysis of piping systems with two phase flow involving Owner's engineers Transient analysis and optimum sizing of feed suction piping together with Owner's engineers.	Familiarization with feed back (in super critical plant) on failure analysis and vibration analysis of piping. Study of Feed back regarding hanger setting strategies and practice	Cold Setting of spring hanger Cyclic tests carried on spring hangers. Cyclic tests carried on expansion joints Manufacturing process of critical piping components and appreciation of their testing facilities at shop	



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PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Static and dynamic analysis of critical piping including seismic and other occasional load analysis (safety valve blowing condition). A joint activity together with Owner's engineers. Study and collection of data pertaining to special welding requirements (pre and post weld heat treatment and electrode selection criteria etc.) of materials used in high temp piping system. Study and collection of data on special requirements in case of welding dissimilar metals and electrode selection criteria			
MANDAYS	45	10	10	



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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

[illegible]

ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE (To be raised by the Bidder)							DOC. NO.:			
		Bidder :				Welding Code:							REV. NO.:			
		Bidder No. :											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																



2 x 800 MW Supercritical Coal Based Uppur Thermal Power Project

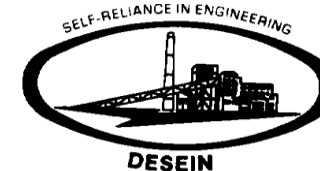
Spec. No
Vol. II:77

ANNEXURE-VI

MFGR.'s LOGO	MANUFACTURER'S AND ADDRESS	NAME		MANUFACTURING QUALITY PLAN				PROJECT :				
		ITEM :		SUB-SYSTEM:		QP NO.: REV.NO.: DATE: PAGE: OF....		PACKAGE :		CONTRACT NO. :		
								MAIN-SUPPLIER:				
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"	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, IDENTIFIED 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)	OWNER USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL
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**TAMILNADU GENERATION AND DISTRIBUTION
CORPORATION LIMITED
2X800 MW SUPERCRITICAL COAL BASED UPPUR
TPP**

**DOUBLE GIRDER CRANE
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**



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

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR DOUBLE GIRDER CRANE 2X800 MW SUPERCRITICAL COAL BASED UPPUR TPP	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO.: 00 DATE: 11.08.17
		SHEET: 1 OF 1

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C	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
C	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
C	EXPLANATORY NOTES FOR CABLE ROUTING	1
C	SUB VENDOR LIST (ANNEXURE-IV)	1
D	STANDARD SPECIFICATION FOR LT MOTORS	4
D	QUALITY PLAN (FOR MOTORS BELOW 55 KW)	2
D	QUALITY PLAN (FOR MOTORS ABOVE & 55 KW)	9
D	TECHNICAL SPECIFICATION FOR LT SWITCHGEAR	15
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**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER CRANE
(ELECTRICAL PORTION)**

SPECIFICATION NO.
VOLUME II B
SECTION-C
REV 0
PAGE 1 OF 2
DATE 11.08.2017

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

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

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

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet “Electrical Equipment Specification for DOUBLE GIRDER CRANE” and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
 - b) Electrical load requirement in the load data format .
 - c) If there is any conflict, customer motor specification will prevail over BHEL motor specification.



**TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER CRANE
(ELECTRICAL PORTION)**

SPECIFICATION NO.
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PAGE 2 OF 2

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

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.
- c) Datasheets & quality plan for motors.
- d) Electrical Load data format (Annexure –II)
- e) BHEL cable listing format (Annexure –III)
- f) Sub vendor list for motors (Annexure-IV)
- g) Technical specification for LT switchgear
- h) Electricals of EOT Cranes
- i) Technical specification for motors
- j) Technical specification LV cables
- k) Technical specification for control cables
- l) Technical specification cabling
- m) Technical specification for earthing & lighting protection

[illegible]

ANNEXURE III

[illegible]

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

ANNEXURE-IV

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

LV MOTORS (NON FLAME PROOF)	ABB
	BHARAT BIJLEE LTD.
	CROMPTON GREAVES
	GE-POWER
	KIRLOSKAR ELECTRIC CO LTD.
	LAXMI HYDRAULICS PVT. LTD
	MARATHON
	NGEF
	RAJINDRA ELECT INDUSTRIES
	SIEMENS
LV MOTORS (FLAME PROOF)	RAJINDRA ELECT INDUSTRIES

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101																														
		VOLUME NO. : II-B																														
		SECTION : D																														
		REV NO. : 00 DATE : 29/08/2005																														
		SHEET : 1 OF 4																														
1.0 INTENT OF SPECIFIATION The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station. Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.																																
2.0 CODES AND STANDARDS Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards: <table><tr><td>IS:325</td><td>Three phase Induction motors</td></tr><tr><td>IS : 900</td><td>Code of practice for installation and maintenance of induction motors</td></tr><tr><td>IS: 996</td><td>Single phase small AC and universal motors</td></tr><tr><td>IS: 4722</td><td>Rotating Electrical machines</td></tr><tr><td>IS: 4691</td><td>Degree of Protection provided by enclosures for rotating electrical machines</td></tr><tr><td>IS: 4728</td><td>Terminal marking and direction of rotation rotating electrical machines</td></tr><tr><td>IS: 1231</td><td>Dimensions of three phase foot mounted induction motors</td></tr><tr><td>IS: 8789</td><td>Values of performance characteristics for three phase induction motors</td></tr><tr><td>IS: 13555</td><td>Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment</td></tr><tr><td>IS: 2148</td><td>Flame proof enclosures for electrical appliance</td></tr><tr><td>IS: 5571</td><td>Guide for selection of electrical equipment for hazardous areas</td></tr><tr><td>IS: 12824</td><td>Type of duty and classes of rating assigned</td></tr><tr><td>IS: 12802</td><td>Temperature rise measurement for rotating electrical machnines</td></tr><tr><td>IS: 12065</td><td>Permissible limits of noise level for rotating electrical machines</td></tr><tr><td>IS: 12075</td><td>Mechanical vibration of rotating electrical machines</td></tr></table> In case of imported motors, motors as per IEC-34 shall also be acceptable.			IS:325	Three phase Induction motors	IS : 900	Code of practice for installation and maintenance of induction motors	IS: 996	Single phase small AC and universal motors	IS: 4722	Rotating Electrical machines	IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines	IS: 4728	Terminal marking and direction of rotation rotating electrical machines	IS: 1231	Dimensions of three phase foot mounted induction motors	IS: 8789	Values of performance characteristics for three phase induction motors	IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment	IS: 2148	Flame proof enclosures for electrical appliance	IS: 5571	Guide for selection of electrical equipment for hazardous areas	IS: 12824	Type of duty and classes of rating assigned	IS: 12802	Temperature rise measurement for rotating electrical machnines	IS: 12065	Permissible limits of noise level for rotating electrical machines	IS: 12075	Mechanical vibration of rotating electrical machines
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IS: 12075	Mechanical vibration of rotating electrical machines																															
3.0 DESIGN REQUIREMENTS 3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A 3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above. 3.3 Starting Requirements 3.3.1 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% higher than that of the driven equipment. 3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.																																

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4
The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.		
3.3.3 The following frequency of starts shall apply		
i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.		
ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)		
iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor		
3.4 Running Requirements		
3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.		
3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.		
3.5 Stress During bus Transfer		
3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.		
3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.		
3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.		
3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.		
4.0 CONSTRUCTIONAL FEATURES		
4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy		
4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.		
Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled		
4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.		

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".	
4.7.2	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.	
4.7.3	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 U W & V respectively.	
4.7.4	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.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ VENDOR :		TITLE			NUMBER :			
		SHEET 1 OF 2		SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
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
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	-	-	NOTE -1 & NOTE-3
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		
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

	QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :			
			BIDDER/ :			TITLE			NUMBER :			
	SHEET 2 OF 2		VENDOR			NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION :			
		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			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: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <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		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 1 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
1.0	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	RELEVENT 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	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		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			SPECIFICATION :				
				BIDDER/ :		TITLE			NUMBER :				
				VENDOR		QUALITY PLAN			SPECIFICATION :				
SHEET 2 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION			
ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		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	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			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-	MANUFR'S DRG.	LOG BOOK	3	-	2		
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1		
1.6	SPACE HEATERS, CONNec- TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2		
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'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 :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 3 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
1.7	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	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		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	MANUFR'S DRG. .	MANUFR'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	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				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	10		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.HV/IR	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		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 5 OF 9		VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		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
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	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 TITLE			SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
		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	10	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		
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		FOR MV MOTOR
		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		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT		SPECIFICATION :			
				BIDDER/ :			TITLE		NUMBER :			
		SHEET 7 OF 9		VENDOR			QUALITY PLAN NUMBER PED-506-00-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			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
		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, BTD & 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												

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 8 OF 9		VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION		
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			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
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
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		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 9 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
									P	W	V
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			

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- | | |
|----------|--|
| 11.01.11 | All 415V PCC, PMCC & MCC shall generally be of intelligent type compatible with IEC 61850 Communication protocol. However utility MCCs as mentioned in the single line diagram shall be non-intelligent type. . A marshalling module shall be provided on each bus of LV Switchgear (PCC, PMCC, MCC) for interfacing with DCS. Control of incomers and bus-coupler breakers of LV switchgear shall be possible from the DCS. The check synchronizing relay shall be housed in the respective switchboards. Dummy panels shall be integral part of the LV Switchgear and of same size. |
| 11.01.12 | MCCs shall be used to supply power to contactor controlled motors rated below 90 kW, local panels, local starter panels etc. |
| 11.01.13 | PCCs / PMCCs shall be used to supply power to motor of ratings 90 to 200 KW through ACBs. |
| 11.01.14 | Incomers of MCCs of rating 630A and above shall be through Air Circuit Breakers while incomers of lower rating can be through motorized MCCBs. |
| 11.01.15 | All Outgoing feeders (non motor feeders) of PCC/PMCC rated 630A & above shall be Air Circuit Breakers while rated below 630A shall be MCCB. |
| 11.01.16 | Motors less than 90 KW shall be provided with MCCB/ MPCB, contactors and intelligent controllers. |
| 11.01.17 | Motors rated 90 KW and above shall have comprehensive motor protection relays. They shall be numerical type and shall communicate with DCS through Open protocol (IEC 61850). |
| 11.01.18 | All MCCs/PMCCs except PCC portion of PMCC shall be of double front construction. PCCs and PCC portion of PMCCs shall be single front. All Switchgears/MCCs shall be sectionalized unless specifically mentioned in the single line diagram. |
| 11.01.19 | All Switchgears shall be easily extendable on either side. The Bidder shall supply Switchgear in various shipping sections consisting of Incomer, Ties and Motor modules. Bidder may be required to change module types, sizes and the components in respect of certain feeders even during erection, testing and commissioning. |
| 11.01.20 | The Bidder shall furnish calculations and/or type-test certificates to prove adequacy of the bus bar sizes offered, for specified current and short time current ratings. Bus bars in particular and droppers (HBB/VBB) shall be supported on flame-retardant, track resistant type bus insulators with high creepage distance and covered with heat-shrunk PVC sleeves which shall be shrunk fit and not capable of being removed without destruction. While continuous current ratings of the droppers in each Switchgear Cubicle shall be at least equal to the corresponding Breaker rating, short time current rating shall be same as that for Horizontal Main Bus bars. Only those dropper ratings shall be allowed as have passed a type test. |
| 11.01.21 | All MCCB, MPCB and contactors shall conform to Type-II class of Co-ordination as per IS-13947. Bidder shall furnish Type-II Co-ordination, p & q type test report as per IS: 13947 for all modules. |
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DATASHEET FOR 415V PCC/PMCC/MCC/DBs

SL NO.	DESCRIPTION	SPECIFICATION	REQUIREMENTS
(a)	Rated voltage, phases and frequency	415V, 3 phase, 4 wire, 50 Hz.	
(b)	System neutral earthing	Solidly earthed	
(c)	Reference Ambient air temperature	50°C	
(d)	Material of bus bars	Al. or Al. Alloy	
(e)	Maximum temp. of bus bars joints, droppers and along the run at site reference ambient of 50°C With Plain or Tin joints With silver plated joints Bus enclosure and structure	40°C 55°C 30°C	
(f)	Short time rating for 1.0 Sec. (kA rms)	50	
(g)	Momentary rating (kA peak)	105	
(h)	Degree of protection for as per IS:2147	IP-54 for outdoor IP52 for indoor panels with current rating less than and including 1600A and IP 42 for panels with current rating more than 1600A	
(i)	Thickness of sheet steel in mm		
	(i) Load bearing members	2	
	(ii) Non-load bearing members	1.6	
(j)	Colour finish shade	Interior Exterior	Glossy white As mentioned in Chapter 1.



SL NO.	DESCRIPTION	SPECIFICATION	REQUIREMENTS
Air Circuit Breaker			
1	Service	:	Indoor
2	Type	:	Air – break
3	Rated service voltage	:	415 V +/- 10%
4	Rated Current	:	As per requirement or 630A/1000A/1250A/2000A/2500A/3000A
5	Rated frequency	:	50 Hz +/- 5%
6	System earthing	:	Solidly grounded
7	Rated short time withstand current for 1 sec.	:	50 KA (r.m.s.)
8	Rated Symmetrical breaking current at rated voltage	:	50 KA (r.m.s.)
9	Rated making capacity (min)	:	105 KA
10	Rated operating duty	:	The duty of circuit breaker for motor feeder involves direct-on- line starting of motors. The motor starting current varies from 6 to 8 times the full load current at a very low power factor Frequency of starts of motors: Three (3) Starts per hour & Two (2) Consecutive Cold starts and one (1) hot restart.
11	Duty cycle	:	O-3 min-CO-3 min-CO
12	Operating mechanism	:	Stored energy type
	a) Closing	:	motor wound spring operated
	b) Opening	:	shunt trip coil
	c) Latching arrangement	:	Mechanically & Electrically trip free
13)	Auxiliary Voltage	:	
	Closing	:	220V D.C. (85% - 110%)
	Tripping	:	220V D.C. (70% - 110%)
	Spring charging motor	:	220 V +/- 10% D.C.
	Space heater & lamp	:	240 V +/- 10% AC 50 Hz
14	Anti-pumping feature	:	Electrical anti-pumping feature shall be provided.
15	No. of poles	:	3/4
16	Aux. Switch contact	:	Min (6 NO + 6 NC)
17	Mounting	:	Draw-out type transfer truck within switchgear cubicle
18	Limits of temp. rise	:	As per IS:2516 part I & II / Sec I
19	Termination	:	



SL NO.	DESCRIPTION	SPECIFICATION REQUIREMENTS	
	Incomer	:	Bus duct (top)
	Outgoing	:	Armoured aluminum cable
20	Static built in release	:	To be provided
21	Finish paint shade	:	As mentioned in Chapter 1.
	HRC FUSES	:	
	Type	:	Link type
	Reference standard	:	IS : 9224
	Rated current	:	As specified
	Operation indicator	:	Required
	Fuse characteristics	:	Bidder to furnish
	CONTACTOR	:	AC DC
1	Service	:	Indoor within steel cubicle for maximum system voltage, starting of motors and miscellaneous loads.
2	No. of Poles	:	3
3	Rated service voltage	:	415 V +/- 10%
4	Rated frequency	:	50 Hz +/- 5%
5	System earthing	:	Solidly grounded
6	Short time rating	:	To be coordinated with MCCB/MPCB Preceding it.
7	Continuous current	:	To suit motor continuous current rating Conditions specified.
8	Short circuit level	:	50 KA (rms) at 415 V
9	Location of control	:	One point control Logic adopted



SL NO	DESCRIPTION	SPECIFICATION REQUIREMENTS	
10	Control circuit	:	110V $\pm 10\%$ 1-ph 50 Hz $\pm 5\%$ derived from 415/110V control transformer provided in each control module.
11	Utilization category	:	AC 3 for uni- directional motors
			AC 4 for Bi-directional Motors.
	CONTACTOR	:	AC DC
12	Duty Class:	:	0.1
	Intermittent class for Uni-directional motors (IS:2959)		
	Intermittent class for Bi-directional motors (IS:2959)	:	0.3
13	Aux. Contact requirement	:	Min. 2 NO &
			2 NC contacts
14	Limits of operation	:	
	Closing (pick-up)	:	85% to 110%
	Dropout	:	45 – 65% of rated
15	High voltage test values (one Min. value)	:	
	a. Main power circuit	:	2.5 KV
	b. Control & auxiliary circuit volts	:	2.0 KV
16	Limits of temperature	:	As per IS:2959
CURRENT TRANSFORMERS			
1	Service	:	Indoor
2	System	:	415V, 3 phase, 4 wire, 50Hz, Solidly earthed neutral
	Insulation class	:	E or better.
3	Type	:	Resin cast
4	Rated voltage	:	415 V +10%



SL NO.	DESCRIPTION	SPECIFICATION	REQUIREMENTS
5	Quantity required	:	As per requirements of individual feeders and as mentioned in the specification drawings.
6	Ratio and burden	:	As required, C.T. secondary rating shall be 1 AMP.
7	Accuracy	:	5P10 or better for protection and class-1 for metering.
8	Power frequency withstand voltage	:	2.5 KV (r.m.s) for one minute
9	Rated short time current	:	
10.	Short time withstand current for 1 sec	:	50 KA (r.m.s)
11.	Dynamic current	:	105 KA (peak)
12	Mounting	:	Inside switchgear cubicle in stationary portion.
Potential Transformer			
1	Service	:	Indoor
2	System	:	451V, 3 phase, 4 wire, 50 Hz, Solidly earthed neutral
3	Type	:	Cast resin
4	Rating- Voltage ratio	:	415/√3 / 110/√3
5	Rated burden	:	As specified
6	Accuracy class	:	As per requirement, to be furnish during detail engineering
7	Power frequency withstand voltage	:	Primary: 11.0 KV for one minute
			Secondary : 2.0 KV for one minute
8	Mounting	:	Fixed type
9	Quantity	:	As per requirement

Microprocessor based numerical relays with communication facility

The numerical relays for 0.415KV Switchgears shall comply with but not limited to the following technical requirements.



S. NO.	DESCRIPTION	: SPECIFICATION
1	Purpose	: Control & Protection, Metering and Monitoring of all switchgears and MCCs with synchro-check facility for Incomers, Bus couplers.
2	Auxiliary Supply	: 220V DC for ACBs and 110V AC for MCC only.
3	CT Secondary Current	: 1Amp.
4	PT Secondary Voltage	: 110V AC, 3 Phase
5	Ambient Temperature	: 50°C
6	Degree of protection	: IP 54
7	Communication	: Compatible with DCS system through suitable connectivity (IEC61850) & suitable software.
8	Input & Output	: Required number of analog and digital inputs/outputs as per scheme requirement with spare.
9	Control	Close / open control of breakers through lap top from the front fort/through key pad (Built in)/ through rear port connection from DCS.
10	Metering	: Instantaneous and Integrated values as indicated.
11	Protection	: Complete protection for Incomer, Tie, Bus coupler, feeders as indicated.
12	Monitoring	: Self-diagnostic facility.
	Facilities to be made available in the relay	Programming keys for complete access without computer (built in). Provision for external programming unit through suitable software and communication ports. Display unit. Read/Write set points. Current & Voltage actual values and any other analog measurement. Event recording with Pre-trip data with starting characteristics. Statistical data. Output relays. Tamper proof security system



SECTION – 14: AC & DC MOTORS
14.01.00 SCOPE

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

14.01.01 Site Conditions

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

14.01.02 Gases, Fumes & Dust Particles

General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

14.01.03 Dust Particles

- i) Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.
- ii) Indoor Locations.
- iii) Coal conveyors - As for outdoor as per clause 14.01.3 (i) above.
- iv) Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

14.01.04 Special Fumes

- i) Water treatment plant and acid cleaning room - Acid and alkali fumes present.
- ii) Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).
- iii) For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

14.02.00 LOCATION OF MOTOR - As required**14.03.00 CODES STANDARDS**

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.



Code	Name of standard
IS : 325	Specification for three phase induction motor.
IS : 900	Code of Practice for installation and maintenance of induction motors
IS : 996	Single phase AC motors
IS : 1231	Dimensions of three-phase foot-mounted induction motors
IS : 1271	Thermal evaluation and classification of electrical insulation.
IS : 2223	Dimensions of flange mounted ac induction motors.
IS : 2254	Dimensions of vertical shaft motors for pumps
IS : 3043	Code of practice for earthing.
IS : 3177	Crane duty motors
IS : 4029	Guide for testing three phase induction motors.
IS : 4691	Degree of protection for enclosures of rotating electrical machinery.
IS : 4722	Specification for rotating electrical machinery.
IS : 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS : 4889	Methods of determination of efficiency of rotating electrical machines.
IS : 5571	Guide for selection of electrical equipment for hazardous areas.
IS : 6362	Designation of Method of Cooling of Rotating electrical machines.
IS : 8223	Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.
IS : 8789	Values of performance characteristics for three phase induction motors.
IS : 12065	Noise level of motors.
IS : 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS : 12615	Induction motors - Energy efficient, three-phase, squirrel cage – Specification
IS : 12802	Temperature rise measurement of rotating electrical machines.
IS : 12824	Temperature rise measurement of rotating electrical machines



IS : 12824	Type of duty and classes of rating assigned.
IS : 14222	Requirements and method of Impulse withstand test
IEC: 60034-1	Rotating electrical machines.
ISO : 1940-1	Mechanical vibration – Determination of permissible residual unbalance
NEMA, MG-1	Motors and Generators
DIN/IEC/IS	RTD
BS 5308 part II	RTD triad Cable

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be furnished during detail engineering.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

14.04.00 TYPE

14.04.01 AC Motors:

- i) Squirrel cage induction motor suitable for direct-on-line starting.
- ii) Continuous duty LT motors rated above 0.37kW upto 200 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30. However this is not applicable for geared motors (motors completely integrated with driven equipment) which are specifically designed to suit the driven equipment duty.
- iii) Crane duty motors shall be squirrel cage Induction motor of S4 duty and 40% CDF.

14.04.02 DC Motors shunt wound.

14.05.00 VOLTAGE (NOMINAL)

14.05.01 LV Motors

For motors upto and including 200 KW - Four hundred fifteen (415) V.

14.05.02 MV Motors

For motors above 200 kW upto and including 2000kW. Six point six (6.) kV.



- 14.05.03 HV Motors
- i) For motors above 2000kW - eleven (11) KV
 ii) All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.
- 14.06.00 FREQUENCY (NOMINAL) - fifty (50) Hertz**
- 14.07.00 NUMBER OF PHASES - Three (3)**
- 14.08.00 SPEED - As required by the driven equipment**
- 14.09.00 TYPE OF STARTING - Direct on-line**
- 14.10.00 DUTY**
- 14.10.01 Continuous 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 and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.
- 14.10.02 Motor rating shall be such that it is not overloaded at any operating point of driven equipment from zero to full load.
- 14.10.03 The break-away torque, pull-up torque and pull-out torque of the motors shall be properly co-ordinated with the requirements of driven equipment to ensure smooth and rapid starting and steady operation. The torque-speed characteristic of motor super imposed thereon on driven equipment torque-speed characteristics at 100%, 90%, 80% shall be furnished.
- 14.10.04 Maximum torque shall not be less than 205% of full load torque.
- 14.10.05 All HV & MV motors shall be provided with vibration pads for mounting vibration detectors.
- 14.10.06 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
- 14.10.07 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.
- 14.10.08 All LV motors rated 0.37kW and higher upto and including 200kW (LV Motors) with S1 duty shall be compulsorily be of energy efficiency level IE 3 as per IS 12615:2011.



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- 14.10.09 HV & MV motors shall have full load efficiency of 95% minimum and rated full load power factor of 0.8 minimum. The required power factor shall be achieved without using external capacitor.
- 14.11.00 SUPPLY VARIATIONS** Motors shall be capable of running continuously at full load under following variations in power supply.
- 14.11.01 Voltage (percent of nominal voltage) Plus minus ($\pm$) ten (10) for LT
Plus minus ($\pm$) Six (6) for MV & HT
- 14.11.02 Frequency (percent of minimal frequency)..... Plus Three 3 & minus (-) five (5)
- 14.11.03 Combined voltage & frequency (percent) Ten (10) (sum of absolute percentage value of voltage and frequency variation)
- 14.12.00 ABNORMAL CONDITIONS CAPABILITY**
- Motor shall have following capabilities as specified design ambient temperature:-
- 14.12.01 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.
- 14.12.02 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.
- 14.12.03 Low Voltage Running:-
- Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.
- 14.12.04 Momentary Low Voltage Withstanding:
- Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.
- 14.13.00 STARTING CAPABILITY**
- 14.13.01 Low Voltage Starting
- Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80) percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.
- 14.13.02 Cold Motor Starting



Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes. (with initial temperature of the motor at ambient temperature)

14.13.03 Hot Motor Starting

Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes. (with initial temperature of the motor at full load operating level)

14.13.04 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

14.13.05 Break-away Starting Current

Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:-

- i) Motors upto 1000 KW 600% subject to IS Tolerance of plus 20%
- ii) Motors (above 1000 KW upto 3000 KW) 600%. Subject to 20% IS tolerance.
- iii) Motors above 3000 KW.....450%. Not subject to any positive tolerance.For energy efficient
- iv) LT motors, locked rotor current shall be as per IS: 12615.
- v) Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current, and is subject to IS tolerance

14.14.06 Where variable voltage and variable frequency (VVFD) operation is envisaged through VVFD drives, motors shall be specially designed for such application.

14.14.00 STARTING VOLTAGE REQUIREMENT

14.14.01 All Motors (except Mill Motors)

- i) 80% of rated voltage for Motors upto 4000 kW
- ii) 75% of rated voltage for Motors above 4000 kW

14.14.02 For Mill Motors:

- i) 85% of rated voltage for Motors above 1000 kW
- ii) 90% of rated voltage for Motors below 1000 kW

14.15.00 TORQUE REQUIREMENTS



14.15.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10%. Motor full load torque.

14.15.02 Full out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

14.16.00 STARTING TIME

14.16.01 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.

14.16.02 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.

14.16.03 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.

14.16.04 At no stage, speed switch shall be provided to achieve requirements mentioned in Clause No. 14.16.01 to 14.16.03.

14.17.00 CLASS OF INSULATION

14.17.01 LV Motors Class F.

14.17.02 HV & MV Motors Class F

14.17.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both MV, HV & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.

14.17.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 78114.0

14.17.05 For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages,

14.17.06 HT motors shall withstand 1.2/50 micro sec impulse Voltage wave of 4U+5 kV (U=Line voltage in kV). The coil inter-turn insulation shall be as per IEC-60034 – Part 15 followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.

14.18.00 TEMPERATURE RISE UNDER NORMAL CONDITIONS



- 14.18.01 Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
i)	50°C	60°C	70°C

- 14.18.02 For Water Cooled Motors, temperature rise of insulation should be limited to 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method.

14.19.00 BUS TRANSFER WITHSTAND CAPABILITY

Motors shall be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/ vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 14.19.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 14.19.03 That the motor winding's shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 14.19.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

14.20.00 TYPE OF ENCLOSURE

- 14.20.01 Outdoor Motors.....IP 55 (Additional canopy to be provided by Bidder).
- 14.20.02 Indoor Motors IP 55
- 14.20.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.

14.21.00 METHOD OF COOLING

- 14.21.01 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 14.21.02 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.



14.22.00 TYPE OF MOUNTING As required for the driven equipment.

14.23.00 MAXIMUM MECHANICAL VIBRATIONS

Vibration shall be limited within the limits prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HV & MV motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads. Vibration pads with screwed holes along with vibration probes shall be provided at both DE and NDE.

14.24.00 NOISE LEVEL

14.24.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). at 1m from operating motor measured in accordance with IS: 10265.

14.24.02 Motor body shall have two earthing points on opposite sides.

14.24.03 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE – I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

14.24.04 For HV & MV motors the distance between gland plate and the terminal studs shall not be less than 500 mm.



14.24.05 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.

14.24.06 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

14.25.00 WINDING & INSULATION

14.25.01 Type : Non-hygroscopic, oil resistant, flame resistant

14.25.02 11kV & 6.6 kV AC : Thermal class 155 (F) insulation and the motors temperature rise shall be limited to Class B. Winding material shall be of copper. The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & inter-turn insulation surge withstand level shall be as per IEC-60034 part-15

14.25.03 240VAC, 415V : Thermal Class(F)
AC & 220V
DC motors

14.26.00 DIRECTION OF ROTATION

14.26.01 As needed by driven equipment.

14.26.02 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

14.26.03 If, in the case of HV & MV motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

14.27.00 BEARINGS

14.27.01 Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 40000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.

14.27.02 Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.



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- 14.27.03 If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- 14.27.04 Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- 14.27.05 For MV & HV motors rated 1000KW and above, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- 14.27.06 When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- 14.27.07 Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- 14.27.08 Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- 14.27.09 Bearings shall be of internationally reputed make subject to the approval of the Owner/Consulting Engineer.
- 14.27.10 Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 14.28.00 **SHAFT EXTENSION** Key slotted bare shaft extension of required length with key on driving end.
- 14.29.00 **DRAIN HOLES** Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 14.30.00 **LIFTING DEVICES** Motors shall be provided with eye-bolts, lugs or other means to facilitate safe lifting.
- 14.31.00 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven equipment assembly) or at site after erection (for separate supplies of above equipment).



- 14.32.00 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.
- 14.33.00 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.
- 14.34.00 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:-
- 14.34.01 In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.
- 14.34.02 Temperature rise under normal/abnormal conditions.
- 14.34.03 Type of bearing and recommended lubricants.
- 14.35.00 FINISH**
- 14.35.01 Motor shall have synthetic enamel paint shade as mentioned in Chapter 1.
- 14.35.02 All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.
- 14.36.00 TERMINAL BOXES**
- 14.36.01 General
- i) Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals, Neutral CT terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination cable to be finalized during detailed engineering.
- ii) The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core



cables are to be terminated. All HV & MV motors shall be provided with phase segregated terminal box.

- iii) Terminal bushings and clamps shall be non-absorbent, non-inflammable, insulated material for connecting with cable.

14.36.02 Main Terminal Box

- i) LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.
- ii) MV & HV Motors shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. For motors rated below 1000 KW should be interchangeable to facilitate cable routing.
- iii) Neutral terminal box for HV motors rated 1000 KW and above shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These CTs shall be mounted in the motor neutral terminal box. Stator phase terminal box shall be phase segregated terminal box suitable for both top or bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable terminating Kit. Terminal leading shall be stud type or leading wire type.
- iv) Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables.
- v) The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.
- vi) Phase to Phase/ Phase to Earth Air Clearance:-
- a) Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:-

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

- vii) Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes.

14.37.00 TYPE AND SIZE OF CABLES



14.37.01 Space Heaters

- i) For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- ii) For MV & HV Motors: Six (6) mm² two core aluminium conductor XLPE insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- iii) For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- iv) Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- v) For Moisture Detectors.....As for space heaters as per Clause 14.041.1 (i) above.

14.37.02 For Main Terminals:-

- i) LT Motors
 - a) Three (3) core cablesStranded aluminium conductor, XLPE insulated, colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire / strip armoured, FRLS PVC type-ST2 jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
 - b) Single core cablesStranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC type ST2 jacketed overall, 1100V grade, heavy duty cable as per IS: 1554 (Part-I).
- ii) HV & MV Motors

Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire/strip armoured FRLS PVC type ST2 jacketed overall, 6.6 KV / 11 KV un earthed grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

14.38.00 GROUNDING



If the motor is of CACA or CACW enclosure, dial type temperature indicator shall be provided (one each for hot and cold air temperature monitoring for CACA and CACW and one each for inlet and outlet water temperature monitoring for CACW). In addition one (1) duplex type RTD shall be provided in each enclosure for alarm and if trip is required for cooling air temperature, temperature switch shall be provided.

14.43.00 WATER FLOW INDICATOR

If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits. In addition one (1) duplex type RTD shall be provided in each water inlet and outlet circuit

14.44.00 MOISTURE DETECTORS

Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

14.45.00 BED PLATE

Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

14.46.00 OTHER ACCESSORIES

Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

14.47.00 TESTS

14.47.01 HV & MV Motors

i) Routine Tests

All equipment shall be completely assembled, wired, adjusted and all acceptance and routine tests as per the specification and relevant standards shall be carried out. These tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. Charges for these shall be deemed to be included in the equipment price.

ii) Type Tests

- a) For each type & rating of HV & MV motors the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards. These reports should be for the tests conducted on the equipment similar to those proposed to be



supplied under this contract and the test(s) should have been conducted at an independent laboratory. Period - With in 5 Years from the zero date.

- b) In case the Bidder is not able to submit report of the type test(s) conducted,, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval, for which a minimum 7 days notice shall be given by the Bidder. Charges for these shall be deemed to be included in the equipment price

iii) List of minimum type tests to be conducted

The following Minimum type tests shall be conducted on each type and rating of HV & MV motor:-

- a) No load saturation and loss curves upto approximately 115% of rated voltage.
- b) Measurement of noise at no load.
- c) Momentary excess torque test.
- d) Full load test
- e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. 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. In case due to test bed limitations at the manufacturing works, mixed frequency method as per latest IEC 60034 is also acceptable.
- f) Lightning Impulse withstand test on the sample coil shall be as per IEC-60034, part-15
- g) Surge-withstand test on interturn insulation shall be as per clause no. 5.1.2 of IEC60034, part-15
- h) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- i) Terminal box-fault level withstand test for each type of terminal box.
- j) 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.

14.47.02 LT Motors

i) Routine Test



All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS/IEC Standards at manufacturer's works in the presence of Consultant /Owner or his representative.

ii) List of minimum tests for which reports have to be submitted

The following minimum type test reports shall be submitted for each type and rating of LT motor of above 30 KW only

- a) Measurement of resistance of windings of stator and wound rotor.
- b) No load test at rated voltage to determine input current power and speed.
- c) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
- d) Full load test to determine efficiency power factor and slip.
- e) Temperature rise test.
- f) Momentary excess torque test.
- g) High voltage test.
- h) Test for vibration severity of motor.
- i) Test for noise levels of motor(Shall be limited as per clause No. 14.24.00 of this section)
- j) Test for degree of protection and
- k) Over speed test.
- l) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

iii) 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.

14.48.00 INFORMATION WITH PROPOSAL

- 14.48.01 AC Motor Data Sheet.
- 14.48.02 Dimension Drawing/Foundation load details of motor and driven equipment.
- 14.48.03 Manufacturer's catalogue showing constructional details.

14.49.00 INFORMATION ON AWARD OF CONTRACT

- 14.49.01 Motor Data Sheet

Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

- 14.49.02 Following characteristics curves:-



- i) Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment except for mill motor. For mill motor torque speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment
- ii) Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage
- iii) Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- iv) Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor thermal withstand curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- v) Efficiency, power factor, current and speed versus power output curves.
- vi) Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor speed time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- vii) Negative phase sequence current withstand characteristics.

14.50.00 DC MOTOR

- 14.50.01 D.C. Motor provided for emergency service shall be shunt / compound would type. The starting current shall be as per manufacturer's standard.
- 14.50.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- 14.50.03 Starter panel complete with all accessories shall be included in the scope of supply.

14.51.00 DRAWINGS, DATA & MANUALS

- 14.51.01 Minimum Drawings, data & manuals for the motors to be submitted
 - i) Dimensional General Arrangement drawing
 - ii) Foundation Plan & Loading
 - iii) Cable end box details
 - iv) Space requirement for rotor removal
 - v) Thermal withstand curves hot & cold



- vi) Starting and speed torque characteristics at 80% & 100% voltage except for mill motor. For mill motor Starting and speed torque characteristics at 90% & 100% voltage.
- vii) Complete motor data
- viii) Erection & Maintenance Manual
- ix) Test reports
- x) QAP



DATASHEET

	Auxiliary power supply	
1.1	HV supply	
	11kV, 3 Φ , 3W, 50 Hz non effectively earthed Earthed through resistance, limiting earth fault current to 400 Amps	Motors rated above 2000 kW
	Fault level	50 kA for 1 second
	HV Motors	shall be controlled through vacuum circuit breaker
	The cooling tubes of Motor	Shall be of Stainless Steel
1.2	MV supply	
	6.6kV, 3 Φ , 3W, 50 Hz non effectively earthed. Earthed through resistance, limiting earth fault current to 400 Amps	Motors above 200kW upto and including 2000kW
	Fault level	40 kA for 1 second
	MV Motors	shall be controlled through vacuum circuit breaker
	The cooling tubes of Motor	Shall be of Stainless Steel
1.3	LV supply	
	415V, 3 Φ , 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1 Φ , 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
	LT motors rated up to 90 kW	shall be controlled through MPCB/ MCCB and contactor.
	LT motors rated more than 90 kW	Shall be controlled through air circuit breaker
1.4	DC supply	
	220V, 2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	



	voltage	-----
	Frequency	-----
	Combined voltage & frequency	-----
2.2	DC supply	198 to 240 V
Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.		



TECHNICAL DATA SHEET OF MOTORS**A) TO BE FURNISHED SEPRATELY FOR H.T. & L.T. MOTORS**

Sr. No.	Description	
1.0	Type and frame size & design code no.	:
2.0	Nos. required	:
3.0	Application	:
4.0	Specification & Codes	:
5.0	Capacity for	
i)	for specified climatic conditions (50°C)	:
ii)	At 40°C ambient	:
8.0	Location for installation	:
9.0	Type of enclosure & ventilation	:
10.0	Degree of protection	:
11.0	Type of duty	:
12.0	No. of phases, frequency & voltage	:
13.0	Permissible variations in	
a)	Voltage	:
b)	Frequency	:
c)	Combined	:



14.0	At rated voltage & frequency	
	a) Full load current	:
	b) Full load speed	:
	c) No load current	:
15.0	Minimum permissible voltage during starting	:
16.0	Maximum permissible time at minimum permissible voltage during running at full load.	:
17.0	Maximum permissible time at 75% of rated voltage during running at full load.	:
18.0	Whether motor stalls at 70% of rated voltage.	:
19.0	Efficiency & power factor	
	Load (% of full load)	Efficiency Power factor
	100	:
	50	:
	25	:
	0	:
	At start	:
	Duty Point	:
20.0	Stator winding	
i)	Connection	:
ii)	Type & nos. of terminals:	
	Brought out	
iii)	Resistance between terminals at 20deg C	:
iv)	Resistance per phase at 20deg C	:
v)	Inductance per phase	:
vi)	Capacitance per phase	:
21.0	Starting current as % of full load current	



	i) With IS tolerance	
	ii) Without IS tolerance	
22.0	Torque at full load in Kgm.	:
23.0	Break away torque in % of full load torque	:
24.0	Pull up torque in % of full load torque	:
25.0	Pull out torque in % of full load torque	:
26.0	Starting time in sec.	
	Without mechanism coupled or Mechanism coupled through hydraulic coupling when it may be presumed that load is transferred to motor shaft only after attaining almost full speed.	
	i) with rated voltage	:
	ii) with 80% of rated voltage	:
	iii) with 110% of rated voltage	:



27.0	Starting time in sec.	
	With mechanism coupled through Flexible coupling.	
	i) with rated voltage	:
	ii) with 80% of rated voltage	:
	iii) with 110% of rated voltage	:
28.0	Safe stall time (hot motor)	
	i) At rated voltage	:
	ii) At 80% of rated voltage	:
	iii) At 110% of rated voltage	:
29.0	Safe stall time (Cold motor)	
	i) At rated voltage	:
	ii) At 80% of rated voltage	:
	iii) At 110% of rated voltage	:
30.0	Limiting motor temperature to determine safe stall time	:
31.0	Permissible maximum accelerating time (hot motor)	
	i) At rated voltage	:
	ii) At 80% of rated voltage	:
	iii) At 110% of rated voltage	:



- 32.0 Permissible maximum accelerating time (cold motor)
- i) At rated voltage :
 - ii) At 80% of rated voltage :
 - iii) At 110% of rated voltage :
- 33.0 Insulation
- i) Class of insulation :
 - ii) Material & treatment of insulation :
- 34.0 Whether insulation is suitable for 415 V, 3.3KV,11kV ungrounded system :
- 35.0 Temperature rise under normal conditions over 50°C ambient temperature
- i) By resistance method : Degree centigrade over cooling water temp. for CACW motors.
Degree centigrade overcooling air temp. for CACA motor.
 - ii) By Thermometer method : Degree centigrade over cooling water temp. for CACW motor.
Degree centigrade over cooling air temp. for CACA motor.
- 36.0 Method of starting :
- 37.0 Permissible starting duty cycles :
- 38.0 Stator thermal time constant :
- 39.0 Maximum permissible voltage : During high speed bus transfer & special design feature.
- 40.0 Time required for voltage to decay down to when driving voltage is removed. :
- i) At 50% of rated voltage :



- ii) At 40% of rated voltage :
- iii) At 25% of rated voltage :
- iv) At 0% of rated voltage

Method of cooling

41.0 Details of water cooling system

- i) No. of cooler
- ii) Water requirement per cooler
- iii) Losses removed by cooler
- iv) Max. permissible temperature
Of cooling water at inlet
- v) Max. permissible temperature
Of cooling water at outlet
- vi) Maximum permissible pressure
At water outlet
- vii) Water pressure drop through
The cooler
- viii) Temp. of cold air coming
Out & entering the machine
For permissible cooling
Water temp.
- ix) Temp. rise of air passing
through machine at full
load.
- x) Air pressure drop through
The cooler
- xi) Temp. rise of water through
cooler
- xii) Protection against leakage :
of water
- xiii) Arrangement to ensure the
water flow

Bearings

- i) Number :
- ii) Type :
- iii) Lubrication system :



- iv) Quantity of lubrican reqd. for both the bearings. :
- v) Life in hours at rated speed :
- vi) Recommended lubricant :
- vii) Bearing end play :
- viii) Inlet oil pressure :
- ix) Temp. rise of oil through :
- x) Max. permissible temp. of Bearing :
- xi) Max. permissible temp. of Oil :
- xii) Permissible running time without forced oil at full load & full speed :
- xiii) Whether bearings are provided with 4 wire, platinum RTD having 100-ohm resistance at 0°C for remote temp. indication. :
- xiv) Whether bearings are provided with local temperature indicator having two adjustable contacts rated for 2A at 240V AC or 0.2A at 220V DC. : Yes/No
- xv) If forced lub oil system provided : Yes / No
- xvi) Qty. of lubricant required for initial filling.
- xvii) Recommended period after which lubricant should be replaced.
- xviii) Bearing cooling water requirement.
- xix) Max. permissible bearing cooling water inlet temp. (permissible)
- xx) Max. permissible bearing cooling water outlet temp.
- 42.0 Terminal designation correspond to direction of rotation (Facing driving end).
- 43.0 Terminal boxes with accessories separate terminal boxes provided.

i) Main



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- ii) Space heaters
 - iii) Winding temp. detectors
 - iv) Bearing temp. detectors
 - v) Moisture detectors
 - vi) Neutral terminals
- 44.0 Main terminal box details
- i) Type & Nos.
 - ii) Fault level permissible for 0.25 sec.
 - iii) Location
 - iv) Cable gland size & no.
 - v) Direction of cable entry.
- 45.0 Space Heater
- i) Number
 - ii) Location
 - iii) Capacity of each
 - iv) Total power requirement
 - v) Voltage.
- 46.0 Details of 4 wire platinum RTD having 100 ohm resistance at 0°C for winding temp. detector.
- i) Nos. provided
 - ii) Location



47.0	Whether CTs for differential protection are provided	:	Yes / No
i)	If Yes, no. of CTs supplied alongwith motors. C.T. details		
a)	C.T. ratio		
b)	Knee point voltage		
	S.C. withstand capacity	:	
48.0	Type of mounting	:	
49.0	Shaft orientation	:	
50.0	Shaft extension	:	
51.0	Grounding pads size nos. & location		
52.0	Method of coupling to driven mechanism		
53.0	Motor GD2	:	
54.0	Lifting device		
55.0	Weight		
i)	Weight of stator (wound)		
ii)	Weight of rotor (wound)		
iii)	Weight of base plats.		
iv)	Weight of cooler		
56.0	Net weight of motor	:	
57.0	Shipping dimensions & weight	:	
58.0	Thermometer provided	:	
	i) In cold air path		
	ii) In hot air path		
	iii) For measurement of oil temp.		
59.0	Characteristic curves furnished		
	i)		Speed vs. current at rated voltage
	ii)		Speed vs. torque at



		110%, 100%, 90% and 80% of rated voltage
	iii)	Thermal withstand curve for hot & cold conditions.
	iv)	Efficiency vs. load
	v)	P.F. Vs. load
	vi)	Current vs. time
	vii)	Negative phase sequence curve
60.	Drawings furnished	
	i)	General arrangement of motor
	ii)	Main terminal box showing the method of terminating the Board's incoming cables



iii)

Instruction
manuals.

61.0 Rotor design as per specification clause 5.04.00 : Yes / No

B) DC Motor**1. GENERAL**

- i) Equipment driven by Motor
:
- ii) Motor type :
- iii) Country of origin :



2. DESIGN & PERFORMANCE

- | | | | |
|-------|--|---|--|
| i) | Frame Size | : | |
| ii) | Type of duty | : | |
| iii) | Type of enclosure & type of cooling | : | |
| iv) | Applicable standard to which
motor generally confirms | : | |
| v) | Type of mounting | : | |
| vi) | Direction of rotation | : | |
| vii) | KW rating at amb. Temp. 50 deg C | : | |
| viii) | Rated power supply voltage | : | With Resistance/ Without
Resistance |
| a) | Armature circuit (v) | : | |
| b) | Field (v) | : | |
| ix) | Permissible voltage variation | : | |
| x) | Minimum permissible starting voltage | : | |
| xi) | Rated speed at rated voltage (RPM) | : | |
| xii) | At rated voltage | : | |
| a) | Full load current (A) | : | |
| b) | No load current (A) | : | |
| xiii) | Starting current (A) | : | |
| a) | 100% voltage | : | |
| b) | 85% voltage | : | |
| xiv) | Starting time (with pump coupled) | : | |
| a) | 100% voltage (Sec) | : | |
| b) | 85 % voltage | : | |
| c) | 80 % voltage | : | |
| xv) | Efficiency at rated voltage at : | | |



- a) 100% load :
- b) 75% load :
- c) 50% load :
- xvi) Safe stall time (sec) at 110% :
- a) Hot condition :
- b) Cold condition :
- xvii) Torque (Kg-m) :
- a) Starting at min. permissible voltage :
- b) Rated :
- xviii) Fly wheel moment (GD2) motor (Kg-m) :

3. CONSTRUCTIONAL FEATURES

- i) Winding insulation :
- a) Class & type :
- b) Tropicalised (Yes/No) :
- c) Temp. rise over specified ambient of 50 deg. :
- d) Method of temp. measurement :
- ii) Degree of protection of terminal box for :
- a) Main terminal box :
- b) Space heaters (AUX. TB) :
- iii) For main terminal box :
- a) No. and type of cable gland :
- b) Recommended cable size (Armature/field) :
- c) Fault level (KA, sec) :
- iv) Bearings :
- a) Type (at DE/NDE) :



- b) Recommended lubricant :
- c) Life :
- v) Weight of motor (Kg.) :
- vi) Field current at rated speed (A) :
- vii) Field resistance (Ohm) at rated speed at 30 deg :
- viii) Field trimmer rating (Ohm) for getting basic speed at 30 deg C. :
- ix) Resistance (Ohm) between terminals at 30 deg C.
- a) Armature :
- b) Series winding :
- c) Inter pole winding :
- d) Shunt winding resistance :
- x) 1st and 2nd critical speed :
- xi) Overload that can be carried by motor without changing overall performance and period for which it is applicable :
- xii) Grounding device :
- xiii) Space heater :
- a) No. & location :
- b) Volt & KW rating :

4. RESISTORS

- i) Starting (external) resistance :
- a) Type of resistor :
- b) Ohmic, current & power rating of resistor elements :



- | | | |
|----|--|---|
| c) | Max. permissible temp. of resistor elements | : |
| d) | Connection diag. Of resistor elements | : |
| e) | No. of startup stages/steps | : |
| f) | Resistance values of stages | : |
| | -at 30 deg. C (Ohm) | : |
| | - at running condition (Ohm) | : |
| g) | Expected temp of resistor at running condition | : |
| h) | Expected temp of box at running condition | : |
| i) | Mounting/stacking of resistor elements and G.A. of resistor box | : |
| j) | Size current rating of output terminals for : | : |
| - | Starting resistor | : |
| - | Field trimmer resistor | : |
| k) | No., type, size of cable gland for | : |
| - | Starting resistor | : |
| - | Field trimmer resistor | : |
| l) | Field Trimmer resistor | : |
| a) | Type | : |
| b) | Ohmic, current & power rating | : |
| c) | Permissible temp. | : |
| 5. | Schematic connection diag. Of motor with starting resistor and field trimmer resistor. | : |

6. CHARACTERISTIC CURVES

- | | | |
|----|------------------------|---|
| l) | Starting current/times | : |
|----|------------------------|---|



II) cold condition	Thermal withstand curve for hot and :
III)	Torque/speed :
IV)	Load/Efficiency :
Speed/Time	:



- 16.02.01 The scope of supply covers all electrical equipment commencing from Isolator, trailing cables, complete down shop leads (DSL) system in the shop and main current collectors on the crane and all other electrical items beyond the main current collectors of the crane i.e. DSL main current collectors, power disconnecting switch on bridge platform after main current collectors, protective and control switch gear ,motors, VVFD, control and brake panels ,resistors, brakes, limit switches, all power and control cables, socket outlets, lighting distribution panel and lighting fixtures with lamps, festoon cable system for crane trolley magnet/ grab and cable reeling drum, if specified for grab/magnet, master controllers, indicating lamps, push buttons, earthing materials etc. The scope of work also includes complete assembly and wiring of crane and testing at manufacture's works, erection and testing and commissioning of all electrical equipment.
- 16.02.02 All sundry erection materials required for installation and connecting up of electrical equipment with cable laying and fixing accessories shall be included in scope of supply by Bidder.
- 16.02.03 Power supply to the crane shall be from the 415V ACDB as shown in the Electrical SLD.
- 16.02.04 Power supply and Standard voltage levels
- i) The following standardized voltage levels shall be adopted:-
- 1) LTAC : 415V, 3 phase, 50 Hz, 4 wire solidly earthed system. Power supply be made available at this voltage only. Other voltages shall be obtained by providing transformer/ transformer – rectifier unit with MCBs on both primary and secondary side and $\pm 5\%$ and $\pm 10\%$ taps on transformers secondary.
 - 2) AC control and signaling : 110 V AC voltage
 - 3) Socket outlets for
 - i) Hand lamps : 24 V, single phase, 50 Hz, AC obtained through suitable transformers
 - ii) Hand tools : 240 V, 15A, 2 pin plus earth with plug interlocked switch
 - d) Electro-magnetic brakes : 220 V, DC obtained through individual brake control panels.



- 4) Monitoring and signaling : 24/ 48 V. DC
in electronic installations,
mimic panels
- 5) Illumination/ lighting : 240 V, AC
The three phase symmetrical short-circuit ratings of the switch gear
at 415 V shall be 50 kA for 1 second.
The system/ unit/ equipment shall be designed so as to be suitable
for the following variations in voltage and frequency :
- | Voltage | Frequency |
|---|---------------------------------------|
| Permissible variations with
rated performance, rated
current and control
effectiveness maintained | $\pm 10\%$ +5% & -5%
For LT system |
| Permissible variations for
control and regulation
equipment with rated
performance and control
quality maintained | $\pm 10\%$ +3% & - 6% |

16.02.05 Standards

- i) The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the relevant IS specifications (latest revision). In case the Bidder is not in a position to comply fully with certain BIS specifications, or in respect of certain items for which there are no IBIS specifications, the Bidder may base his proposals on IEC recommendations or other reputed national or international standards subject to the approval of the Purchaser.
- ii) All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India and the Government of Uttar Pradesh and with the Indian Electricity Rules
- iii) Wherever specified, a set of batteries, a battery charger, one annunciation system and other accessories shall also be provided along with magnet so that the magnet can hold the full load for at least half an hour in case of power failure.

16.02.06 Equipment in operator's cabin and on pendant unit

- i) Following shall be included on the pendant unit:

Push button for	Hoist slow, hoist fast, lower slow, lower fast, left cross traverse, right cross traverse, forward long travel, backward long travel, emergency stop conditions.
-----------------	--



Switch for	Lights and bells
Lamps for	Power 'ON' indication, Control "ON" and emergency corner switch operation.

ii) The Pendent Push Button station shall be supported independently, earthed separately independent of suspension.

iii) Cabin operated cranes:

a) The operator's cabin shall contain the following:-

- 1) Master controllers for all the motions and magnet (wherever applicable).
- 2) Emergency stop push button.
- 3) Foot switch for alarm or bell.
- 4) Switches for all lighting equipment on crane.
- 5) Switches for exhaust fan and for cabin fan.
- 6) A fire extinguisher.
- 7) Insulating mat and operator's chair.
- 8) Cabin light and fan.

Annunciation panel with indication lamps for power 'ON' control 'ON' emergency corner switch operated, ammeter and voltmeter with selector switches.

iv) Radio remote control:-

- a) In this mode of control system, all the 3 motions
 - 1) Hoist.
 - 2) Main/creep for main hoist &aux hoist separately.
 - 3) Cross travel and Long travel can be controlled.
- b) The system shall have capability to provide range of 1.5 times the long travel distance of the crane.
- c) In the case of signal failure, all motion shall come to a safe stop.
- d) The system shall have facility of controlling speed in two steps:-
 - 1) Slow speed on the first step of the breaker contact / pushbutton of the radio remote control representing the first or second notch of the master controller.
 - 2) Full speed on the second step of the breaker contact / pushbutton of the radio remote control representing the final notch of the master controller.



v) Transmitter:-

a) Transmitter shall have following features:-

- 1) Constructed with sophisticated microprocessor technology and surface mounted electronics.
- 2) Transmission type: - FM FSK
- 3) Transmission speed: - 9.6 Kbps.
- 4) Built in self test for all functions.
- 5) Transmitter shall consist of switching breaker, dial switch and push buttons.
- 6) Switching breaker shall be non locking to zero position or maintained function.
- 7) Indications:-
- 8) Operation status
- 9) Battery status
- 10) Indicators that display information from crane.
- 11) PIN -code (Personal Identification Number)
- 12) Internal antenna.
- 13) Rechargeable battery.
- 14) Battery 7.2 V NiCd
- 15) Operating time: - About 8 hours.
- 16) Different operating frequencies (minimum 16 nos.)
- 17) Two hand upstart.
- 18) Stop push button.
- 19) Operating conditions: - Areas having large temperature variations, dusty, more vibrations, oil and humidity.
- 20) Operating temperature range: - Min. 10 deg.C to Max. 60 deg.C
- 21) Protection class: IP - 54.
- 22) Casing material: Polycarbonate / ABS plastic.

vi) Receiver:-

a) Receiver shall have following features:-

- 1) Upto 20 functions exclusive safety relays (for transmitting preset reference values to VFD in the crane).
- 2) 2 safety relays (for control of main contactor)
- 3) Power supply suitable for 240 V AC, 6 A.
- 4) Minimum 16 different operating frequencies.
- 5) Two redundant microprocessors for monitoring each others.
- 6) Cyclically redundancy checks check for high security of transmitted radio messages.
- 7) Frequency scanning in the receiver.
- 8) Memories last 10 users.



- 9) Interlocking of the relays.
- 10) Momentary or latched relay functions.
- 11) Two hand up start (to avoid unintentional start).
- 12) Protection class: IP - 65.
- 13) Casing material: Aluminium profile for fast mounting on DIN rail
- 14) Operating temperature range:- Min. 10 deg.C to Max. 60 deg. C

vii) Enclosure Class

- a) For indoor operations
 - 1) Resistance boxes : IP : 11
 - 2) Motors : IP : 54
 - 3) All other electric equipment : IP : 54
- b) For outdoor operations
 - 1) Resistance boxes : IP : 33 with canopy
 - 2) Motors & panel : IP : 55 with canopy
 - 3) All other electrical equipment : IP : 65 with canopy

16.02.07 Cables (For EOT Only)

- i) Power cable suitable for 3 Phase, 4 wire, AC power supply system.
- ii) All cables shall have stranded copper conductors. Control wiring shall be with 2.5 mm² copper; minimum size of power cable shall be 6.0 mm². Fixed wiring on cranes shall be carried out with XLPE insulated. PVC sheathed armoured cable or EPR insulated CSP sheathed cable or better.
- iii) All flexible cables (i.e. cables for magnet, trolley, feed, pendant unit etc.) shall have copper conductor, EPR insulation and CSP sheathing or better.
- iv) All cable shall be suitably de-rated for grouping and higher ambient temperature.
- v) All cables shall be of 1100 Volts grade.
- vi) All accessories like cable glands, clamps, pipes, wire and terminal marks etc. shall also be provided.
- vii) Cable laying and terminations shall be such that the chances of cables getting damaged is remote.
- viii) Cable sizes shall be selected considering motor rated current.
- ix) In all passages and on trolley the cable shall be laid in trays and shall be covered by similar trays and properly clamped & fixed:-



a) LT Power Cable

1.1 kV, heavy duty power cable, 4/3.5 core with stranded sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) Copper conductors as applicable, XLPE insulated operation as per IS:5831-1984, core stranded together provided with a common covering of Extruded FRLS PVC inner sheath of type ST2, galvanized round steel wire / strip armoured and Extruded FRLS PVC TYPE ST2 outer sheathed, multi core conforming to IS:1554 (Part-I – 1988) Type TWY.

b) Control Cables

1.1 kV, circular stranded (rm), annealed copper conductor, PVC insulated suitable for type ST1 (70°C) operation, as per IS:5831-1984, cores stranded together provided with a common covering of PVC inner sheath, galvanised round steel wire armoured and Extruded FRLS PVC outer sheathed, multi-core similar to IS:1554- (Part-I)-1988, Type YWY.

c) Flexible Trailing Cable

1.1 kV grade, heavy duty type with tinned annealed high conductivity flexible copper conductors, ethylene propylene (EPR) insulated and chlorosulphorated polyethylene (CSP) sheathed conforming to IS:8130-1984, IS:6380-1984 and IS:9968 (Part-I)-1988.

16.02.08 Earthing

- i) A ring earthing system shall be provided on the crane. Each and every electrical equipment shall be connected to this earthing at least at two points. However the electronic circuit insulated earth wire shall run in panel and terminate at main earth connection only at one point. The earthing shall be connected to the fourth trolley line in DSL system through 2 nos of current collector. Additionally current collectors shall also be provided on crane rails for earthing on crane . All these collectors shall be connected to earthing ring.
- ii) An earth core shall be provided in trolley feed cable and the magnet. The cable reeling drum shall have a separate slipring for earthing purpose.
- iii) It shall conform to general specification for earthing.



- iv) Rubber mattings shall be provided in front of the protective and control panels.
- v) All bonds between earth conductors and crane parts shall be welded if possible, or rivetted and soldered. Where screwed bonds are made, care shall be taken that there is satisfactory contact surface and nuts shall be locked to prevent their loosening? Earth connections to equipment shall be made by means of multi strand flexible conductor to adequate section.
- vi) The earth ring on the crane/ machine shall be connected to the plant earthing system through to gantry rails. Each end of each gantry rail shall be bonded to the plant earthing system.
- vii) In addition, intermediate earthing bond shall also be provided on the rails at every 60 m in case of longer tracks.
- viii) Flexible copper bonds shall be provided across any gap in the running gantry rail. For mobile equipment with flexible cables, one separate copper conductor of adequate size shall be provided for earthing.

16.02.09 Operation

- i) The crane shall be operated either from cabin in the crane bridge and from a pendant control station and through remote control unit as specified in Data Specification Sheet

16.02.10 Operator's Cabin

- i) The operator's cabin shall be steel fabricated closed cabin type, and air conditioned, fire proof construction and complete with light, fan and seat. The cabin shall be located on one end of the crane bridge and on the opposite side of Down Shop Lead (DSL) and under one of the bridge girders, so that it is offset to one side. The cabin shall be provided with guarding handrails and the floor shall be covered with electric insulating carpet. A clear headroom of 2000 mm shall be ensured within the cabin. The cabin shall be well braced in order to provide adequate strength and rigidity. The outside surfaces of the cabin and floor beams shall present smooth and pleasing appearance.



- ii) A foot operated type-warning gong shall be provided within the cabin. The cabin shall be compact and adequately sized (approximately 2.5x2x2.3 meters dear high) to accommodate controllers, protective panel, distribution board and other accessories required for operating the crane. Arrangement shall be such as to provide unrestricted view of load at any position to the operator.
- iii) Dead man's Handle/Control for each of the crane motions shall be provided in the cabin.
- iv) Cabin's platform shall be provided with 10 mm thick rubber sheet on the floor to comply with I.E. Rules. No wooden paneling shall be permitted. The sides of the cabin shall be covered with plate steel to a height of one (1) metre. The floor shall be designed for a load of 300 kg per metre square of floor area exclusive of the weight of any equipment mounted on or attached to the cab. An access ladder shall be provided from the bridge girder to the Operator's cabin.
- v) In addition to above, accessories not limited to the following shall be adequately arranged/ mounted in the cabin:-
 - a) Manually operated master control switches, main line disconnecting switches and other necessary controls and wiring with fittings.
 - b) A swing way operator's chair.
 - c) Complete concise instructions covering the crane operation, maintenance and periodical lubrication etc typed in English and neatly framed in a permanent frame for each reference.
 - d) A non-oscillating-ventilating fan having 350 mm swing (240V AC, single phase) with suitable guard, and separate regulator.
 - e) Adequate fluorescent illumination with switch inside the cabin.
 - f) An electric alarm gong and an additional 300 mm dia hand operated metal gong.
 - g) Portable carbon dioxide fire extinguisher and sand bucket.
 - h) One No Suitably rated window Air conditioner.
- vi) Location of the cabin shall be on one side of the crane so as to permit maximum visibility of all operations of the crane. Location of cabin and/or access ladder shall be such as to prevent personnel from making accidental contact with crane and/or trolley runway conductors.
- vii) Enclosure protection class of all Electrical equipment shall be at least IP 54 or better except that for motor which shall have IP-55 protection & Resistance boxes, which may have IP-23 protection.

16.02.11 Pendent Station



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- i) The pendent station shall locate the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor.
 - ii) With pendent operation, foot operated travel brake and the drum controllers need not be provided.

16.02.12 Repair Cage

- i) A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. In case, the trolley current collectors are located below trolley rail level on the inside webs of the bridge girders, guards shall be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors as well as a repair cage shall be provided on the trolley to attend to these conductors.
- ii) Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.
- iii) The repair cages shall be adequately sized, guarded for safety and correctly located for the intended service. Suitable access to the cages shall be provided.

16.02.13 Guarding

- i) Guards of an approved design, which shall push forward or off the rail track any object placed across it, such as person's foot or arm, shall be attached to each end of the end carriage.
- ii) Protection guards to live electrical wirings/conductors shall be provided.
- iii) Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, shall be provided.
- iv) The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent trapping of a hand between a sheave and the in running rope.
- v) Effective means of guiding the wire ropes over the sheaves shall be provided so as to prevent dismounting of rope from the sheave grooves even when a slack rope condition is developed.
- vi) All openings in foot walk flooring, for access to bottom chord platform, if any, and to other inspection platforms, shall be provided with covers having suitable locking means to avoid any accidental opening.
- vii) All electrical panels, resistance boxes and crane trolley wires shall have suitable rain/dust hoods over them to prevent water and building construction material falling on them, as it is apprehended that erection and commissioning of the crane might have to be taken up before the completion of the building roof.



supports for the full length of the working zone parallel to the I beam carrying the hoist unit. The retracting trolleys shall run on a separate supporting beam. Vendors shall specify the supporting beam according to the retracting rollers offered by him to enable provide such beam in the building structure.

- ii) One end of the festoon cable shall terminate in main cable junction box at the extreme end of the monorail beam. The other end shall terminate on to the main power disconnecting switch located in the control panel. The flexible trailing cable shall have ample length to cover full track length & shall be supported at suitable intervals by means of properly selected movable trolleys. These retracting rollers shall be prevented from bumping through suitable spacers so that undue stress is avoided on the cable. Similarly the trolleys shall be inter-connected through metallic drag chains to avoid pull on cables. Suspension of flexible cable system below the support rail shall be restricted to avoid mechanical damage & interference with operation.

16.03.13 Earthing

- i) TN-CS type of earthing shall be provided. This would require a separate earth conductor in the power cables, both for fixed wiring as well as for flexible festoon cables. Earth bus shall be formed on the hoist and each equipment shall be earthed through this earth bus.

16.04.00 ELECTRICAL DETAILS OF EOT U/S CRANE

The electrical details of electrically operated under slung crane are same as the electricals of electrically operated (EOT) crane as described in Cl. 16.02.00 above except that operator cabin, cabin operated cranes and radio remote control mentioned at Sl. No. 16.02.10, 16.02.6 (iii) 16.02.6 (iv) are not applicable.



SECTION – 18: LV POWER CABLES**18.01.00 SCOPE OF SUPPLY**

- i) The LV Power cables shall be supplied, installed and commissioned in accordance with the following specification.
- ii) Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the power plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

18.02.00 CODES & STANDARDS

- i) All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on zero date. 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:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 V.
IS: 2982	Copper conductor in insulated cables and cords.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanized 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	Drums for electric cables.
IS : 10810	Methods of tests for cables.
IEC: 60	High voltage test techniques
IEC: 230	Impulse tests on cables and their accessories
IEC: 287	Calculation of the continuous current rating of the cables (100% load factor).
IEC: 288	Nominal cross sectional area and composition of conductor of insulated cables.
IEC-331	Fire resisting characteristics of electric cables
IEC: 502	Extruded solid dielectric insulated power cables for rated voltages from 1kV up to 30kV.
IEC: 540	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEC -60332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)



IEEE-383	Standard for type test of Class IE Electric 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.
NES-715-1	Temperature index
SS-4241475 classF3	Swedish Chimney test
SVENSK Standard SS-4241475 Class F3	

- ii) BICC Hand Book For cables in fire regarding temperature index- chapter-6
- iii) Indian Electricity Rule.
- iv) Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.
- v) The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

18.03.00 DESIGN CRITERIA

- i) The cables shall be used for connection of power circuits of the system. Actual cable sizes shall be selected based on approved sizing calculations. Number of different sizes selected shall be kept to a minimum for optimization.
- ii) Cables shall be generally laid on ladder type cable trays. For interplant connection cables shall be routed along overhead cable bridge.
- iii) For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.
- iv) The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- v) The inner and outer sheath shall have flame retardant low smoke (FRLS) characteristics or fire survival characteristics as the case may be, and shall meet the requirements of additional tests specified for the purpose.
- vi) Core identification for multicore cable shall be provided by colour coding.



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- vii) Cables shall be so designed and manufactured that no damage occurs during handling, transit, storage, installation under any operative conditions which they may be subjected to.
 - viii) Maximum continuous operating temperature shall be 90 deg C under normal operation and 250 deg C under short circuit condition. 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.
 - ix) Power cables shall be chosen taking into account the factors mentioned in Section-I.

18.04.00 SPECIFIC REQUIREMENTS / CONSTRUCTIONAL REQUIREMENTS

18.04.01 1.1KV Aluminium Conductor Power Cables

- i) 1100 volt, 90 Deg. C rating, heavy duty power cables with stranded aluminium conductor, extruded XLPE insulation, extruded PVC,FR-LS inner sheath, aluminium round wire armour for single core cables and galvanized steel strip /wire armour for three (3) core cables, and extruded PVC, FR-LS overall sheath. Cables shall be manufactured in conformity to IS-7098 part 1 - 1988, amended up to date and bearing ISI mark.
- iii) Conductor

The cable conductor shall be made from standard Aluminum of grade H2 and Class 2 to form compact conductor having a resistance within the limits specified. All the cables of size 25mm² and above shall have sector shaped conductors.
- iv) Insulation

The insulation shall be XLPE type. It shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The insulation of the cables shall be of high standard quality.
- v) Inner Sheath
 - a) The laid up insulated cores of twin and multicore power cables shall be provided with an inner sheath of extruded FRLS PVC, compound conforming to Type ST2 of IS:5831. Single core power cables need not be provided with any inner sheath.



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- vi) Armour
 - a) For single core armoured cables, armouring shall be of aluminium wires/formed wires of H4 grade.
 - b) For multicore armoured cables, armouring shall be of galvanised steel strip /wire.
 - vii) Overall Sheath
 - a) Outer sheath shall be of extruded FRLS PVC compound conforming to type ST2 as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall be applied with anti rodent and termite additives.

18.04.02 1.1KV Grade Copper Conductor Fire Survival Power Cables

- i) 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. The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988. The cables can withstand 750 Deg. C temperature for three (3) hours.
- ii) Conductor
 - a) Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130.
 - b) A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
- iii) Insulation
 - a) Cores of the cable 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 & Black
- iv) Laying up of cores (For multi core cables only)
 - a) The core shall be suitably identified in accordance with IS: 9968 (Part-I).



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- b) The suitable fire retardant material fillers shall be used for filling in the interstices.
 - c) Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
 - v) Inner Sheath
 - a) 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 conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fiber tape over the insulation.
 - vi) Armour
 - a) For Single core cables to be used in A.C system, the armouring over inner sheath shall consist of single layer of round copper wire.
 - b) For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanized steel wire.
 - vii) Outer Sheath
 - a) The extruded 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.
 - b) Minimum value of 'Tensile Strength' and 'Percentage elongation at rupture' shall be 8 Newton/Sq. mm and 250% respectively.
 - c) The colour of outer sheath shall be black or any other colour agreed mutually between Owner and Supplier.

18.04.03 Flexible Trailing Cables

1100 V Grade flexible trailing cable shall be tinned copper of Class – 5 of IS – 8130, heat resistant electrometric compound based on EPR insulation, inner sheath of heat resistant electrometric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty electrometric compound FRLS CSP outer sheath.



18.05.00 GENERAL REQUIREMENTS**18.05.01 Drum Length & tolerance**

- i) Cable shall be supplied in wooden drums. The standard single length of each drum shall be minimum 500 metres for large size of cable minimum 1000 metre for smaller size of cables.
- ii) 1.1KV Copper Fire Survival Power cables shall be supplied in wooden drums. Each drum shall be minimum 500 metres single length of cable.
- iii) Allowable tolerance on individual drum length is (+) 5%.

18.05.02 Non-standard length

Contractor shall be required to obtain Owner's approval before packing the non standard length of cables on drums. Non-standard lengths shall not be less than half of the standard packing length in any case.

18.05.03 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following:

- a) TANGEDCO
- b) Manufacturer's name or trademark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation and sheath, e.g. XLPE /PVC FRLS, IE2/SE3 F.S. as applicable.
- f) No. of core and size of cables.
- g) Sequential length marking at an interval of 1m through out the length of the cable.
- h) ISI mark with C/ML Number
- i) Type of improved fire performance, e.g. FR /FR-LSH /FS.

18.05.04 Packing

- i) Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction as per relevant IS. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden drums shall be treated by immersing in copper nitrate solution
- ii) Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment. Heat shrinkable cable seals shall be used for this purpose
- iii) A label shall be securely attached to each end of the reel indicating the length, type, voltage grade, conductor size and number of core of the cable. A tag containing the same information shall be attached to the leading end of the cable inside. An arrow and necessary instructions



shall be marked on the drum indicating the direction in which it should be rolled. Drum numbers are to be indicated on cable drums.

- iv) The cable drums should carry the following details in printed form (non returnable):-
- a) TANGEDCO & Manufacturer's name or trade make
 - b) Type of cable & voltage grade
 - c) Year of manufacture
 - d) Type of insulation / sheath e.g. XLPE /PVC FRLS, IE2/SE3 F.S. as applicable.
 - e) No. of core and size of cables
 - f) Cable code
 - g) Length of cable on drum
 - h) Direction of rotation, by arrow
 - i) Approx. gross mass.
 - j) ISI mark
 - i) IS / IEC number

18.06.00 TESTING PROCEDURE

18.06.01 Tests During Manufacture:-

During the manufacture of cables, manufacturer's standard tests shall be performed and record / test report shall be made available to Owner's representative during inspection / testing.

18.06.02 Type Tests:-

- i) Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.
- ii) These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted with in last 5 years from the zero date at an independent laboratory. If type test certificate are not available or in the case of type test report(s) are not found to be meeting the specification requirements, the same shall be conducted in the presence of the Owner free of cost.

18.07.00 SPECIAL TESTS ON PVC 'FR-LS' MATERIAL

- i) All the sizes of XLPE power cables of the 'FRLS' PVC sheathed type shall pass following special test requirements. Inner sheath wherever applicable shall also be of the 'FR-LS' type 'PVC' to meet these special tests:-
 - a) Oxygen/Temperature Index test on sheath material:-
 - b) This test shall be carried out as per American National Std. A STM-D-2863/77.
 - c) The minimum oxygen index shall be 29 at room temperature.



- d) For determination of the temp.index, the oxygen index test shall be carried out at different temperature upto 250°C. However, the test shall be carried out by extra-polation method beyond temperature at which the material of sheath may start deformation. The minimum temperature index (i.e. the temperature at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.
- ii) Acid gas emission test on sheath material:-
This test shall be carried out as per IEC Std. 754-1. The maximum acid gas emission shall be less than 20 by weight.
- iii) Smoke density test on sheath material:-
This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). The ASTM test method is compulsory. For passing this test, the requirement of light transmission shall be minimum 40% after the test.
- iv) Flammability test on finished cable sample:-
This test shall be carried out as per the following method:
- v) Swedish Std.SS:424-14-75 Class-F3. This test known as Swedish Chimney test is compulsory.
- vi) IEEE std. 383-1974 – This test known as the vertical tray flame propagation test shall be conducted if insisted by Owner.
- vii) IEC Std: 332-1. – The cable should meet the requirement of all the above standards.

18.08.00 ROUTINE TESTS

The following tests shall be carried out as Routine tests on each and every drum length of cable, as per IS 7098 (Part 2) / 1985:-

- a) High Voltage Test
b) Conductor Resistance Test
c) Partial discharge test (for screened cables) – on full drum length.

18.09.00 ACCEPTANCE TEST

- i) The following test shall be carried out as Acceptance Test in the presence of TANGEDCO Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis in each lot for the Acceptance Tests which shall be carried out at manufacturer's/supplier's cost:-
- a) High Voltage Test
b) Conductor Resistance Test



-
- c) Tensile / wrapping test.
 - d) Partial discharge test (In screened cables).
 - e) Insulation Resistance/Volume resistivity test
 - f) Measurement of thickness of insulation and sheath and other dimensions
 - g) Tensile strength & elongation at break for insulation & sheath.
 - h) Hot set test on XLPE insulation
 - i) Flammability test as per Swedish standard SS:424-15-75 Class-F-3 (Swedish Chimney test)
 - j) Acid gas generation test as per IEC-754-1.
 - k) Smoke density test as per ASTM-D-2843/1977
 - l) Oxygen index test as per ASTM-D 2863/1977
 - m) Temp. index test as per ASTM-2863/77
 - n) Test for Rodent and termite repulsion property

18.10.00 TEST WITNESS

Tests shall be performed in presence of Owner's representative. The Contractor shall give atleast fifteen (15) days advance notice of the date on which the tests are to be carried out.

18.11.00 TEST CERTIFICATES

- i) Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner's representative.
- ii) Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.
- iii) The cables shall be dispatched from works only after receipt of Owner's written approval of the test reports.

18.12.00 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



DATA SHEET

1100 V grade, power cable conforming to following requirement and in line with IS-1554, IS-5831, IS-8130 & IS-3975.			
S.NO.	DESCRIPTION	:	SPECIFICATION
1	Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2/stranded, high conductivity annealed plain copper, generally conforming to IS:8130
2	Insulation	:	Extruded Cross linked Polyethylene (XLPE).
3	Inner Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS: 5831 for multicore cable. Single core power cables need not be provided with any inner sheath.
4	Armour	:	Galvanised single round/ strip steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 grade for single core cables.
	Overall Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS: 5831.



SECTION – 19: CONTROL CABLES**19.01.00 SCOPE OF SUPPLY**

The cables shall be supplied, installed and commissioned in accordance with the following specification.

19.02.00 CODES & STANDARDS

- i) All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on zero date. 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:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 V.
IS: 2982	Copper conductor in insulated cables and cords.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanized 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	Drums for electric cables.
IS : 10810	Methods of tests for cables.
IEC: 60	High voltage test techniques
IEC: 230	Impulse tests on cables and their accessories
IEC: 287	Calculation of the continuous current rating of the cables(100% load factor).
IEC: 288	Nominal cross sectional area and composition of conductor of insulated cables.
IEC-331	Fire resisting characteristics of electric cables
IEC: 502	Extruded solid dielectric insulated power cables for rated voltages from 1kV upto 30kV.
IEC: 540	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEC -60332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)
IEEE-383	Standard for type test of Class IE Electric 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.
NES-715-1	Temperature index
SS-4241475 classF3	Swedish Chimney test
	SVENSK Standard SS-4241475 Class F3

- ii) BICC Hand Book For cables in fire regarding temperature index- chapter-6
- iii) Indian Electricity Rule.
- iv) Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.
- v) The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

19.03.00 DESIGN CRITERIA

- 19.03.01 The cables shall be used for connecting control circuits.
- 19.03.02 Cables shall be generally laid on overhead cable trays/cable trays in cable trenches. For interplant connection cables routed along overhead cable bridge.
- 19.03.03 Perforated type cable trays to be used for control cables. Only in cable risers ladder type cable trays can be used for control cables.
- 19.03.04 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.
- 19.03.05 The insulation and sheath materials shall be resistant to oil acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 19.03.06 The inner and outer sheath shall have flame retardant low smoke (FRLSH) characteristics or fire survival characteristics as the case may be, and shall meet the requirements of additional tests specified for the purpose.
- 19.03.07 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 sq.mm. For CT circuit minimum size shall be 4.0sq.mm copper. Control cables shall have 20% spare cores. For PT circuit minimum size shall be 2.5 sqmm
- 19.03.08 Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq.mm copper conductor exceeds this value, higher conductor sizes shall be used.



19.03.09 The cables shall be designed and manufactured in accordance with the best engineering practice and shall be such as has been proven to be suited for the intended purpose.

19.03.10 For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 975 amended upto date.

19.04.00 SPECIFIC REQUIREMENTS / CONSTRUCTIONAL REQUIREMENTS

19.04.01 1100 V Copper Conductor PVC FRLS Control Cables

1100 Volt grade, control cables with stranded copper conductors, PVC Insulation Type A, extruded FRLS PVC, of type ST1 Inner sheath, round wire/strip armour as specified elsewhere in the specification and extruded FRLSPVC, of type ST1 overall sheath. The cables shall be suitable for use in 1100V non-effectively earthed system. Control cable shall generally conform to IS 1554 latest and have ISI marked with C/ML Number. Armour shall be GS.

19.04.02 Conductor

Conductor shall be stranded, non-compacted & circular, high conductivity annealed, plain (untinned) copper conductor. Conductor shall be generally conforming to Class-II of IS 8130.

19.04.03 Insulation

The conductors shall be insulated with PVC compound conforming generally to type-A of IS:5831/1984 amended up to date ,except for the special properties / parameters, necessary at normal operation.

19.04.04 Inner Sheath

The laid up insulated cores of twin and multicore control cables shall be provided with an inner sheath of extruded FRLSPVC, compound conforming to Type ST1 of IS:5831/1984 amended up to date.

19.04.05 Armouring

For cables up to and inclusive 7 cores, galvanized round steel wire armour shall be provided. However, for control cables above 7 cores, galvanized steel strip armour shall be provided.

The armouring wire/strip shall generally conforming to IS: 3975 amended up to date.

19.04.06 Overall Sheath

A tough overall sheath of extruded FRLSPVC,Compound conforming to type ST1 of IS: 5831/1984 shall be provided over armour. The colour of outer



sheath shall be black or any other natural colour (with prior approval of the Owner).

19.04.07 1100 V Copper Conductor Fire Survival Control Cables

Fire survival cable shall be of copper conductor and comply with IEC-60331 (withstanding 750 degree C temperature for 3 hours). Also the halogen acid contents in outer sheath shall not be more than 2% when tested as per IEC-60754 and the smoke density in percent light absorption shall not exceed 20% when tested as per ASTM-D-2843. 1.1 kV earthed grade fire survival cables shall constitute the following:

- Circular/shaped stranded and compacted annealed copper conductor
- Elastomeric materials (XLPE, EPR, SR, or LSOH) insulated
- Glass mica tapped
- Extruded FRLS compound or LSOH material as inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS compound or LSOH material as inner sheath

19.04.08 Laying Up Of Cores (For Multi Core Cables Only)

- i) The core shall be suitably identified in accordance with IS: 9968 (Part-I).
- ii) The suitable fire retardant material fillers shall be used for filling in the interstices.
- iii) Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

19.04.09 Inner Sheath

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.

19.04.10 Armour

The armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 3975 amended up to date.

19.04.11 Outer Sheath

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.

The colour of outer sheath shall be black or any other natural colour agreed mutually between Owner.



19.05.00 GENERAL REQUIREMENTS**19.05.01 Drum Length & Tolerance**

- i) The cable shall be supplied in wooden drums. Each drum shall be minimum 1000 meters single length of cable. For above cable drums, allowable tolerance on individual drum length is +/- 5%.
- ii) 1.1KV Copper Fire Survival control cables shall be supplied in wooden drums. Each drum shall be minimum 500 metres single length of cable. Allowable tolerance on individual drum length is +5%.

19.05.02 Non-standard length

Bidder shall be required to obtain Owner's approval before packing the non standard length of cables on drums. Non-standard lengths shall not be less than half of the standard packing length in any case.

19.05.03 Cable identification

- i) Cable identification shall be provided by embossing on every meter on the outer sheath the following:
 - a) TANGEDCO
 - b) Manufacturer's name or trademark
 - c) Voltage grade
 - d) Year of manufacture
 - e) Type of insulation and sheath, e.g. PVC/ FRLS, IE2/SE3/FS as applicable.
 - f) No. of core and size of cables.
 - g) Sequential length marking at an interval of 1m through out the length of the cable.
 - h) ISI marked with C/ML Number
- ii) Type of improved fire performance eg. FR/FR-LSH-FS

19.05.04 Packing

- i) Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction as per relevant IS. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage.
- ii) Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.
- iii) A label shall be securely attached to each end of the reel indicating the length, type, voltage grade, conductor size and number of core of the cable. A tag containing the same information shall be attached to the leading end of the cable inside. An arrow and necessary instructions



shall be marked on the drum indicating the direction in which it should be rolled. Drum numbers shall be indicated on cable drums.

- iv) The cable drums should carry the following details in printed form (non returnable):-
- a) TANGEDCO & Manufacturer's name or trade make
 - b) Type of cable & voltage grade
 - c) Year of manufacture
 - d) Type of insulation / sheath e.g. PVC/ FRLS, IE2/SE3/FS. as applicable.
 - e) No. of core and size of cables.
 - f) Cable code.
 - g) Single length of cable on drum
 - h) Direction of rotation, by arrow
 - i) Approx. gross mass.
 - j) ISI mark.

19.06.00 TESTING PROCEDURE

19.06.01 1100 V Copper Conductor PVC FRLS Control Cables

i) Type Tests:-

Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.

- a) These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available or in the case of type test report(s) are not found to be meeting the specification requirements, the same shall be conducted in the presence of the Owner without cost implication.

ii) Special Tests On PVC 'FRLS' Material

All the sizes of 1.1 KV Grade PVC insulated, PVC Control cables of the FRLSH sheathed type shall pass these special test requirements. Inner sheath wherever applicable shall also be of the 'FRLSH' type 'PVC' to meet these special tests.

iii) Oxygen/Temperature Index Test On Sheath Material

- a) This test shall be carried out as per American National Std. ASTM-D-2863/77. The minimum oxygen index shall be 29 at room temperature.
- b) For determination of the temp index, the oxygen index test shall be carried out at different temperature upto 250°C. However, the test shall be carried out by extrapolation method beyond temperature at which the material of sheath may start deformation. The minimum temp. index (i.e. the temperature



at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.

iv) Acid Gas Emission Test On Sheath Material

This test shall be carried out as per IEC Std. 754-1. The maximum acid gas emission shall be less than 20% by weight.

v) Smoke Density Test On Sheath Material

- a) This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). The ASTM test method is compulsory. For passing this test, the requirement of light transmission shall be minimum 40% after the test (Corresponding to 60 % smoke density).

vi) Flammability Test On Finished Cable Sample

- a) This test shall be carried out as per the following method:-

- i) Swedish Std.SS:424-14-75 Class-F3. (This test known as Swedish Chimney test is compulsory).
- ii) IEEE std. 383-1974 – This test known as the vertical tray flame propagation test shall be conducted if insisted by Owner.
- iii) IEC Std: 332-1. – The cable should meet the requirement of all the above standards.

vii) Routine Tests

- a) The following tests shall be carried out as Routine tests on each and every drum length of cable, as per IS: 1554 / IS: 8130/1984.

- 1) High Voltage Test.
- 2) Conductor Resistance Test.

viii) Acceptance Test

- a) The following test shall be carried out as Acceptance Test in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis for the Acceptance Tests.

- i) Tensile / wrapping test.
- ii) High Voltage Test.
- iii) Conductor Resistance Test
- iv) Insulation Resistance/Volume resistivity test.
- v) Measurement of thickness of insulation and sheath and other dimensions.



-
- vi) Tensile strength & elongation at break for insulation & sheath.
 - vii) Flammability test as per Swedish standard SS: 424-15-75 Class-F-3 (Swedish Chimney test).
 - viii) Acid gas generation test as per IEC-754-1.
 - ix) Smoke density test as per ASTM-D-2843/1977.
 - x) Oxygen index test as per ASTM-D 2863/1977.
 - xi) Temp. index test as per ASTM-2863/77
 - xii) Test for Rodent and termites repulsion property

19.06.02 1100 V Copper Conductor Fire Survival Control Cables

i) Type Tests

Cables shall be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the zero date shall be submitted.

These reports shall be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available the same shall be conducted in the presence of the Owner.

ii) Routine Tests

- a) The following test shall be carried out as Routine Tests on each and every delivery length of cable:-

- | | | | |
|----|---------------------------|---|---------------|
| 1) | High Voltage Test | - | IS: 9968 (I) |
| 2) | Conductor Resistance test | - | IS: 8130/1984 |

iii) Acceptance Tests

- a) Following tests shall be carried out as acceptance tests in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 drums or less shall be selected on random sampling basis:-

- | | | | |
|----|---|---|--------------|
| 1) | Annealing Test | - | IS 9968 (I) |
| 2) | High Voltage test
(Water immersion Test) | - | IS 9968 (I) |
| 3) | Conductor resistance test | - | IS8130/1984 |
| 4) | Insulation Resistance Test | - | IS6380/1984 |
| 5) | Measurements of thickness of
Insulation and sheath and other
Dimensions | - | IS: 9968(I) |
| 6) | Tensile strength & elongation at | - | IS 6380/1984 |



	Break for sheath	
7)	Tensile strength and elongation at - -As per GTP break of sheath	IS 6380/1984
8)	Oxygen index test on inner & outer - 2863/77	ASTM-D-
	Sheath material at room temperature	Min.29 degC
9)	Temp. index test on inner & outer material sheath	- ASTM-D- 2863/77 Min 350 degC IEC-331
10)	Acid gas emission test on inner & sheath material	Acid gas shall be outer less than 2% generation IEC-754-1
11)	Smoke density test on inner & outer material	Max smoke sheath density shall not exceed 20% in percentage light Absorption. ASTM-D-2863/77
12)	Flammability test on finished cable Sample as per following method	
	a) Fire Survival Test	IEC -331
	b) Swedish Chimney Test	SS-424-14-75 Class-F3)

19.07.00 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



DATA SHEET

1100 V grade, PVC Control cable conforming to following requirement and in line with IS-1554, IS-8130, IS-5831 & IS-3975.

S.NO.	DESCRIPTION	:	SPECIFICATION
1	Conductor	:	Conductor shall be Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS:8130.. Conductor shall be generally conforming to Class-II of IS 8130.
2	Insulation	:	The conductors shall be insulated with PVC compound conforming generally to type-A of IS:5831/1984 amended up to date
3	Inner sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS: 5831 for multicore cables. Single core cables shall have no inner sheath
4	Armour	:	For cables up to and inclusive 7 cores, galvanized round steel wire armour shall be provided. However, for control cables above 7 cores, galvanized steel wire/strip armour shall be provided.
5	Overall sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831



SECTION-20: CABLING SYSTEM**20.01.00 SCOPE OF WORK**

20.01.01 The scope of work covers supply, erection, testing and commissioning of complete electrical system including cabling, fire stop mortar seal, fire retardant cable coating system etc. the scope shall broadly cover, but not be limited to:

- i) TG Building & Transformer Yard
- ii) Boiler Area, ESP
- iii) All auxiliary buildings (including electrical rooms of respective buildings) and structures as per details in the general electrical specification/ plot plan & related drawings.
- iv) Service Building
- v) CPU Regeneration Building
- vi) Fuel Oil Pressurisation Pump House
- vii) DG House
- viii) Pipe cum cable rack (within the battery limits).
- ix) Air Washer Units
- x) All electrical equipment as described in different sections.
- xi) As built drawing for all above systems on completion of project.

20.01.02 The scope of work shall also include all civil and structural works necessary for successful installation, commissioning & commercial operation of all electrical equipment to be erected under this specification.

20.02.00 SCOPE OF SUPPLY

20.02.01 The equipments and materials within the scope of supply shall include but not limited to:-

- i) Power & control cabling works (including that of special cables):
- ii) Galvanized steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, cable trays supporting structures etc.
- iii) Supply and installation (including laying & termination) of control cables, special cables, instrumentation cables for all equipments and systems.
- iv) Supply and installation (including laying & termination) of all power cables (HV, MV and LV) for all equipments and systems.
- v) Cable routing has to be planned such that it shall not cross the steam lines, oil lines.
- vi) Fire Sealing Arrangement: All cable entries into the panel (HV & MV & LV SWGR panels) should be provided with fire sealing arrangements.
- vii) Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS



shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.

- viii) Galvanized steel rigid/ flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts etc as required.
- ix) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- x) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the Bidder without any extra charge to the Owner.
- xi) Thickness of galvanizing on steel sections shall be not less than 610 gm/sq.m on all steel sections.

20.03.00 CODES AND STANDARDS

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

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubular and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables up to and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of practice for the protection of building and allied structures against lighting.
IS:2629	Recommended practice for hot dip galvanising of iron & steel.
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:6745	Method for determination of mass of zinc-coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in-line connectors for aluminium conductors of insulated class.
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.



IS:9595	Metal – arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 3.3kv up to and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints

20.03.02 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. shall also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder 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 zero date and shall clearly bring out the salient features for comparison.

20.04.00 DESIGN AND CONSTRUCTIONAL FEATURES

20.04.01 Inter Plant Cabling

Interplant cabling for main routes shall be laid along overhead trestles/ pipe racks. However, from tap-offs, same can be through shallow trenches. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering.

20.04.02 Cable entry

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

20.04.03 Trenches

- i) PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.
- ii) No subzero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant areas.
- iii) All field switches for equipments corresponding to a stream located within a radius of 4-5 m shall be wired out to a field junction box and from field junction box to control panel/Input – Output cabinet by screened instrumentation cables.
- iv) Cable trenches shall be provided in Transformer Yard and Switchgear/MCC rooms. In other areas local cable trenches with length not exceeding 5 metres are allowed just near the equipment.



- v) Two separate cable routes one on each side shall be provided for each boiler unit. Cables for one set of auxiliaries such as ID,FD & PA fans & half of the coal mills shall be routed in one route & for through other set of auxiliaries through other route.
 - vi) Bidder shall provide two independent routes for cables between Switchyard Control Room & Main Plant Control Room. Bidder shall provide the cable trays along with its supporting structure arrangement on the trestle.
- 20.04.04 Cable Vault:
- i) Cable vault of not less than 3.5 metres clear height shall be provided.
 - ii) Clear access passage of at least 750 mm wide & 2.0 Mts clear height shall be provided at entrances & along cable ways. Wherever the passage is through cable routes clear height shall not be less than 1.5 Mts.
 - iii) Cable vaults shall be provided with adequate drainage facility for drainage of fire water.
 - iv) Each cable vault should have two fire proof doors.
 - v) Exit signs shall be provided near doors for personnel escape in case of emergency.

20.05.00 EQUIPMENT DESCRIPTION

20.05.01 Cable trays, Fittings & Accessories

- i) 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 HV, MV & LV power cables and perforated type for control & instrumentation cables. However in vertical risers ladder cable trays shall be used for control & instrumentation cables also.
- ii) These shall be prefabricated hot dip galvanized sheet steel trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- iii) Cable trays shall have standard width of 600 mm, however trays with 450mm, 300mm & 150mm may be used in places considering the requirement and space constraint. The trays shall have 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.
- iv) 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.



- v) Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 1500 mm. 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/75 microns respectively. The amount of zinc deposit shall not be less than 610 gm per square meter.

In areas, where acid/alkalie ingration is likely (such as Battery Room, etc.) to occur, Fibre Reinforced Plastic trays with fire retardant corrosion resistance properties shall be used.

20.05.02 Support System for Cable Trays

- i) Cable tray supports shall be fabricated from standard steel structures of different structures of different sizes. The sizes selected shall be adequate for the weight of cables/trays encountered.
- ii) The steel members shall be cleaned thoroughly for rust and painted as follows:-
- For indoor One shop coat of red oxide zinc chromate primer and two site coats of aluminium alkali paint.
 - For outdoor & corrosive areas like battery room – Hot dip galvanised.

20.05.03 Pipes, Fittings & Accessories

- i) 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
- ii) GI Pipes shall be of medium duty as per IS: 1239.
- iii) 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.

20.05.04 Junction Boxes

- i) Junction box with IP 55 degree of protection shall comprise of a case with hinged door constructed from FRP material. The junction box shall be provided with canopy. The boxes shall include brackets, bolts, nuts, screws, glands, lugs, M8 earthing stud etc.
- ii) Terminal blocks shall be of 650 Volt grade, rated for 10 A and in one piece moulding. It shall be complete with insulating barriers, clip-on-type terminal numbering on wiring diagrams. Terminal block shall be suitable for terminating 2Cx2.5mm² cable on both sides and arranged to facilitate easy termination. Cable entry shall be from bottom.
- iii) The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable / conduit entry knockouts and terminals.



- iv) Junction boxes shall be of two types viz one suitable for control wiring and the other with terminals for power cable terminations. Junction boxes for power cable terminations shall have minimum nine (9) Nos. of terminals. Size of terminals shall be suitable to accommodate cables of sizes as required.
- v) The junction boxes shall have the following indelible markings:-
 - a) Circuit Nos. on top by white-stenciled paint at site.
 - b) Circuit Nos. with ferrules (inside) as per approved drawing.
 - c) Danger sign in case of 415 V circuit.
 - d) Junction boxes shall be provided with two Nos. (2) earthing terminals complete with nuts and washers suitable for connection to 8 SWG G.I. wire.

20.05.05 Terminals

- i) Multi-way terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.
- ii) Each control cable terminal shall be suitable for connection of N nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

20.05.06 Terminations & Straight through Joints

- i) Termination and jointing kits for 11/6.6 kV grade XLPE insulated cables shall be of proven design. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 11/6.6 kV grade joints and terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. The kit shall be complete with the aluminium solder less crimping type cable lugs & ferrule as per DIN standard.
- ii) Straight through joint and termination shall be capable of withstanding the fault level for 11 kV and 6.6 kV systems.
- iii) 1.1 KV grade straight through joints shall be of proven design.

20.05.07 Cable glands

- i) Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful Bidder.



- ii) Cable glands shall be double compression type. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE. Cable glands shall match with the sizes of different HV/MV/LV/Control cables.

20.05.08 Cable lugs/ferrules

- i) The cables lugs shall be conforming to IS: 8309.
- ii) Machine ferruling shall be adopted.
- iii) Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.
- iv) The cable lugs for control/instrumentation/ telephone cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.
- v) Cable lugs shall be suitable for termination of different cross-sections of control/ instrumentation /telephone cables and shall be of following types.
- vi) Copper tubular terminal end for solder less crimping to copper conductors.
- vii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the pan.
- viii) Pin type lugs shall not used.
- ix) Aluminium tubular terminal ends for solder less crimping of two Aluminium conductor.
- x) Solder less crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

20.05.09 Cable Clamps & Straps

- i) The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.
- ii) Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak.



20.05.10 Galvanizing

- i) Galvanizing of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots.
- ii) The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

20.05.11 Welding

The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595.

20.06.00 CONSUMABLES AND HARDWARE

20.06.01 The Bidder shall furnish all erection materials, hardware and consumables required to complete the installation.

20.06.02 The materials shall include but not limited to the following:-

- i) Consumables: Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.
- ii) Hardware: Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.
- iii) Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Bidder.

20.07.00 METHODS AND WORKMANSHIP

20.07.01 All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

20.07.02 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the government.

20.07.03 All details on installation shall be electrically and mechanically correct.

20.07.04 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

20.08.00 INSTALLATION

20.08.01 Cable Tray and Support System Installation

- i) Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other



building structures. All cable trays shall be in vertical configuration in boiler areas.

- ii) Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per relevant Standard. The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant approved tray layout drawings.
- iii) All cable way sections shall have identification, designations as per approved cable way layout as and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.
- iv) In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Bidder shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining Owner's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

20.09.00 CONDUITS/PIPES/DUCTS INSTALLATION

- 20.09.01 The Bidder shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Bidder.
- 20.09.02 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.
- 20.09.03 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.
- 20.09.04 Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 150 to the trench wall. In case of larger dia cables i.e. 50mm and above, adequately sized pipe with larger bend radius shall be



provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Site Engineer.

- 20.09.05 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	Spacing
Up to 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm	3.0 M

- 20.09.06 In areas like WTP, chemical handling, battery room etc. exterior surface of the conduits shall be further coated with chromate or polymer for better resistance to corrosion.

- 20.09.07 All G.I. pipes shall be laid as per approved layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the Bidder), all the burrs from the pipes shall be removed. The bends formed shall be smooth. GI Pipes with bends shall be buried in oil/concrete in such way that that the bends shall be totally concealed. For GI pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Bidder. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the Bidder at no extra cost.

20.10.00 JUNCTION BOXES INSTALLATION

- 20.10.01 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the approved drawings or as decided by Owner and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

20.11.00 CABLE LAYING AND INSTALLATION

- 20.11.01 Cable network shall include power, control, lighting, communication and fire alarm system cables, which shall be laid in trenches, cables trays/conduits as detailed in the approved drawings and cable schedules. Erection of cable trays and aligning and leveling as required shall be the responsibility of the Bidder.

- 20.11.02 Cable installation shall be carried out as per IS: 1255 and other applicable standards. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be



rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

- 20.11.03 Laying of cables directly buried in ground is not acceptable.
- 20.11.04 All tray levels shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings. The Bidder shall have to secure rack/tray supports by welding to those inserts, suitable embedded steel inserts shall be provided. Outdoor trays shall be installed by welding on the steel/concrete structure with inserts by the Bidder. As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.
- 20.11.05 While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.
- 20.11.06 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all cables shall be tapped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.
- 20.11.07 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls columns. Cables shall be so routed that they shall not be subjected to heat from adjacent hot piping or vessels.
- 20.12.00 LAYING OF CABLES IN CABLE TRAYS**
- 20.12.01 Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on approved drawings, Bidder shall route these as directed by the Owner.
- 20.12.02 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.V. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays.

Trefoil Cable Clamps

- Clamps required for single core cables carrying alternating current shall be suitable for holding three cables together in delta formation. Clamps shall be of FRP material.



- Clamps shall be of suitable sizes to firmly hold the cables of various outer diameters including tolerance in OD.
- Clamps should have been type tested for Short Circuit Withstand Test.
- For Trefoil clamps run spacing shall be 2000 mm and axial spacing shall be double the diameter of larger adjacent trefoils cable or 150 mm whichever is less. Supports shall also be provided at each bend

Omega Cable clamps

- Omega clamps shall be of galvanized mild steel and shall be used to fasten the individual multi-core cables.
- Clamps shall be of simple construction, made of 2 mm thick, 25 mm wide strip of omega shape and suitable for clamping on the rungs / perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different outer diameters of cables. Omega cable clamps shall be used for individual cables above 35 mm outer diameter.
- Steel clamps shall be hot dip galvanized. Weight of zinc not less than 610 grams. per sq. metre
- For cables of above 35 mm OD, cables shall be individually clamped at 5000 mm interval for Horizontal runs and shall be individually clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables of up to 35 mm OD, cables shall be collectively clamped at 5000 mm interval for Horizontal runs and shall be collectively clamped at 1000 mm interval for Vertical runs. Supports shall also be provided at each bend.
- For cables supported along structures/ceiling, clamp spacing shall be 750 mm. Supports shall also be provided at each bend.

Strip Cable Clamps

- Strip clamps shall be of galvanized mild steel and shall be used to fasten the group of multi-core cables up to 35 mm diameter only on a full or part of the tray width.
- Clamps shall be of simple construction, made of 3 mm thick Steel, 25 mm wide strip to cover the entire width up to 300 mm wide tray and part of the tray for more than 300 mm wide trays. Strip shall have two right angle bends at each end for fixing on to the rung/ perforated sheet of tray with the help of two bolts.
- Clamps shall be of different sizes for different sizes of tray width. However, the maximum size of clamp shall be 300 mm and for cable trays of greater width, two clamps shall be used.
- Clamps shall be hot dip galvanized. Weight of zinc not less than 610 grams. per sq. metre

Self-locking Clamps

- Clamps shall be of FRP material. Clamps shall have self-locking feature when the cord is looped. Clamps shall be provided with manual lock release.
- Clamp cord shall not move in the backward position once it has been locked, unless the lock release is applied.
- Type test certificates to ascertain the strength of clamps shall be submitted for Owner's approval.
- Not more than four (4) cables shall be clamped together, wherever collective clamping is permitted.



- Clamp length shall be selected such that not more than 80% of lockable length is utilised for clamping.
- Nylon self-locking tie strips for collective clamping (up to 35 mm OD max. group of 4 cables) shall be 4 mm having Tensile strength 30 kg.
- Nylon self-locking tie strips for individual multicore clamping (above 35 mm OD up to 55 mm OD) shall be 4 mm having Tensile strength 20 kg.
- Nylon self-locking tie strips for individual multicore clamping (above 55 mm OD) shall be 7 mm having Tensile strength 60 kg.

All multicore cables shall be laid in touching formation. LT power cables above 95 sq.mm size shall be laid in single layer touching formation in trays while cables upto & including 95 sq.mm shall be laid in maximum of 2 layers. Control and Instrumentation cables can be laid upto a maximum of three layers in each tray.

- 20.12.03 All communication cables (telephone, P.A. System) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench/trays with a minimum clearance of 600mm away from electrical trench/trays as per the direction of Site Engineer and Communication cables shall cross power cables at right angles.
- 20.12.04 Power and control cables shall be secured fixed to trays/support with arrangement described above.
- 20.12.05 Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.
- 20.12.06 Individual cables or small groups which run along structures/walls etc shall be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables. Alternatively small group of cables can be taken through 100mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be drilled where the minimum weakening of the structure shall result.
- 20.12.07 **Multi core power cables, control and instrumentation cables shall be tied and secured with nylon self locking cable ties at an interval of 5 metres when laid in horizontal trays and at an interval of 2 metres when laid in vertical trays or in cable risers (raceway).**
- 20.12.08 Where cables cross roads/rail tracks, the cables shall be laid in Hume pipe/PVC pipe. At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends. The hume pipes shall be laid at a depth of minimum 1000mm such that cables are not damaged.
- 20.12.09 Power and Control Cables, as far as possible, shall be laid in complete, uncut lengths from one termination to the other. Straight through joints in power cable shall be allowed only in nearest of rare situation only after approval of Owner.
- 20.12.10 Joints for less than 250 Meters run of cable shall not be permitted.



- 20.12.11 In each cable run some extra length shall be kept at suitable point to enable one LV/two HV straight through joints to be made, should the cable develop fault at a later stage. Straight through joint and termination shall be capable of withstanding the fault level of 50 kA for 11/11 kV cables and 40 kA for 6.6/6.6 kV Cables. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 20.12.12 Wherever few cables are branching out from main trunk route troughs shall be used.
- 20.12.13 Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Bidder.
- 20.12.14 The Bidder shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule shall be prepared by electrical Bidder and get that approved by site engineer to minimize/avoid straight through joints. The actual number of straight through joints required shall be worked out by the Bidder. During the erection period the Bidder shall furnish a monthly report on cable position in an approved proforma so as to keep the Owner apprised of the position.
- 20.12.15 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Bidder shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
- 20.12.16 Electrical cable trays exposed to hazardous process fluid shall be covered with detachable G.I. covers. The covers shall be suitable to resist wind forces.
- 20.12.17 Separation
- i) Sufficient spacing not less than 300mm shall be provided between different tiers of trays and maintained to permit adequate access for installation and maintenance of cables.
 - ii) At least 300mm clearance shall be provided between:
 - HV power & LV power cables,
 - LV power & LV control/instrumentation cables,
- 20.12.18 Segregation
- i) Segregation means physical isolation to prevent fire jumping.
 - ii) Cables from two different services viz. supply from Station Board and Unit Board shall be segregated.
 - iii) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives



and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

20.13.00 CABLE FIRE SEALING

- 20.13.01 Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be seated by a fire proof sealing system (FPSS) of minimum 2 Hrs rating. The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.
- 20.13.02 Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for two hour shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.
- 20.13.03 In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

20.14.00 Cable laying in trenches

- 20.14.01 RCC cable trenches with removable covers shall be provided by the Bidder for areas as mentioned in Cl 1.35.00 of Chapter - 1.
- 20.14.02 For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.
- 20.14.03 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover tilt such times the final termination to the equipment is completed.
- 20.14.04 Prior to laying of cables inside both indoor and outdoor trenches, the Bidder shall properly clean inside of those trenches.
- 20.14.05 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer. Space between individual tiers shall be filled and compacted with soil and sand.
- 20.14.06 As each row of cables is laid in place and before covering with sand every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 20.14.07 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.



- 20.14.08 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.
- 20.14.09 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.
- 20.14.10 Following guide of the pipe fill shall be used for sizing the pipe size:-
- i) 1 cable in pipe - 53% full
 - ii) 2 cables in pipe - 51% full
 - iii) 3 or more cables - 40% full
- 20.14.11 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and no separate payment shall be allowed.
- 20.14.12 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings shall be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical Bidder shall determine their location and obtain approval of the Site Engineer before cutting is done.
- 20.15.00 CABLE IDENTIFICATION**
- 20.15.01 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry & exit, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables.
- Cables shall be provided with cable number tags for identification.
 - Cable tags shall be of aluminium.
 - Cable numbers shall be engraved type
 - Tags shall be of durable quality of size 60 mm x 12 mm with a tie hole at each end.
 - Samples of tags shall be approved by the Owner before delivery.
 - Tags shall be provided with non-corrosive wire of sufficient strength for tagging.
- 20.15.02 If laying of underground cable is specifically agreed by Owner as a special case then the underground cables shall be provided with identity tags of Stain less steel securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas cable trenches shall be identified by means of markers. These posts shall be placed at location of changes in the direction of cables and at intervals of not



more than 30 M for straight run and at cable joint locations with additional inscription 'Cable Joint'. For buried cables the marker shall project 150mm above ground.

- 20.15.03 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

20.16.00 CABLE TERMINATIONS & CONNECTIONS

- 20.16.01 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer's instructions, drawings and/or as directed by Site Engineer. Cable jointer shall be qualified to carry out satisfactory cable jointing/termination. Bidder shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.
- 20.16.02 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Site Engineer.
- 20.16.03 Responsibility of proper termination shall lie on the Bidder. Guarantee for termination shall also have to be given by the Bidder.
- 20.16.04 The equipment shall be generally provided with undrilled gland plates for cables/conduit entry. The Bidder shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
- 20.16.05 Bidder shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. If the cable end box or terminal chamber provided on the equipment is found unsuitable and requires major modifications the same shall be carried out by the Bidder at the discretion of the Engineer-in-Charge.
- 20.16.06 Control cable cores entering control panel/switchgear /MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
- 20.16.07 The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' along with cable numbers and coiled up after end sealing.
- 20.16.08 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
- 20.16.09 It is the responsibility of the Bidder to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.



- 20.16.10 All cables upto 1.1KV grade shall be terminated at the equipments by means of compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.
- 20.16.11 All cable entries shall be through bottom only and top entry terminations are made only after getting approval of Site Engineer.
- 20.16.12 Power cables, wherever colour coding is not available, shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
- 20.16.13 In case of control cables all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules. Wire numbers shall be as per schematic/ wiring/ inter-connection diagram. Bidders shall have the samples of PVC markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends. Control cables shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
- 20.16.14 Where threaded cable gland is screwed into threaded opening of different size, suitable brass threaded reducing bushing shall be used provided.
- 20.16.15 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.
- 20.16.16 In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom, close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.
- 20.16.17 Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors.
- 20.16.18 Crimping shall be done by hand crimping/hydraulically-operated tool and conducting jelly shall be applied on the conductor.
- 20.16.19 Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.
- 20.16.20 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.
- 20.16.21 All cable entry points shall be properly sealed and made dust and vermin proof. Unusual opening, if any, shall be effectively closed. Sealing work shall



be carried out with approved sealing compound having fire withstand capability for at least three hours.

20.17.00 Cable accessories for H.V. Systems

20.17.01 The H.V. cables terminations/joints shall be done by skilled and experienced jointers duly approved by the Site Engineer.

20.17.02 The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered by the Bidder or the type of cables issued by Owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction shall be included in each kit.

20.17.03 The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor. The termination kits shall preferably be as of the following types.

4.1.1 i) Termination kits shall be 'Push on type' or 'heat shrinkable type'.

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

20.17.04 The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water.

However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of Owner.

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

20.18.00 CLEANING UP OF WORK SITE

20.18.01 The Bidder shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

20.18.02 Upon completion of work, the Bidder shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

20.19.00 QUALITY ASSURANCE PROGRAMME

20.19.01 Bidder 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.



20.20.00 TESTS**20.20.01 Routine / Acceptance Tests**

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied:

20.20.02 Galvanizing Tests

- i) The quality of galvanizing shall be inspected visually and shall be smooth, continuous, and free from flux stains.
- ii) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.
- iii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplanted areas, blisters and modules.
- iv) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

20.21.00 WELDING

20.21.01 The quality of welding shall be visually inspected, particular attention being paid to the following points:-

- i) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.
- ii) The weld metal shall be properly fused with the parent metal without undercutting.
- iii) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.
- iv) Physical and dimensional checks for all items.
- v) All conduits/pipes, etc. shall be routine/acceptance tested as per relevant standards.
- vi) All acceptance and routine tests on cable glands as for BS: 6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.
- vii) Deflection test cable trays.
- viii) All acceptance and routine tests on Junction boxes.
- ix) Following tests shall also be carried out on each type of equipments, devices and materials/items supplied:-
 - a) Physical and Dimensional checks



- b) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.
- c) Check chemical composition of brass parts for cable glands.
- d) Hardness check on gaskets.
- e) Test for uniformity of galvanization.

20.22.00 CABLE TRAYS / SUPPORTS AND ACCESSORIES

- 20.22.01 Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
- 20.22.02 Check for continuity of cable trays over the entire route.
- 20.22.03 Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- 20.22.04 Check for earth continuity and earth connection of cable trays.
- 20.22.05 Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage.
 - General arrangement drawings
 - Technical data sheet
 - Test reports
 - Installation details for junction boxes
 - Sub-vendor list
 - Manufacturing quality plan
 - Field quality plan



SECTION – 24: EARTHING & LIGHTNING PROTECTION**24.01.00 GENERAL**

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site and delivery Grounding and Lightning system complete with all accessories for efficient and trouble-free operation of 2 x 800 MW Supercritical Coal Based Uppur Thermal Power Project in Ramnathapuram District, Tamil Nadu for TANGEDCO.

24.02.00 CODES AND STANDARDS

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments. All work shall be carried out as per the following standards/ codes as applicable.

CODE	NAME OF STANDARD
IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables up to and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables



IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal – arc welding of carbon and carbon manganese steels – recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type, for Aluminum conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.
	National Electrical Code, 1985.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, VDE etc. shall also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidders shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments.

24.03.00 GROUNDING & LIGHTNING PROTECTION

24.03.01 General

The main objectives of grounding system are to:

- a) Provide safety to personnel from contact of dangerous potential caused by ground fault.
- b) Ensure sufficient grounding current for effective relaying.
- c) Stabilize circuit potential with respect to ground.
- d) Contractor shall carry out earth resistivity test of power project site within battery limit and shall establish homogeneous soil resistivity for earthing design. Number of earth resistivity test locations shall be not less than 15. The test locations shall be subject to Owner's approval.

24.03.02 Grounding system

- i) In order to meet the above objectives, ground grid mesh shall be provided for the entire area within battery limit.
- ii) Fault current for the earthing system shall be designed for 50 KA for duration of 1 sec.



- iii) All electrical equipment, non-current carrying metal parts, structures, building steel, lightning protection system, transformer neutrals shall be connected to this station ground grid.
- iv) Treated earth pits including riser shall be provided for Transformer neutral earthing.
- v) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.
- vi) Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.
- vii) The major aspects to be considered for grounding system design are given below:

24.03.03 Ground Grid Conductor

- i) Ground grid conductor of mild steel rod shall be used.
- ii) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm (on diameter of conductor) per year over the design life of 40 years.

24.03.04 Underground Grid

- i) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80.
- ii) The ground grid conductors shall be buried in earth at a depth of 600 mm. However suitable precaution to be taken wherever under ground drains / Trenches are passing through it. The length of ground conductors below earth shall be sufficient to ensure a ground resistance less than one (1) ohm for each area/building.
- iii) The ground grid conductor shall be so laid as to provide short and direct connection to building steel and major electrical equipment.
- iv) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.
- v) All ground grid conductor connections shall be welded type.
- vi) Earth mat of each area/building (ie Main Plant Building, Transformer Yard, Service Building, DG Building and CPU Regeneration building etc) shall be interconnected with the earth mat conductor of the neighbouring area at atleast two (2) points for further reducing the ground grid resistance.
- vii) A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes,



foundations, railway tracks etc. The ground grid conductor shall be re-routed in case it fouls with equipment foundations.

- viii) In some cases, it may happen that the construction work of cable trench, foundation and laying of underground pipes are being taken up after the grounding mat has been laid. It may be required to cut a portion of grounding conductor to avoid fouling with cable trench, equipment foundations, underground pipes etc. In this case, the ground conductor shall be properly rerouted and rejoined/reconnected with the main grounding mat during the construction/laying of above underground objects and good electrical continuity of grounding conductor shall be ensured.
- ix) Grounding conductors crossing the road may have to be laid at greater depth to suit the site conditions.
- x) Grounding conductor around the building shall be buried in earth at a minimum distance of 1200 mm from the outer boundary of the building.
- xi) The Bidder shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc.

24.03.05 Ground Electrode

Ground electrodes shall be 40 mm dia. and 3 metre long M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductors. All connections to the conductors shall be done by arc welding process.

24.03.06 Above Ground Connections

- i) Galvanised steel flats shall be used for all connections above earth.
- ii) Inside building, ground conductors shall be run for each floor supported on building steel and/or cable trays. These ground conductors in turn shall be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.
- iii) Two separate and distinct ground connections shall be provided for each electrical equipment in compliance with I.E. Rules.
- iv) All connections above ground shall be welded type except connection to equipment/structures which shall be bolted type.

24.03.07 Column Grounding

All steel columns and structures shall be connected to the earth mat through 40 mm dia M.S. rods. All welded joints shall be painted to protect from rusting.

24.03.08 Risers

Risers are required for connecting the equipment and structures with the ground mat. Risers are to be provided from underground mat to above ground levels where the ends shall be left free for connecting to the equipment. Each riser



shall be 1 No. 40 mm dia. M.S. rod and shall project above grade level/concrete floor level by minimum 300 mm. They are to be clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding.

24.03.09 Equipment Ground Lead

- i) Equipment ground connections shall be sized to carry the ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.
- ii) The minimum ground conductor sizes for various equipment and structures are given in below.

DESCRIPTION	SIZE	MATERIAL
a) Main Grounding Grid Conductor	40 mm dia Rod	Mild Steel
b) Riser/Pigtail From Grounding Grid/Mat	40 mm dia Rod	Mild Steel
c) Electrode	40 mm dia, 3000 mm long Rod	Mild Steel
Conductor used for connection of various equipment/structures as listed below		
i) TGs, GTs, UATs and IPBD	75 x 10 mm	GI Flat
ii) Transformer body	75x10 mm	GI flat
iii) 11 kV & 6.6 kV Switchgears, Motors	75 x 10 mm	GI Flat
iv) 415V Switchgear, MCCs, Battery Charger, distribution Boards	75 x 10 mm	GI Flat
v) Sub-mat	75 x 10 mm	GI Flat
vi) 415 Motors		
1) Above 100 KW upto 200 KW	75x10 mm	GI Flat
2) Above 55 KW upto 100 KW	40x6 mm	GI Flat
3) Above 22 KW upto 55 KW	40x6 mm	GI Flat
4) Above 5.5 KW upto 22 KW	25 x 6 mm	GI Flat
5) Upto 5.5 KW	4 SWG	GI Wire
vii) Cable Trays	40 x 6 mm	GI Flat



viii) Control Panel & Control Desks etc.	40 x 6 mm	GI Flat
ix) Steel Column	75 x 10 mm	GI Flat
x) Fence and Gate	40 x 6 mm	GI Flat
xi) Push Button Stations	8 SWG	GI Wire
xii) Lighting panel, Junction Boxes	4 SWG	GI Wire
xiii) System neutrals (for service transformers)	1Cx400 sqmm	XLPE cable
xiv) Lighting Fixtures & Receptacles	14 SWG	GI Wire
xv) Welding Outlets	8 SWG	GI Wire
xvi) Rails	40 x 6 mm	GI Flat

- iii) 75 x 10 mm galvanized steel flats(minimum size) shall be run as main earthing conductors above ground along building columns, walls, steel structure, etc. for equipment and other structures earthing. These earthing conductors shall be interconnected between them and to the main ground grid through risers/pigtail. The connection between earthing conductor and riser shall be made above ground. Earthing conductors along their run on column, wall etc. shall be supported by suitable welding/clamping at intervals set exceeding 750 mm.
- iv) Earthing conductors can be embedded in concrete floor of the building wherever necessary without having direct contact with the reinforcement rods. At the crossing of building walls, floors etc. the earthing conductor shall be passed through galvanised conduit sleeves. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- v) All indoor and outdoor electrical equipment and associated non-current carrying metal works, supporting structures, building/ boiler columns, fence, system neutrals, lightning masts/arresters shall be connected to the plant ground system.
- vi) Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. shall be effectively grounded whether specifically shown or not.
- vii) Metallic conduits and pipes shall not be used as earth continuity conductor. These shall be grounded at both ends.
- viii) A continuous 40 x 6 mm (minimum size) G.S. flat earthing conductor shall run along the cable trays and supporting structure of all cable



routes. This earthing conductor shall be attached to each section of cable tray/trays through 40 x 6 mm G.S. flats. The earthing conductor shall be securely connected to the earth mat at both ends.

- ix) Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten (10) metres. Fence gate shall be separately grounded with flexible connection to permit movement.
- x) The street lighting poles, junction boxes mounted on the poles, flood light supporting structures etc. shall be connected to ground grid at minimum two points.
- xi) The steel columns, metallic stairs, hand-rail etc. of the building where electrical equipment are located shall be connected to the nearby ground mat by earthing conductor. Electrical continuity shall be ensured by bonding the different sections of handrails and metallic stairs.
- xii) The railway tracks within plant area shall be bonded across fish plates and the rail tracks shall be connected to grounding grid at different locations. The rail tracks leaving the plant boundary shall be made electrically discontinuous from the rail tracks inside the plant area by providing suitable arrangements at fish plate joints.
- xiii) The overhead crane rails shall be grounded at both ends. In addition all joints shall be bonded to provide electrical continuity.
- xiv) The metallic sheaths, screens and armour of cables shall be earthed at both switchgear/MCC/DB and equipment ends.
- xv) The flexible earthing connection of jumpering wire shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.

24.03.10 Jointing and Connection

- i) All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode. The contact surfaces shall be thoroughly cleaned to provide good electrical continuity.
- ii) The bending of the large diameter ground conductor where necessary shall be done by gas heating.
- iii) The projected portion of riser/pigtail above ground shall be coated with two coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
- iv) The connections between the riser/pigtail and earthing conductors (galvanized steel flats) and between the earthing conductors above ground level shall be made by electric arc welding.
- v) The portion of galvanized steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanizing anti-corrosive paint



after welding.

- vi) The earthing connections to equipment grounding pads/terminals and some removable structures shall be bolted type with GI bolts and nuts. The contact surfaces shall be thoroughly cleaned (to free from scale, paint, enamel, grease, rust) before connection to ensure good electrical contact.
- vii) Equipment/structures ground connections shall be coated with weather resistant paints/cold galvanizing paints after proper checking / testing.
- viii) Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

24.04.00 Earthing of cabling system

- Armour of the HT cables and LT single core cables shall be earthed only at one end of cable.
- Armour of other cables shall be earthed at both ends of cable.
- Screen of HT power cables shall be earthed at one end only.
- Screen of C&I screened control cables shall be earthed at one end.
- Screen of electronic earthing system cables shall be earthed as per the requirements.

After completion of grounding system installation, the measurement of ground resistance shall be performed by the Contractor. Continuity of earth conductors and efficiency of all bonds and joints shall be checked. The method of measurement shall be as per relevant standards / codes. The ground resistance of system shall be not more than 0.5 ohm. Earth resistance at earth terminations shall be measured in presence of Owner's representatives

24.05.00 General:

- i) Electronic earthing shall be provided as per relevant International standard for all control systems (such as DDCMIS, PLC, SAS, EDMS etc.) For electronic equipment chemical earthing pit shall be provided. The earth pit shall be tested and proven type and shall be guaranteed for service life of 40 years. The chemical earth pit shall comprise pipe electrode, crystalline conductive mixture, bentonite etc. constructed in a pit of not less than 4000 mm depth. The pit shall be effective in all weather conditions and offer medium resistance. For electronic earthing system, earthing conductor shall be of copper
- ii) Neutral of Service transformers shall be earthed through minimum of 400 sqmm single core cable through two numbers treated earth pit and in turn shall be connected to station earth grid.
- iii) LV Neutral Points of the following transformers shall be connected to Neutral Grounding Resistors (NGRs). NGR shall be connected to earth through two numbers treated earth pit.
 - Unit transformer



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- Station Transformer
 - Unit auxiliary transformer
 - Station auxiliary transformer
 - Other auxiliary transformers
- iv) Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- v) Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
- vi) Earthing conductors along their run on cable trench, ladder, walls etc. shall be supported by suitable welding / cleating at intervals of 1000 mm. Wherever it passes through walls, floors etc., pipe sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- vii) Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations.
- viii) Electronic panels and equipment shall be grounded utilising an insulated copper ground wire terminated at separate earth electrode.

24.06.00 Lightning Protection System

- i) The main purposes of lightning protection system are to:
- a) Provide protection to structures from lightning strokes.
 - b) Provide a low resistance-conducting path to lightning discharge.
- ii) Lightning protection shall be provided as per IS: 2309 for the structures, equipments and buildings within the battery limit.

24.06.01 System Design

- i) Air termination network with down conductors and earthing electrodes shall be provided on the basis of IS Code of Practice.
- ii) Horizontal air termination shall be so laid out that no part of the roof shall be more than 9 meters from the nearest conductor.
- iii) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.
- iv) Down conductors shall run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.
- v) An earth electrode shall be provided at the connection point of the down conductor with the station ground.
- v) Galvanised steel rods and flats shall be generally used for air termination and



connections. All connections shall be welded type.

- vi) The lightning protection system in the transformer yard shall cover the following equipment in the protection zone.
 - Generator transformers
 - Station transformers
 - Standby transformers
 - Auxiliary transformers
- vii) All areas of the power station shall be provided with lightning protection. The lightning protection system for buildings shall consist of air termination network, down conductors, test link and earth electrodes.
- viii) Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- ix) For Lightning protection, material Thickness of galvanising shall be atleast 610 gm/sq.m for all galvanised steel conductors.
- x) The lightning protection system shall not come in direct contact with other equipment/systems such as cables, conduits, electrical equipment, underground metallic ducts etc. All metallic structures within vicinity shall be bonded to the lightning protection system.
- xi) All welded/brazed joints shall be coated with anti- corrosive paint for rust protection.
- xii) Lightning conductor when used above ground level and shall be connected through test link with earth electrode/earthing system. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.
- xiii) Each down conductor shall be provided with a test link at 1500 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. All joints in the down conductors shall be of welded type.
- xiv) Down conductors shall be cleated on outer side of building wall/ welded to outside building columns at 750 mm interval.
- xv) Lightning conductor on roof shall be cleated on surface of roof using insulated clamps/saddles for conductor fixing at an interval of 1000 mm for horizontal run and 750 mm for vertical run.
- xvi) Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.



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- xvii) Installation of lightning conductors on the roofs of buildings shall include construction of support, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / welding of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

24.06.02 Air Terminations

- i) The vertical air terminal rods shall be installed at the roof of buildings for MCC/Switchgear rooms, ESP Control rooms etc to protect these objects from lightning strokes.
- ii) The projected length of the Air termination rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.
- iii) The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building, the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.
- iv) All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 50 x 6 mm galvanized steel flats. Horizontal air termination (i.e. G.S. Flat conductor) shall be so laid that no part of the rod shall be more than nine (9) metres from the nearest roof conductor.

24.06.03 Shielding Masts

- i) The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of the associated building.
- ii) The shielding mast shall be made of galvanized steel rod and the height of the same shall be decided considering the zones to be protected.
- iii) Each shielding mast shall be connected to grounding grid by a down conductor 50 x 6 mm minimum. Galvanised steel flat run along the building column. In addition all building columns joints shall be electrically bonded.

24.06.04 Down Conductors

- i) Galvanized steel down conductors of suitable size shall be connected with air terminal rod/horizontal conductor at the top of roof/structure and other end connected to the nearest 40 mm dia. mild steel rod riser from ground electrode.
- ii) Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductor of grounding system above ground level.
- iii) The connection between each down conductor and rod electrode (by means of 40 mm mild steel rod riser) shall be made via test link located



at approximately 1500 mm above ground level.

- iv) The down conductor shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleared on outside of the building wall and column/structure at about 750 mm intervals unless stated otherwise in the drawing.
- v) At all supports for down conductor along the column/wall of the buildings etc. the portion embedded inside the building concrete should not touch the reinforcement bars.
- vi) All exposed metallic parts of the buildings shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.
- vii) The down conductors shall be protected at the ground level against mechanical injury by means of non-metallic pipes, viz. PVC pipes filled with bituminous compound.

24.06.05 Electrodes (for Lightning Protection)

- i) The electrodes shall be 40 mm diameter 3000 mm long mild steel rod. These shall be driven into the ground.
- ii) All the electrodes shall be interconnected by means of one (1) 40 mm dia mild steel rod which shall be laid under ground at a minimum depth of 1000 mm below finished grade level unless stated otherwise. This ground mats/electrode in turn shall be connected to main grounding grid.

24.06.06 Riser (for Lightning Protection)

All risers connected to grounding mat shall be 40 mm mild steel rods and shall be projected 300 mm above grade level unless stated otherwise.

24.06.07 Jointing & Connection

- i) All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode.
- ii) The projected portion of riser above ground shall be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
- iii) The joints in the lightning conductors shall be kept to a minimum and there shall be no joint in the underground portions of conductors.
- iv) All the joints shall be done by arc welding process overlapping of the conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be cleaned properly before jointing.
- v) The portion of galvanized steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanizing anti-corrosive paint after welding.



- vi) The bolted joint of the test link shall be covered with thick coating of bitumen paint after successful testing.
- vii) The air terminal rods and shielding mast shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).
- viii) The steel to copper connection shall be brazed type.
- ix) The lightning protection of inflammable liquid storage tanks wherever required, shall be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods shall be connected to rod electrodes, which in turn shall be connected to station ground mat.
- x) The sizes and materials of earthing conductors to be used in lightning protection system are listed below:-

DESCRIPTION	SIZE	MATERIAL
1) Horizontal air termination and down conductors for buildings, boilers and other tall structures.	25 x 6 mm	GI Flat
2) Vertical air termination rods for other buildings / tanks etc.	20 mm dia 1000 mm long	MS rod

Note: The above sizes are indicative only. Actual size shall be arrived at as per design by the Bidder.

24.07.00 DRAWINGS & DOCUMENTS

Bidder shall submit the following minimum drawings and documents for approval during detail engineering stage:

- Soil resistivity report
- Design basis report for earthing and lightning protection system
- Earthing design calculation
- Typical installation drawings for earthing and lightning protection
- Electronic earthing layout and details
- Earthing layout for Transformer Yard
- Earthing layout for Power house building, Boiler and ESP
- Earthing layout for all auxiliary plant buildings
- Earthing layout for all non-plant buildings
- Lightning protection design calculation
- Lightning protection layout for Power house building, Boiler and ESP
- Lightning protection layout for transformer yard
- Lightning protection layout for all auxiliary plant buildings
- Lightning protection layout for all non-plant buildings
- Field quality plan



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SECTION – IC
DATA SHEET – A & CRANE CLEARANCE DIAGRAM



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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	250	
	Test load SWL – tones	(125% of SWL)	
5.2	Aux. Hoists		
	Rated SWL – tones	55	
	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+ Radio Remote Control	
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)



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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 & Auxiliary hook to reach the levels as indicated in Crane clearance diagram	
	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 with three rail system with top rail at 1500 mm shall be adopted with provision of kick plate (100 mm high and 8mm 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
9.4	Sheaves details	Main hoist	Aux. Hoist
	Material	Fe 410 WA IS: 2062 Gr. A or B / CS Gr. 280-520 IS: 1030	



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		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 (for TG Hall Crane)	AH micro
	Type of mounting of gear box	Horizontal / Vertical			
	Classification	Suitable for M5 duty			



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	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)					
	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/					



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		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 swiveling 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.	
10.0	Brakes	All brakes shall have weatherproof enclosures	
A.0	Hoist Motions	MH	AH



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	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 It should also be possible to operate Electro-hydraulic thruster brake from foot operation from cabin.		
	Number provided	1+1 (per motor)		1+1 (per motor)		
	Additional Hydraulic rail clamps two nos. per cranes to be provided (to be designed with basic 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 / 750				
	Type of connection to end carriage	By fitted bolts				
14.0	Rails					
	Type / section	Rails sections as per IS: 3443 Grade 55 C 11/ 50 C 12. Rail to rail				



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		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., 3 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, 60 % CDF			
	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B			



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	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, 3 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, 60 % CDF			
	Class of insulation	Class 'F' for sq. cage motors with temperature 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.			



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	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/ Al) bus bar. CT: Flexible trailing cable ERP insulated Cu conductor as per IS: 9968			
	Size	Shall be sized with a margin of 20%. Voltage drop for all conductors and cables/ wires shall be limited to 3% of rated voltage between the main disconnect witch and motor terminals.			
	Length	Suitable for entire bay length			
19.0	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 3mm 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	The panels shall have a degree of protection not less than IP-54 and shall be fabricated with 3 mm thick cold rolled sheet steel for front and rear equipment bearing surfaces and bottom gland plates, and 2 mm for sides and top. The doors and removable covers shall be gasketted. The panels shall be provided with anti vibration pads.			
	Numbers and location	One each for MH, AH, CT and LT located on bridge platform			
	Degree of Protection	IP 54			
	Illumination	Internal illumination with florescent lamp			



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21.0	<u>Master 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	As per customer specification			
	Size				
	Type				
	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.			
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 415/110V , Lighting 415/240V and hand lamp 415/24V.			
	KVA rating	20% over loading to be considered while sizing the rating			



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31.0	Illumination	
	In Cabin	Two 20W CFL along with 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 8 mm thick o/p 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 750 mm clear with hand railing with three rail system with top rail at 1500mm shall be adopted 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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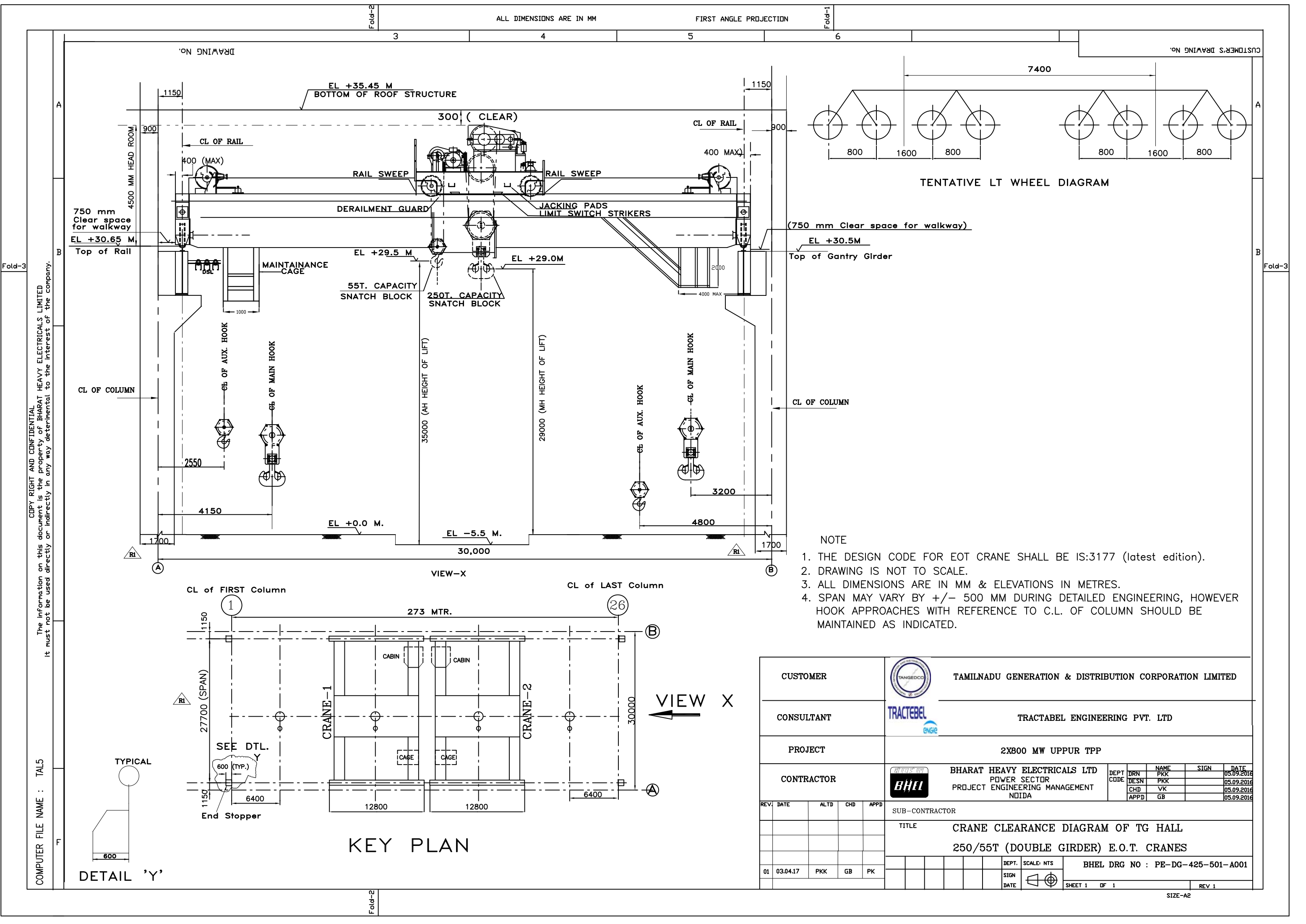
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	Warning horn & light	- An electrical horn shall be provided and mounted on under side of the cabin operated by foot switches as and when required by the driver. Horn shall be heavy-duty howler to produce 95 dB at 3.5 M, double bell projector suitable 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	The VVf drive control shall be used for control of each motion. The VVf drive shall be equipped at least with 1024 pulse incard, droop control for synchronization and crane software. The rating of VVf 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
	Starting torque of VVVF	Up to 200% typical with encoder.
	Starting current	Less than 150 % of rated torque.
	Temperature	VVVF system shall be capable of withstanding upto 50 deg 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 defined elsewhere
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-

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- for Storm brake calculation, Basic wind speed at project site is 50 m/sec. as per IS:875 -1987 Part-3 Probability factor,(k1 risk coefficient), terrain, height and structure size factor, k2 and 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 infrared sensing devices) shall be provided. Protection for electrical faults (short circuit, overload, single phase, earth fault) etc. shall be provided.





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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.



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xxxi) BS: 970 Wrought steels in the form of blooms, billets, bars and forgings.

xxxii) IS: 5749/ BS 3017 Specification for Forged Rams horn Hooks

Indian electricity rules - 1956.

In the event of any conflict between the specification 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.



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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.

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.



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

3.2.0 STRUCTURAL DETAILS

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

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

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

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

3.2.1.4 Nuts and Bolts will be as per IS:1363, IS: 1364 and IS: 1367

High-tension friction grip bolts as per IS: 3757 and High- tension friction grip nuts as per IS: 6623

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

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

3.2.1.7 Fillet welding on load carrying members shall be avoided.

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



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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 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



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between the diaphragms. Full depth diaphragms or stiffeners shall be furnished at bridge drive supports and below the line shaft bearings.

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

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

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

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

3.2.2.9 Maximum Span/ Depth ratio for 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.



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

3.2.4 Crab (Trolley)

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

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

3.2.4.3 Platforms and Ladders

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

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

c) Safety hand railing of tubular construction 32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1100 mm and 600 mm and vertical post spacing not exceeding 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



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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 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



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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 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



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gears in the last stage of speed reduction. Surface hardening of teeth is not acceptable. Gear teeth shall preferably be cut in metric module system. Gears shall be designed to meet requirement of crane duty as per IS: 3177. The ratings of gears shall be established as per IS: 4660.

3.3.9 Gear Box

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

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

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



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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 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.



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

3.3.15 Brakes

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

i) **SERVICE BRAKE**

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

ii) **HOIST CONTROL**

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

3.4.0 ELECTRICAL

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

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

3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipment on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 3% or specified in data sheet "A". It shall be supplied with brackets. Maintenance cage for DSL shall be provided on crane.



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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.

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



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shall be self-reset type. The limit switches shall be as per "Data Sheet A"

3.4.4 Switch

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

3.4.5. Contactors.

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

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

3.4.6 Push button and lamp

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

3.4.7 Protective Panel

3.4.7.1 The electrical protective panel shall be a cubicle fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick with lockable-hinged door. The control cabinet's door shall be interlocked with the operating handles of isolating switches of supply circuits so as to prevent opening of the door when an isolating switch is closed. A device for bypassing the interlock shall also be provided. It shall be dust and vermin proof with degree of protection as IP-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.



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- b) One triple pole main line connecting/disconnecting switch.
- c) Emergency push button at convenient height for the operation for interruption of the entire power.
- d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.
- e) Contactors, timer and auxiliary contactors.
- f) Portable Lighting Transformer rated for 415/24V.
- g) Lighting Voltage Transformer with fuse 415/24V.
- h) Control transformer with fuses.
- i) Indicating lamps to indicate the live condition of all three phases.
- j) Main supply ON/OFF lamps on the door of the protective panel.
- k) Electrical interlock shall be provided to prevent the main contactor being closed unless all controllers are in OFF position.
- l) Other equipment as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The main contacts shall have the rating for 5 Amps or as specified in the data sheet A. The contactor drop off voltage shall be between 45-50% of rated voltage.
- m) All internal wiring shall be identified with numbering rules at both ends as per the relevant wiring diagram.
- n) Each panel shall have internal illumination with fluorescent lamp. The inside of the panel shall be painted white.
- o) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. At least 20% spare terminals for the wire terminations shall be provided in the cabinet.

3.4.8 Starter Panel

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

- a) Contactors : AC4 duty for reversing applications
AC3 duty for non-reversing applications
- b) Switches : AC23 for motor application.
AC22 for other application



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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 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.



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- 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

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



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- a) All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion. All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductor
- b) All wiring shall be done with 1100V grade fire resistance PVC insulated wire in conduits or by 1100V grade PVCA PVC cables with extruded inner sheath.
- c) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.
- d) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.
- e) Each motor shall be wired independently. Power and control wiring shall be effectively separated.
- f) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.
- g) All wire termination to the panels shall be provided with clamp type connections screw. Screw Type terminals with screw directly impinging on conductors are not acceptable.
- h) Multi way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring.
- i) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points
- j) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.



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CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

Project name:

Project number:

Package Name:

Sl.no. & Sections	Description	Yes	No	Not Applicable	Remarks
1.	Cover page				
1.1	Project Name				
1.2	Customer Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX email address				
1.5	Name and sign of prepared by , checked by & approved by				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant				
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				
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	Transportation and handling at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				



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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 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.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to				



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	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.				

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.

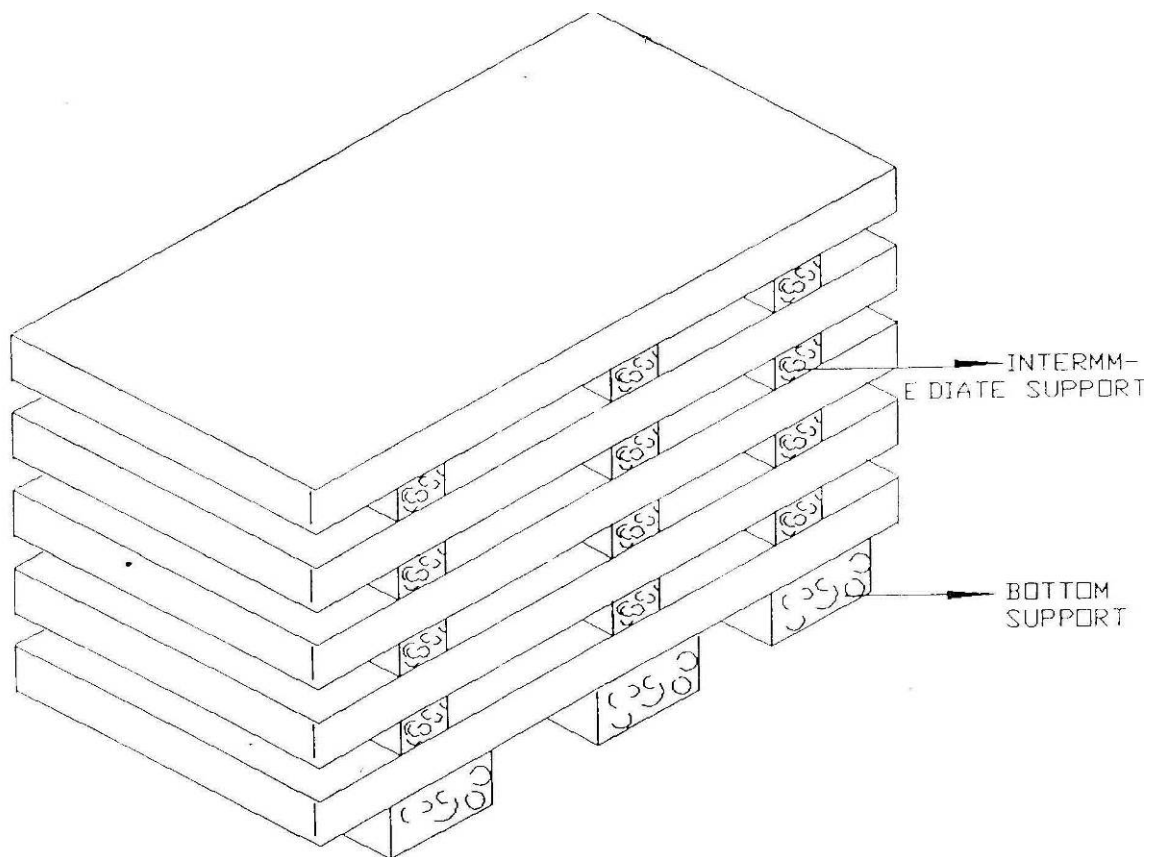


Figure – 1 – PLATE STACKING ARRANGEMENT

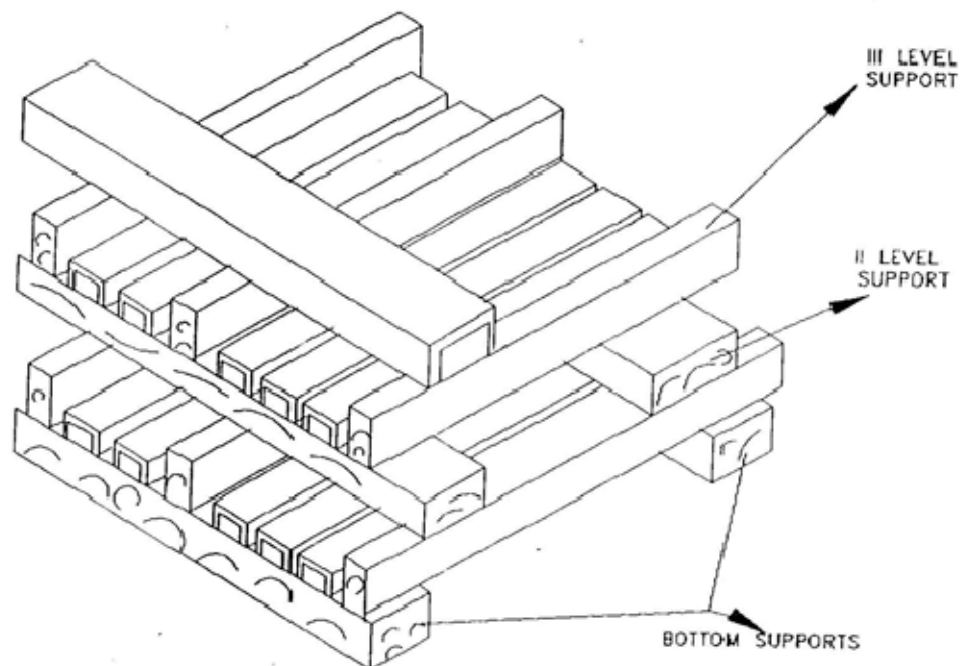


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



TANGEDCO UPPUR TPP BTG
(2 X 800 MW)
DOUBLE GIRDER EOT CRANES FOR TG HALL
(250/55 T)

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SECTION-III

DOCUMENTS TO BE SUBMITTED ALONG WITH BID



TANGEDCO UPPUR TPP BTG
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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

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.



**TANGEDCO UPPUR TPP BTG
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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.



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- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- 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.



**TANGEDCO UPPUR TPP BTG
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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



TANGEDCO UPPUR TPP BTG
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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 250/55 T capacity, Double girder EOT cranes with 29 M lift of main hook, 35 m lift of auxiliary hook, 27.7 (± 0.5) 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-425-501-A301.	2 sets	77.0 %
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 273.0 M bay length complete with all accessories for the total scope defined as per technical specification PE-TS-425-501-A301.	1 set	3.25 %
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 273.0 M bay length Gantry rail complete with all accessories for the total scope defined as per technical specification PE-TS-425-501-A301.	1 set	6.5 %
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-425-501-A301.	2 sets	1.5 %
5.	Lump sum price of STORM BRAKE (LT hydraulic rail clamps/parking brakes) as per technical specification PE-TS-425-501-A301.	2 sets	0.5 %
6.	Lump sum price of MAIN HOOK AND AUXILLIARY HOOK ASSEMBLY as per technical specification PE-TS-425-501-A301.	2 sets	1.0 %
7.	Total lumpsum price for Maintenance tools and Tackles as per technical specification PE-TS-425-501-A301.	1 set	0.25 %

NOTE: -These prices shall be used for billing purpose during contract stage.

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.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	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		350 KW	U	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. Location of changeover switch shall be at mid of the bay.			Feeder/s shall be sized to cater to cumulative requirement for TG hall EOT crane 1 & 2 together.		
TG HALL EOT CRANE NO 2			U	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 800 MW UPPUR TPP				NAME				DATA FILLED UP ON						
		SYSTEM		DOUBLE GIRDER EOT CRANE (250/55T)				SIGN.				DATA ENTERED ON						
		DEPTT. / SECTION		ELECTRICAL				SHEET 1 OF 1		REV. 00		DE'S SIGN. & DATE						



PROJECT:-2 x 800 MW UPPUR TPP
PACKAGE:- DOUBLE GIRDER EOT CRANES
TENDER ENQUIRY REFERENCE:-
SPECIFICATION NO PE-TS-425-501-A001

VOLUME III

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION / TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

[illegible]

COMMERCIAL DEVIATIONS

[illegible]

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE	

NOTES:

- | |
|---|
| 1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only. |
| 2. For directly dispatchable items, cost of withdrawal 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 withdrawal 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 descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.