

NTPC LTD

**RAMMAM STAGE-III HYDRO ELECTRIC PROJECT
(3 X 40 MW)**

**TECHNICAL SPECIFICATION FOR D/G EOT CRANES
FOR POWER HOUSE (125/25T)**

SPECIFICATION NO.: PE-TS-414-501-A001



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

	RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANE FOR POWER HOUSE (125/25 T)	SPECIFICATION NO.: PE-TS-414-501-A001	
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SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA – Specific Technical Requirement (Mechanical)

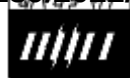
SUB-SECTION IB – Specific Technical Requirement (Electrical)

SUB-SECTION IC – Data Sheet A

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SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, fill of lubricants & consumables, mandatory spares alongwith spares for erection, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, trial run at site, carrying out performance guarantee/Functional/Demonstration tests at site, Operation and Maintenance service for two years after load testing at site and handing over to Employer after completion of O&M services of One (1) no. 125/ 25 T capacity x 20.4 m span, 29.5 m lift and 64.55 m travel length double girder EOT crane for Power house along with two (2) nos. 5T capacity 28.5 m (approx.) lift wire rope electric hoist running on ISMB below each bridge girder of crane, training of customer/client O&M staff for **3 X 40 MW RAMMAM STAGE-III HYDRO ELECTRIC PROJECT**.
- 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.



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1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

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

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

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

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

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

Note:

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

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's Internal proxy setting should not block DMS application's link (<https://www.bhelpem.com/WrenchWeb/>)
- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor section. For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.htm>.



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1.0.0. SCOPE OF WORK

Scope of work under this section covers design and engineering, manufacture, quality assurance, quality control, shop assembly, inspection, shop testing at manufacturer's/sub vendor works, packing, transportation & delivery at site, unloading and loading, 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, Operation and Maintenance service for two years after load testing at site and handing over to Employer after completion of O&M services of One (1) no. 125/ 25T capacity x 20.4 m span, 29.5 m lift and 64.55 m travel length double girder EOT crane for Power house along with two (2) nos. 5T capacity 28.5 m (approx.) lift wire rope electric hoist running on ISMB below each bridge girder of crane along with all other accessories.

1.1.0. SCOPE OF SUPPLY (MAIN):

It shall cover design and engineering, manufacture, quality assurance, quality control, shop assembly, inspection, shop testing at manufacturer's/sub vendor works, packing, transportation & delivery at site of the following,

(a) One (1) no Electrically operated overhead travelling crane of 20.4 m span for Powerhouse having main hoist of capacity 125 T, auxiliary hoist of 25 T & two nos. 5T monorail electric hoist complete with motors, brakes, rope drums, wire ropes, slings, protective and control equipment, VVVF drive, radio remote control equipment's comprising of transmitter, receiver, battery, battery charger, runway rails along with fixing arrangement, sole plates, striker plates, limit switches, Down Shop Lead (DSL) conductors, insulators, current collectors etc. EOT Crane shall be as per IS-3177 & 807(Latest Standard).All the consumables with like welding electrodes, oil & grease [100 % reserve] etc and the paint required at site shall be supplied with the equipment.

(b) One (1) Set of runway rails for the full length of the powerhouse suitable for concrete beam with base plates, full length sole plates, foundation/ anchor bolts, rail clamps, lock nuts, end stops & limit switches (reset type) etc. The base plates & other embedded parts for installation & alignment of crane rails shall be supplied a month in advance or as per Customer's requirement for embedding by civil contractor. The same shall be informed after award of contract.

(c) One (1) Set of DSL complete shrouded copper conductors, collector trolleys, all fittings and connections, Three (3) phase indicating lamps for both ends of the power house etc. for total run length of power house. One (1) number two way supply control switch with OFF position with metal enclosure for wall mounting for the



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Power House crane along with power cable for incoming supply to control switch shall be supplied with DSL System. Supply and laying of power cables from Station Service Board (SSB) panel shall be in bidder's scope. Refer Plan at EL 416.0 M - Drg no 1 200 00 198 56 Rev 0 in drawing section for location Station Service Board.

- (d) One (1) no 3.5 Core Power copper flexible cable 60 m long of suitable size as per load calculation for commissioning & testing of EOT Crane till such time the DSL is charged.
- (e) Five (5) pairs of wire rope slings for different loads of 10T, 25T, 50T, 100T & 125T rated capacity of min. 10m length. A storage rack for safe keeping of the slings shall also be supplied.
- (f) One (1) number cradle or test load frame and associated slings suitable for rated load and overload tests.
- (g) One (1) Set of Maintenance tools and tackles as per Annexure III.

1.1.1 Inspection and testing at Manufacturer's works:

Copy of documents approved with original stamp and signature (one set) shall be available at the place of inspection. This is to be ensured by supplier.

A. Shop inspection and tests: Please refer customer's specification

B. Testing At Works.

The crane shall be shop assembled as completely as possible and then operated and load tested in the shop for adequacy of design and suitability for reliable, safe and proper operation. The complete crane shall be fully assembled at vendor's works. Full load and 25% overload test shall be carried out at vendor's works as per IS 3177 which shall be witnessed by BHEL and /or Customer.

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

1.2.0 SCOPE OF SUPPLY (MANDATORY SPARES): As per list elsewhere in the specification.

1.3.0 PACKING AND TRANSPORTATION: After the workshop assembly & prior to dismantling for shipment to the site, all items shall be carefully match marked to facilitate site erection. Wherever applicable, these markings shall be punched or painted so they are clearly visible. Dismantling shall be done into convenient sections, so that the weights & sizes are suitable for transport to site & for handling on the site under the special conditions of the project. All individual pieces shall be marked with the correct designation shown on the detailed drawings and other documents (packing lists, spare part lists, in Operating and Maintenance Instructions, etc.). Marking shall be done preferably by punching the marks into the metal before painting, galvanising etc, and shall be clearly legible after painting, galvanising etc. In labeling, shall be as few

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designations as possible and each part of identical size and detail shall have the same designation, regardless of its final position in the plant. All parts shall be suitably protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc. All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in high & pressure polyethylene foil. Where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled. Purchaser/Customer reserves the right to inspect & approve the packing before the items are dispatched but the contractor shall be entirely responsible for ensuring that the packing is suitable for transit & such inspection will not exonerate the bidder from any loss or damage due to faulty packing.

As per present information maximum weight allowed is 15T inclusive of lorry/trailer weight with maximum dimension of 8mx 3m x 6m (LxBxH). The Contractor shall inform himself fully as to all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Bidder shall also be responsible for obtaining from the Indian railway or highway authorities any permit that may be required for the transport of loads exceeding the normal gauges

1.4.0 SCOPE OF SERVICES: Shall include unloading and loading , 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, Operation and Maintenance service for two years after load testing at site and handing over to Employer, of One (1) no. 125/ 25T capacity x 20.4 m span, 29 m lift and 64.55 m travel length double girder EOT crane for Power house along with two (2) nos. 5 T capacity x 28.5 m lift wire rope electric hoist running on ISMB below each crane girder along with all other accessories.

1.4.1 Unloading, storage and handling at site.

1.4.1.1 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. All parts of the plant shall be brought, as far as possible, to their final place of erection. 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 plant which already have been finally painted. If large parts are stored in the open air, they shall be provided with weather resistant and fire & resistant covers. Electrical parts, which are not packed 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

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humidity. All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers.

1.4.2 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:

1.4.2.1 Ensure and coordinate proper embedment of base plates, sole plates, etc. in concrete beam with civil contractor for proper laying & alignment of runway rails and DSL conductors.

1.4.2.2 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.

1.4.2.3 Tests during installation and pre commissioning

1.4.2.4 Commissioning Tests: The Details of the tests are given in attached Quality Assurance 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. Test loads shall be arranged by the bidder. Dead Weight for load testing of cranes shall be provided within 2 km of crane location. Load from this location is to be transported to crane location and placed back to this location after load testing by bidder. Cradle and slings required for load testing shall be supplied by the Bidder on non- returnable basis.

1.4.2.5 Training: Vendor shall provide training to customer's staff at project site during erection & commissioning of the equipment as per the programme decided mutually. The training, to be organised on the equipment, shall cover but not to be limited to following aspects:

- Informing operators on the specific use for which an item of lifting equipment is intended, ensuring access to operating instructions.
- Correct method of use of equipment and warning on incorrect & dangerous practices.
- Identifying and understanding equipments workings.
- Identification of hazards, assessment of the associated risks and method of controlling the risks.
- Training on pre-lift checks, such as load & angle estimation and identification & reporting of basic equipment defects.
- Correct method of attaching load, slings & other accessories.
- Lifting & lowering procedures are to be followed, signal to be used between staffs, possible faults that



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can occur, appropriate storage of equipments & slings after use.

Notes:

The Rails/ DSL erection may be extended in 3-4 stages as per availability of civil fronts.

The bidder shall furnish a complete outline of the proposed methods and procedures to be followed for the testing, including a list of equipment and instruments to be used to the Employer's representative, for review, at least 60 days before the scheduled testing.

1.4.3. OPERATION AND MAINTENANCE SERVICES (O & M)

1.0 Scope covers operation and maintenance service for two years (i.e 24 crane months) including manpower, supervision, consumables etc. of one no. 125/ 25T capacity crane with two nos. 5 T electric hoists after successful erection, commissioning & load testing. The Operation period of two years shall be started after successful load testing of crane at site & may be extended on the discretion of site management.

2.0 For Operation of the crane an experienced crane operator or shall be available as and when required by BHEL for at least 16hrs a day, daily.

3.0 For Maintenance of the Crane

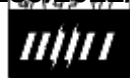
a) Break-Down Maintenance

- 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 the first month of operation.



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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. Earthings 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 equipments for loose connection such as selector switches, junction boxes, min isolator switch etc.
Lubrication	All gear box and thrusters' oil level will be checked. All bearings, couplings' grease will be checked.
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.

i) 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 meager test will be carried out.
Resistance Box	All resistance boxes' step resistance value will be checked.



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ii) 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.

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.

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.



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- iii Radiographs shall be inspected to a sensitivity of 2%.
- iv Ultrasonic test on forgings and casting of critical components like cross head (hook suspension block), Hooks, Shafts, Axles, Gears, Wheels, Pulleys etc. Ultrasonic test on forgings shall be carried out as per norms given below. UT shall be carried out in Proof machined condition (single diameter/ Flat surface without steps, keyways, teeth cutting or other profile machining which can create difficulty in ultrasonic testing). Components shall be identified with Heat number and serial number by punching). Hardening operation shall be carried out prior to Ultrasonic testing.

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps
2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.'
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.
4. Defects giving indication of 2 to 4 mm dia. equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per 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



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transferring by BHEL shall be followed at subsequent stages to ensure trace ability.

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

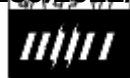
FINAL INSPECTION- Testing At Works.

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

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



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DOUBLE GIRDER EOT CRANES FOR
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- 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 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



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3.0.0	Backlash
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	Area of Contact:
4.1.0	Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2) For final stage of Hoist gearing: h / H shall be more than 30% (a – c) / b shall be more than 40% For all other gears: h / H shall be more than 40% (a – c) / b shall be more than 50%
5.0.0	Running Test
5.1.0	The gear boxes shall be run under no-load condition at the rated speed for minimum four hours in each direction and the following are to be checked: i. All bolts at the joints remain tight ii. All gear mesh lines are getting enough lubrication iii. All bearings are getting enough lubrication iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour. v. Vibration : Maximum limit 125 microns (peak to peak) vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm. vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.
6.0.0	General



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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.

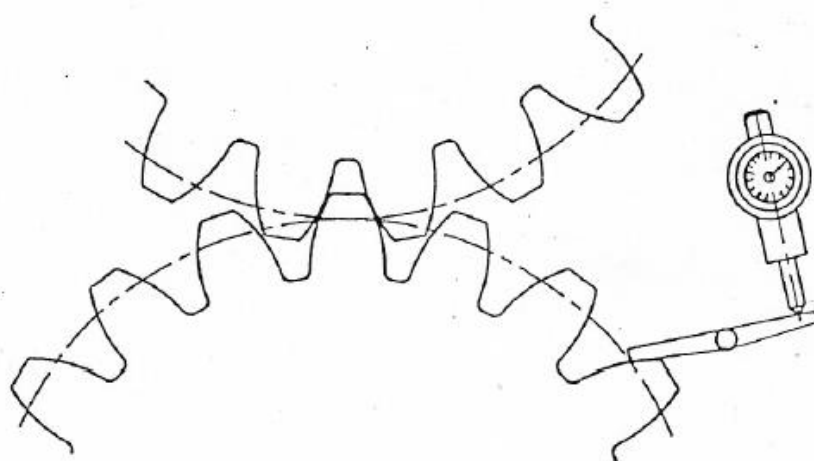
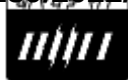


FIG.1 MEASUREMENT OF BACKLASH



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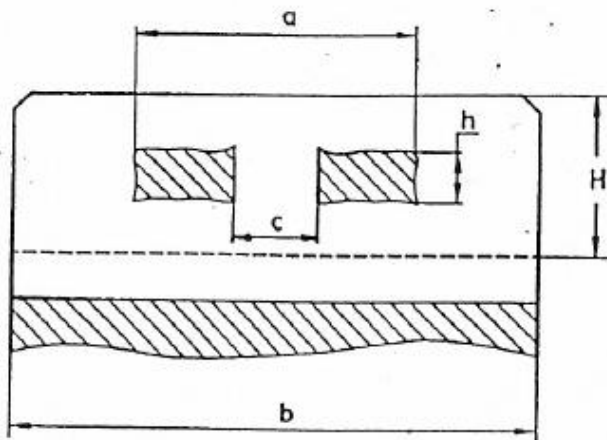
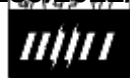


FIG.2 AREA OF CONTACT OF GEAR TEETH

Table-1**Backlash for Gearing specified by module (Clause 3.1.0)**

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



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ANNEXURE-I

MAKES OF SUB-VENDOR ITEMS

1. THE SUB VENDOR LIST 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.
4. ALL THE TRAILING CABLES SHALL BE SOURCED FROM ONLY ONE SUB-VENDOR FROM THE LIST.

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		

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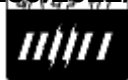
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		BHARAT BIJLI		
		MARATHON		
		ABB		
7.	BRAKES	ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
		PETHE		
8.	CONTACTOR	SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
		BCH		
9.	OVER LOAD RELAYS	SIEMENS		
		L&T		
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS		
		BAJAJ		
		CROMPTON		
16.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
17.	HOOTERS	BEACON		
		OSC		
		TARGET		
		KHERAJ		
18.	LIGHTING SWITCHES	ANCHOR		
		ELLORA		
		BAJAJ		
		PHILIPS		
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	

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		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
20.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	
		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	

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		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
21.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
22.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		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	

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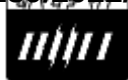
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23.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
24.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
25.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		
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		

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		BCH		
		SIEMENS		
		STANDARD		
31.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER		
32.	PANELS	OEM		
		RITTAL		
		PYROTECH		
33.	RESISTANCE BOXES	ENAPROS		
		OEM		
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD.		
		ASHOKA ENGINEERING COMPANY		
		KANADIA FYR FYTER PVT. LTD		
		NITIN FIRE PROTECTION INDUSTRIES LTD		
		NEW ENGINEERING CORPORATION		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		
		MITSUBISHI ELECTRIC		
		CROMPTON		
36.	SHROUDED DSL	SUSHEEL		
		STROMAG		
37.	ANTI COLLISION DEVICE	ELECTRONIC SWITCHES INDIA		
38.	LOAD CELL	IPA		
		SARTORIUS		
39.	RRC	ACROPOLIS ENGINEERING	-	
		SNT CONTROLS	-	

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40.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
41.	RAIL	BONGFILIOLI*		
		JSPL		
		SAIL		

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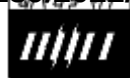
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ANNEXURE – II

(LIST OF MANDATORY SPARES)

- One Set is defined as the total number required for one crane.
- If any item is not applicable due to vendor's specific design, its equivalent spare/s shall be quoted.
- Any item which quoted as “not applicable” in the list and is found to be applicable at a later date shall be supplied by the Bidder without any extra cost.



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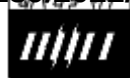
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CLAUSE NO.	LIST OF MANDATORY SPARES (MECHANICAL)		एनटीपीसी NTPC समृद्धि hydro
Clause No.	Item	Quantity	
2.02.02	Bearings of pump	1 set	
2.02.03	Unloader valve	1 no.	
2.02.04	Oil control valve	1 set	
2.02.05	Non-return valve	1 no.	
2.02.06	Safety relief valve	1 no.	
2.02.07	Oil filters	3 nos.	
2.02.08	Level relays	1 set	
2.02.09	Pressure gauges	2 nos.	
2.02.10	Solenoid Valves	1 of each type	
2.02.11	Flow restrictors for regulating valve opening/closing time	1 set	
2.02.12	Pressure oil pump impeller and shaft required to make a pump	1 set	
2.03.00	General		
2.03.01	Limit Switches	1 of each type	
2.03.02	Alarm switches	1 of each type	
2.03.03	Pressure switches	1 of each type	
2.03.04	Indicating Lamps	12 nos.	
2.03.05	Control relays etc.	1 of each type	
3.00.00	EOT Crane		
	For each Crane :		
3.01.00	Bearing for		
3.01.01	Bridge travel wheels	2 nos.	
3.01.02	Trolley wheels	1 nos.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART - F SUB-SECTION-I (MECHANICAL)
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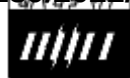
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CLAUSE NO.	LIST OF MANDATORY SPARES (MECHANICAL)		एन टी पी सी NTPC नगरजीवो hydro
Clause No.	Item	Quantity	
3.01.03	Long travel motor	1 set	
3.01.04	Cross travel motor	1 set	
3.01.05	Main hoist motor	1 set	
3.01.06	Aux. hoist motor	1 set	
3.01.07	Rope drums	1 set	
3.01.08	Pulleys for main hoist	1 set	
3.01.09	Pulleys for aux. Hoist	1 set	
3.01.10	Pulleys for under slung hoist	1 set	
3.02.00	Pair of brake shoe / disc with lining for each size of brake used viz. D.C. operated Electro-mechanical or Hydraulic Thruster operated.		
3.02.01	Long travel motion	2 sets	
3.02.02	Cross travel motion	2 sets	
3.02.03	Main hoist	2 sets	
3.02.04	Auxiliary hoist	2 sets	
3.02.05	Under slung hoist	2 sets	
3.03.00	Pair of brake linings with rivets or each size of brake used.		
3.03.01	Long travel motion	2 sets	
3.03.02	Cross travel motion	2 sets	
3.03.03	Main hoist	2 sets	
3.03.04	Auxiliary hoist	2 sets	
3.03.05	Under slung hoist	2 sets	
3.04.00	Main springs for each size of brake used.		
3.04.01	Long travel motion	2 sets	
3.04.02	Cross travel motion	2 sets	
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CLAUSE NO.	LIST OF MANDATORY SPARES (MECHANICAL)	
		
Clause No.	Item	Quantity
3.04.03	Main hoist	2 sets
3.04.04	Auxiliary hoist	2 sets
3.04.05	Under slung hoist	2 sets
3.05.00	Current collectors for DS.	5 nos.
3.06.00	Insulator for conductors support assembly	6 nos.
3.07.00	Limit switches	one of each type
3.08.00	Thruster of each size used.	2 nos.
3.09.00	Pair of oil seals for each gear box used	1 set
3.10.00	Contactors of each size used	1 no.
3.11.00	Fixed & Moving contacts of each size of contactors used.	1 no.
3.12.00	3 Nos. coils for each size of contactor used.	
3.12.01	Main hoist	2 sets
3.12.02	Auxiliary hoist	2 sets
3.12.03	Cross travel	2 sets
3.12.04	Long travel	2 sets
3.12.05	Under slung hoist	2 sets
3.13.00	3 - Phase overload relay for each motor.	2 nos.
3.14.00	3 nos. fuse links of each size used on cranes	4 sets
3.15.00	1 printed circuit of each size and type	1 set
3.16.00	Complete set of lamps for lighting and signals	2 sets
3.17.00	Rope for auxiliary hoist	1 set
4.00.00	~~Fire Protection System~~	
4.01.00	~~Automatic and manual Release System~~	~~One of each type/size used in the system~~
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART - F SUB-SECTION-I (MECHANICAL) PAGE 9 OF 13



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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)	As applicable.

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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC रामम hydro
	ANNEXURE-IV	
	<u>SURFACE TREATMENT AND COATINGS</u>	
	Object: The present specifications apply to equipment and spare part surface coating. They define surface coating, the types of recommended coating, and the associated guarantees. In any case, the Contractor shall submit to the Employer his coating schemes.	
1.00.00	CORROSION PROTECTION	
	The Contractor shall take all necessary favorable measures to protect equipment from all abnormal corrosion and, taking into account project specific risks.	
	In particular, the Contractor shall choose the materials most suited to this project and shall submit a modification request to the Employer when the materials indicated in the specifications are considered unable to guarantee its behaviour against corrosion.	
1.01.00	Equipment in Contact with Reservoir Water.	
	For all equipment on the water conveyance circuit (trashracks, valves, pipes, pump turbines instruments), the use of uncoated carbon steel is prohibited, even where corrosion allowance is planned. If he considers it necessary, the Contractor may apply stainless steel cladding to some carbon steel parts, or manufacture these parts in solid stainless steel.	
	If maintenance is unsure because of peculiar equipment arrangement, or if the equipment cannot easily be shutdown, the Contractor may submit to the Employer, alternative corrosion protection methods, so that vulnerable surfaces can be protected effectively.	
1.01.01	Outdoor Exposed Equipment.	
	Among these equipment can be distinguished: those figuring as the subject of a particular specification, and for which the nature of materials and corrosion protection is clearly defined, those which, unlike the above, are not functional in nature and so are not subject to the same attention regarding problems of corrosion: parapets, gratings, lighting poles, etc. Even this second category of equipment shall be subject to particular attention with regard to choice of materials and corrosion protection.	
	In general, attention shall be paid to taking constructive measures or acquiring standard equipment, whatever the function, to avoid any water build-up. Such constructive measures are, for example: for constructive using structural sections (dam gates, stop logs), that all horizontal sheet metal sections have drainage holes at regular intervals, for auxiliary structures, embedding holes shall be completely filled with concrete, taking care to avoid any break in corrosion protection where concrete is exposed to the air.	



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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
2.00.0	GENERAL The Contractor shall provide a complete and reliable surface treatment of the equipment furnished for corrosion protection. Surface protection shall comprise: A surface preparation phase with mechanical cleaning, grit blasting or chemical cleaning, a surface treatment phase with either metallizing and application of one or two priming coats suited to the type of metal surface, or application of priming coat, an application phase with several coatings of products, including final colored coat. Surface protection shall be performed either in the Contractor's shops or on site with the necessary precautions taken. Finishing touch-ups shall be performed on site upon completion of erection.	
3.00.00	SURFACE PREPARATION. All surfaces to be coated shall first be mechanically or chemically cleaned.	
3.01.00	MECHANICAL CLEANING. Surfaces shall be mechanically cleaned using one of the following methods: shot-blasting or grit blasting, scraping, stripping, mechanical brushing.	
3.01.01	SHOT-BLASTING OR GRIT BLASTING. If mineral abrasives are used, they shall be selected in compliance with the prevailing regulations concerning workers' safety. The required care levels of surface states after cleaning are defined by the illustrations in standard ISO 8501, or equivalent. The required care shall be as follows: ♦ preparation of steel surfaces to be imbedded set in concrete = Level 1, ♦ preparation of steel surfaces to receive definitive protection = Level 2.5, ♦ preparation of steel surfaces to receive metallized protection = Level 3. The roughness of the cleaned surfaces shall be $R_a = 12.5 \mu m$, except for surfaces that shall be metallized later, for which the roughness shall be $R_a = 6.3 \mu m$.	



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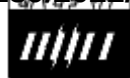
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एन टी पी सी NTPC हाइड्रो hydro
3.01.02	SCRAPING, STRIPPING, MECHANICAL BRUSHING. This type of cleaning shall concern: - Parts to be set in concrete, which shall not be coated. These parts shall be brushed immediately prior to concreting. - Repair of defective surface coating. In this case, cleaning by scraping, stripping or brushing shall only be performed if shot-blasting or grit blasting is impossible. The required care shall be as follows: - St 2 for surfaces which shall subsequently receive a definitive coating. - St 1 for surfaces to be set in concrete with no surface protection. After cleaning, all surfaces shall be thoroughly dusted.	
3.01.03	SURFACE PROTECTION REPAIR Before surface protection is repaired, the old protection shall be partially or entirely removed. A new defects liability period shall start as soon as the zone in question has been repaired. The old coating shall be completely removed by shot-blasting or grit blasting, in compliance with the specifications in 3.01.01. If this process is impossible, the old coating shall be removed by scraping, stripping or mechanical brushing, in compliance with the specifications in 3.01.02.	
4.00.00	CHEMICAL CLEANING All traces of pollution shall be removed with solvents (degreasing, neutralisation). The surfaces shall then be rinsed and dried (with special cleaning paper). The Contractor shall submit, for the Employer's approval, a list with the characteristics of the solvents that he intends to use.	
5.00.00	SURFACE TREATMENT Immediately after surface preparation, the Contractor shall employ one of the following three surface treatment processes:	



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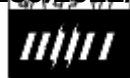
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एन टी पी सी NTPC राममम hydro
6.00.00	METALIZING Metalizing shall be performed within 2 hours after preparation. The chemical composition of the metal used shall be: 85 % Zinc - 15 % Aluminum. The thickness shall be 120 μm. Application shall be by spray gun in compliance with ISO standard R 2053. After metalizing, pores shall be plugged by applying a wash primer, or, if the equipment is intended for immersion, by applying a thin coat of zinc epoxy (max. 20 μm).	
7.00.00	HOT GALVANIZING This coating performed by quenching shall have the following characteristics: ♦ minimum unit mass : 5g/dm², ♦ average thickness : 70 μm This process shall be used when metalizing cannot be performed under satisfactory conditions.	
8.00.00	PRIMING COAT APPLICATION This coating shall have the following characteristics: ♦ product : zinc epoxy coat, ♦ thickness : minimum 40 μm.	
9.00.00	APPLICATION OF THE PROTECTION The Contractor shall carefully control relative humidity and temperature before and during applying any coating. In any case, the relative humidity shall not exceed 80%. All traces of condensation shall be eliminated before protection is applied. If the relative humidity remains between 50 and 80%, the first coat shall be applied four (4) hours after the surface preparation. The undercoats or finish coats shall be applied in compliance with the drying time required between each application. Each coat shall be of a different color.	



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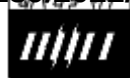
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एन टी पी सी NTPC राम रामो hydro						
10.00.00	TOUCH-UPS If more than 20 % of the total surface area of a given zone shall be touched-up, the Contractor shall replace the surface treatment over the entire surface.							
11.00.00	PROTECTION OF THE SURROUNDING SURFACES The Contractor shall take every measure to protect the surrounding equipment and surfaces from product spattering, and from any damage caused by the surface preparation that he performs. Equipment or surfaces that are soiled or deteriorated in spite of these measures shall be repaired or cleaned, or if this is impossible, replaced at the Contractor's expense.							
12.00.00	CARBON STEEL - STAINLESS STEEL CONNECTION When carbon steel and stainless steel parts are connected, the surface coating shall be prolonged by 50 cm on the stainless steel part.							
13.00.00	TYPES OF COATING The coatings to be applied, except when expressly stipulated otherwise in the equipment specifications, shall be defined as follows:							
14.00.00	CARBON STEEL SURFACES IN CONTACT WITH WATER <table><tr><th>System chosen</th><th>Thickness</th></tr><tr><td> 1 zinc epoxy priming coat </td><td>40 μm</td></tr><tr><td> 2 or 3 coats of epoxy-coal pitch finishing paint </td><td>2 x 225 or 3 x 150 μm</td></tr></table> The system's minimum thickness shall be 450 μm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.	System chosen	Thickness	1 zinc epoxy priming coat	40 μm	2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 μm	
System chosen	Thickness							
1 zinc epoxy priming coat	40 μm							
2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 μm							



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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC हाइड्रो hydro						
15.00.00	CARBON STEEL SURFACES IN CONTACT WITH AIR AND INSTALLED OUTSIDE								
	<table><tr><th>System chosen</th><th>Thickness</th></tr><tr><td> 1 epoxy priming coat </td><td>40 μm</td></tr><tr><td> 2 or 3 coats of epoxy-coal pitch finishing paint </td><td>2 x 225 or 3 x 150 μm</td></tr></table>	System chosen	Thickness	1 epoxy priming coat	40 μm	2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 μm		
System chosen	Thickness								
1 epoxy priming coat	40 μm								
2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 μm								
	The system's minimum thickness shall be 450 μm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.								
16.00.00	CARBON STEEL SURFACES UNDER COVER THAT STILL RISK CONDENSATION								
	<table><tr><th>System chosen</th><th>Thickness</th></tr><tr><td> - Zinc epoxy priming coat </td><td>40 μm</td></tr><tr><td> 2 coats colored solvented epoxy pitch </td><td>2 x 150 μm minimum</td></tr></table>	System chosen	Thickness	Zinc epoxy priming coat	40 μm	2 coats colored solvented epoxy pitch	2 x 150 μm minimum		
System chosen	Thickness								
Zinc epoxy priming coat	40 μm								
2 coats colored solvented epoxy pitch	2 x 150 μm minimum								
	The system's minimum thickness shall be 300 μm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.								
17.00.00	CARBON STEEL SURFACES UNDER COVER WITH NO RISK OF CONDENSATION								
	<table><tr><th>System chosen</th><th>Thickness</th></tr><tr><td> - Zinc epoxy priming coat </td><td>50 μm</td></tr><tr><td> 2 coats colored solvented epoxy pitch </td><td>2 x 100 μm minimum</td></tr></table>	System chosen	Thickness	Zinc epoxy priming coat	50 μm	2 coats colored solvented epoxy pitch	2 x 100 μm minimum		
System chosen	Thickness								
Zinc epoxy priming coat	50 μm								
2 coats colored solvented epoxy pitch	2 x 100 μm minimum								
	The system's minimum thickness shall be 200 μm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.								



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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC व्यवस्थापन hydro										
22.00.00	SPARE PARTS The spare parts' surface coating shall be applied in compliance with the present specifications. All temporary surface protections (until the spare parts are used) shall be designed to last for 15 years storage of the parts.											
23.00.00	COLOR OF THE FINISH COAT The Employer shall define the color of the finish coat.											
24.00.00	PROTECTION THICKNESS Protection thickness shall be checked in compliance with the following specifications:											
24.01.00	Number of measurement points The number of measurement points is defined in the following table: <table><tr><th>Size of the surface to be tested (reference zone, in m² or in linear meter))</th><th>Number of measuring points recommended</th></tr><tr><td>< 10</td><td>10 to 20</td></tr><tr><td>10 to 100</td><td>20 to 50</td></tr><tr><td>100 to 1000</td><td>50 to 100</td></tr><tr><td>1000 to 10000</td><td>100 to 200</td></tr></table>	Size of the surface to be tested (reference zone, in m ² or in linear meter))	Number of measuring points recommended	< 10	10 to 20	10 to 100	20 to 50	100 to 1000	50 to 100	1000 to 10000	100 to 200	
Size of the surface to be tested (reference zone, in m ² or in linear meter))	Number of measuring points recommended											
< 10	10 to 20											
10 to 100	20 to 50											
100 to 1000	50 to 100											
1000 to 10000	100 to 200											
24.02.00	Tolerance on system minimum thickness Spot measurements less than the minimum thickness shall be accepted if both following conditions are fulfilled: ♦ the average of all the measurements performed on the reference zone is equal to or greater than the required minimum value, and ♦ no measurement point is less than 80% of the required minimum value. In case of non-compliance with the criteria listed here above, the Contractor shall be obliged to touch up surface protection, either locally or completely. The touch-up procedure shall be submitted to the Employer.											

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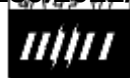
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एन टी पी सी NTPC हाइड्रो hydro
25.00.00	PRODUCT CHARACTERISTICS DATA SHEET For each product, the Contractor shall provide a characteristics data sheet specifying: ♦ the manufacturer's references, ♦ product characteristics, ♦ application conditions. The Contractor shall submit a model data sheet to the Employer. This sheet shall then be used for all surface protection works.	
26.00.00	PAINT/COATING QUALITY CONTROL SHEET During coating operations, the Contractor shall follow quality control procedure as agreed between the Employer and the Contractor:	

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COLOR SHADE

S. No	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow Shade: RAL 1004	IDENTIFICATION TAG/BAND: White Equivalent RAL 9010
2	Bottom block assembly	Golden Yellow Shade: RAL 1004	IDENTIFICATION TAG/BAND: White Equivalent RAL 9010
3	Hooks	Signal Red Shade: RAL 3001	
4	Electrical Equipment	Motor- RAL 5012 Control panels & other equipments- RAL9002 for Front & rear side and RAL 5012 for end Panel side.	



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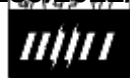
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ANNEXURE-V**DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

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

Sl no	NTPC drg no	BHEL drg no	Document title	Category	SCH**
1	5602-003-H143-PVM-U-059	PE-V0-414-501-A304	PH EDT: EOT MECHANISM CALCULATIONS - SELECTION OF MOTOR, CT & LT RAIL, BRIDGE GIRDER, WHEEL SIZE, WIRE ROPE	A*	21
2	5602-003-H143-PVE-B-027	PE-V0-414-501-A333	PH EOT: Electrical DRAWING OF 5T MONO Rail Hoist	A	35
3	5602-003-H143-PVE-B-028	PE-V0-414-501-A334	PH EOT: GA DRAWING OF Component Inside 5T MONO Rail Hoist Panel	I	35
4	5602-003-H143-PVE-B-029	PE-V0-414-501-A318	PH EOT :GA OF PANEL LAYOUT EOT CRANE	I*	28
5	5602-003-H143-PVE-B-043	PE-V0-414-501-A308	PH EOT:DSL FIXING ARRANGEMENT	A	21
6	5602-003-H143-PVE-H-030	PE-V0-414-501-A319A	PH EOT : CABLE SCHEDULE	I	35
7	5602-003-H143-PVE-U-031	PE-V0-414-501-A319B	PH EOT :CABLE SIZING CALCULATION/ SELECTION FOR CRANE	A*	28
8	5602-003-H143-PVE-U-032	PE-V0-414-501-A319C	PH EOT: VOLTAGE DROP CALCULATION IN DSL	I	28
9	5602-003-H143-PVE-W-033	PE-V0-414-501-A317A	PH EOT :DESIGN PHILOSOPHY FOR ELECTRICAL SYSTEM	I	28
10	5602-003-H143-PVE-W-034	PE-V0-414-501-A317B	PH EOT :PROTECTIVE CIRCUIT AND PARTS LIST FOR INDIVIDUAL OPERATION	A*	21

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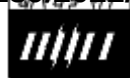
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11	5602-003-H143-PVE-W-035	PE-V0-414-501-A317C	PH EOT :POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS AND PART LIST FOR C.T. MOTION	A*	35
12	5602-003-H143-PVE-W-036	PE-V0-414-501-A317D	PH EOT :POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS AND PART LIST FOR L.T. MOTION	A*	35
13	5602-003-H143-PVE-W-037	PE-V0-414-501-A317E	RADIO-REMOTE STATION AND REMOTE CIRCUIT FOR PH EOT CRANE	A*	35
14	5602-003-H143-PVE-W-061	PE-V0-414-501-A317F	PH EOT:POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS AND PART LIST FOR MAIN HOIST MOTION	A*	35
15	5602-003-H143-PVE-W-062	PE-V0-414-501-A317G	PH EOT:POWER CIRCUIT, CONTROL CIRCUIT, CONTROLLER & CONTACTORS & PART LIST FOR AUXILIARY HOIST MOTION	A*	35
16	5602-003-H143-PVE-Y-038	PE-V0-414-501-A303	PH EOT :TECHNICAL DATA SHEET AND CURVES FOR MOTORS	A*	42
17	5602-003-H143-PVM-B-040	PE-V0-414-501-A305A	PH EOT :GA DRAWING OF EOT CRANE	A*	21
18	5602-003-H143-PVM-B-041	PE-V0-414-501-A332	PH EOT :RAIL FIXING SUB-ASSEMBLY DRAWING	A	21
19	5602-003-H143-PVM-B-042	PE-V0-414-501-A306A	PH EOT : CRAB SUB-ASSEMBLY DRAWING	A*	21
20	5602-003-H143-PVM-B-044	PE-V0-414-501-A310	PH EOT :LT DRIVE ASSEMBLY DRAWING	A	28
21	5602-003-H143-PVM-B-045	PE-V0-414-501-A309A	PH EOT :125 T SNATCH BLOCK SUB- ASSEMBLY FOR MH	I	28

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**RAMMAM STAGE-III HYDRO
ELECTRIC
PROJECT (3 X 40 MW)
DOUBLE GIRDER EOT CRANES FOR
POWER HOUSE (125/25 T)**

SPECIFICATION NO.: PE-TS-414-501-A001

SECTION: I

SUB SECTION: IA

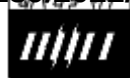
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22	5602-003-H143-PVM-B-046	PE-V0-414-501-A309B	PH EOT :25 T SNATCH BLOCK SUB ASSEMBLY FOR AH	I	28
23	5602-003-H143-PVM-B-047	PE-V0-414-501-A306C	PH EOT :GA OF MAINTENANCE PLATFORM ON TROLLEY	I	35
24	5602-003-H143-PVM-B-048	PE-V0-414-501-A337	PH EOT :ASSEMBLY AND DETAIL OF BOGIE COMPENSATING BEAM AND TIE BEAM	A	35
25	5602-003-H143-PVM-B-049	PE-V0-414-501-A306C	PH EOT :CT DRIVE ASSEMBLY	A	28
26	5602-003-H143-PVM-B-050	PE-V0-414-501-A309C	PH EOT: 125T HOOK AND NUT DETAIL	I*	28
27	5602-003-H143-PVM-B-051	PE-V0-414-501-A309D	PH EOT : 25T HOOK AND NUT DETAIL	I*	28
28	5602-003-H143-PVM-B-052	PE-V0-414-501-A335	PH EOT: GA DRAWING OF 5T MONO Rail Hoist	A	35
29	5602-003-H143-PVM-B-053	PE-V0-414-501-A336	PH EOT: GA DRG OF CRADLE FOR 125/25 T EOT CRANE	A	49
30	5602-003-H143-PVM-B-054	PE-V0-414-501-A338	PH EOT: GA DRAWING OF WIRE ROPE SLINGS	A	49
31	5602-003-H143-PVM-F-055	PE-V0-414-501-A339	PH EOT :EQUIPMENT LAYOUT	I	42
32	5602-003-H143-PVM-F-056	PE-V0-414-501-A316	PH EOT :CABIN LAYOUT	I	35
33	5602-003-H143-PVM-U-058	PE-V0-414-501-A312	PH EOT :STRUCTURAL SIZING CALCULATION	I*	35

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34	5602-003-H143-PVM-W-060	PE-V0-414-501-A305B	PH EOT:EOT CRANE NAME PLATE	I	42
35	NTPC DOC NO. IS REQUIRED TO BE OBTAINED	PE-V0-414-501-A340	PH EOT:OPERATION & MAINTENANCE MANUAL	I	55
36	5602-003-QVM-Q-135	PE-V0-414-501-A301	QUALITY PLAN FOR EOT CRANE	A*	21

LEGENDS

SCH** - Starts with date of LOI

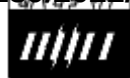
A= Approval category

I= Information category

Any comment given on an "I" type drawing shall have the same effect as if it were given on a "A" type drawing.

Notes:

- The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
- Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
- Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
- Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.
- All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.



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- d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
- e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.
- f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
- g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
- h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
- i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- j) Bidder to follow the following the drawing submission schedule:
 - i. 1st submission of drawings from date of LOI as per the submission schedule.
 - ii. Every revised submission incorporating comments – within 10 days.
- k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.
- l) * marked drawings/documents are basic engineering documents.



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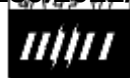
ANNEXURE VI – PACKING PROCEDURE

Packing and Marking

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

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

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



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ANNEXURE-VII

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

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

Basic Assumptions / Inputs for testing at Works:

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

Procedure for Load / Overload testing:

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

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

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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.

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.

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		CUSTOMER : NTPC LTD				QP NO.:---		DATE:--	
		PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)				PO NO.:		DATE:	
		ITEM: DG EOT UPTO 100T		SYSTEM: EOT CRANE		SECTION:		SHEET OF	

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

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Prepared by:			Checked by:					Reviewed by:			
Reviewed by:			Reviewed by:					Approved by:			

694239/2022/PS-PEM-MAX 	MANUFACTURER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-414-501-A001	DATE: 14-01-2022
		CUSTOMER : NTPC LTD		QP NO.:---	DATE:--
		PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)		PO NO.:	DATE:
		ITEM: DG EOT UPTO 100T	SYSTEM: EOT CRANE	SECTION:	SHEET OF

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

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Reviewed by:			Reviewed by:					Approved by:			

694239/2022/PS-PEM-MAX 	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS		QUALITY PLAN						SPEC. NO : PE-TS-414-501-A001				DATE: 14-01-2022	
			CUSTOMER : NTPC LTD						QP NO.:---				DATE:--	
			PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)						PO NO.:				DATE:	
			ITEM: DG EOT UPTO 100T			SYSTEM: EOT CRANE			SECTION:				SHEET OF	

		2.NDT	Major	U.T (only boss area)	100%	-	ASME Sec.V,article-23,SA-609	SA - 609 , Level - II	I.R.	✓	P	V	V	
f.	Seamless Pipe for Rope Drum	1. Chemical & Physical	Major	Chemical & Physical	100%		ASTM - A 106 GR . B	ASTM - A 106 GR . B	T.C	✓	P	V	V	
		2.NDT	Major	U.T	100%		ASTM A 435 / A 578 LEVEL B	ASTM A 435 / A 578 LEVEL B	I.R	✓	P	V	V	
			Major	Mac ro Etching/Flattening for Seamless Pipe	100%		ASTM A 106-2007,GR-B	ASTM A 106-2007,GR-B	I.R.	✓	P	V	V	
2.	BOUGHT OUT ITEMS													
a.	Hook	Forging Raw material	Major	Visual Check	100%		Drg. / Tech. Spec./ IS :1875-1992	No Visual defect	I.R	—	P	W	V	
			Major	UT after forging	100%		ASTM A 388-2007	UT PROCEDURE (Attached)	I.R	✓	P	#W	V	# For MH Hook , UT in proof machined condition and AH Hook in grinding condition.
		Heat treatment	Major	Heat treatment after forging	100%		Mfg. Std. / Drg./Tech. Spec./ IS:1875	Mfg. Std. / Drg./Tech. Spec./ IS:1875	HT Chart	✓	P	#V/W	V	# HT chart review for Main Hook at mfg. place
		Chemical test	Major	Chemical integral test piece.	Per Heat/ Batch		Appd. Drg. / IS :1875 -1992 , CLASS – II	Appd. Drg. / IS :1875 -1992 , CLASS – II	T.C.	✓	P	V	V	
		Physical test	Major	Tensil test on integral test piece after heat treatment	Per Heat/ Batch		Appd. Drg. / IS :1875 -1992 , CLASS – II	Appd. Drg. / IS :1875 -1992 , CLASS – II	T.C.	✓	P	W	W	Test Piece will be drawn from top of shank portion to be identified by BHEL and CUSTOMER.

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694239/2022/PS-PEM-MAX 	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN				SPEC. NO : PE-TS-414-501-A001				DATE: 14-01-2022			
		CUSTOMER : NTPC LTD				QP NO.:---				DATE:--			
		PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)				PO NO.:				DATE:			
		ITEM: DG EOT UPTO 100T		SYSTEM: EOT CRANE		SECTION:				SHEET OF			

		Macro etching	Major	Grain Size	100%		ASTM E 112	Grain size 6 or final	Lab T.C	√	P	V	V	
		NDT before Proof Load	Major	UT	100%		ASTM A 388-2007	UT PROCEDURE (Attached)	I.R	√	P	V	V	
			Major	DPT	100%		ASME Sec V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R	√	P	V	V	
		Proof Load Test	Major	Proof Load Test	100%		Drawing / IS: 5749/ IS: 15560 / DS	Drawing / IS: 5749/ IS: 15560 / DS	I.R	√	P	W	# V/ W	# W - FOR MAIN HOOK
		NDT after Proof Load (UT only shank portion)	Major	U.T & MPI after Proof Load Test	100%		ASTM A 388-2007 / ASTM E 709-2007	ASTM A 388-2007 / ASTM E 709-2007	I.R	√	P	W	# V/ W	
		Identification Punch	Major	Visual	100%		—	—	—	—	P	H	H	H - Hold point (identification by CUSTOMER & BHEL)
b.	Wire Rope & slings	Visual & Breaking Strength	Major	Type, grade, breaking strength & visual , Diameter	100%		IS: 2266 – 2002 / G.A DRG / DATA SHEET	IS: 2266 – 2002 / G.A DRG / DATA SHEET	Mill T.C.	√	P	V	V	
c.	Rails	Chemical & Tensile , Cross section , Hardness , Dimension	Major	Chemical & Tensile , Hardness , Dimension	100%		G.A Drawing / IS: 3443-1980/APPD DATA SHEET	G.A Drawing / IS: 3443-1980/APPD DATA SHEET	T.C / I.R	√	P	V	V	

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694239/2022/PS-DEM-MAX 	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN					SPEC. NO : PE-TS-414-501-A001			DATE: 14-01-2022		
		CUSTOMER : NTPC LTD					QP NO.:---			DATE:--		
		PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)					PO NO.:			DATE:		
		ITEM: DG EOT UPTO 100T		SYSTEM: EOT CRANE			SECTION:			SHEET OF		

3.	ELECTRICAL ITEMS													
a.	Transformer (like Control transformer ,Light transformer)	Make , Rating	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		IR		P	V	V	
		Routine Test	Major	Doc. Review	100%		Mfg. Catalog / DS	IS :2026 & IS: 12021 for control transformer	Mfg. TC		P	V	V	
b.	SFU , MCCB , MCB , CONTRACTORS , DSL, RELAYS , FUSES , RESISTENCE BANK,HOOTER, PUSH BUTTONS, indicating instruments , junction box, Limit Switches	Make / Rating / Type / Size	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		IR		P	V	V	
		Functional / Continuity Check	Major	Doc. Review	100%		Drg./ Data Sheet / Relavant Std.	Drg./ Data Sheet / Relavant Std.	IR / COC		P	V	V	10% Verification by CUSTOMER
c.	Motor	Type, Rating, Make, Size	Major	Visual	100%		CUSTOMER approved BOI list & ADS / DRG		Mfg. TC	√	P	V	V	Refer Note 6 for Motor Up to 50 KW. For Motor above 50 KW separate QP Shall be applicable.
		Routine Test / Clearance of QP for Motor above 50 KW	Major	Measurement	100%		IS: 325 / App. Data sheet/CUSTOMER ADS	IS: 325 / App. Data sheet/CUSTOMER ADS	COC / Mfg T.C. (As per Note-3)	√	P	V	V	
d.	Brakes	Make,Type, Rating	Major	Measurement	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg. TC		P	V	V	
		IR,HV,Functional Test	Major	Measurement	100%		MFG. STD.	MFG. STD.	Mfg. TC		P	V	V	

BHEL					
ENGINEERING			QUALITY		
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Reviewed by:			Reviewed by:		

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Approved by:			

694239/2022/PS-PEN-MAX 	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN					SPEC. NO : PE-TS-414-501-A001			DATE: 14-01-2022		
		CUSTOMER : NTPC LTD					QP NO.:---			DATE:--		
		PROJECT: RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW)					PO NO.:			DATE:		
		ITEM: DG EOT UPTO 100T		SYSTEM: EOT CRANE			SECTION:			SHEET OF		

e.	VVVF Drive	Type, Rating, Make,	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg. TC/ COC		P	V	V	
		Routine Test	Major	Measurement	100%		CUSTOMER APPD DA/GA DRG.	CUSTOMER APPD DA/GA DRG.	Mfg. TC	√	P	V	V	
f.	Cables (Power / Control / Trialing / Flexible)	Make, Type, Size	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC		P	V	V	Being small quantity of cables used for each size and type less than 500 mtr. Separate QAP for cable not required.
		Routine Test	Major	Measurement	100%		CUSTOMER Spec. / IS : 9963 / IS:694 /IS: 1554 / IS:7098	CUSTOMER Spec. / IS : 9963 / IS:694 /IS: 1554 / IS:7098	Mfg TC	√	P	V	V	
g.	Radio Remote, Master Controller, Pendent Station, Switches	Make / Rating / Type / Functional	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC / IR / COC		P	V	V	
h.	Anti - Collision Device , Cable Gland & lugs , Rectifier ,Lamps, load Cell	Make / Type	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC / IR / COC		P	V	V	
4.	OTHER BOUGHT OUT ITEMS													
	Bearings	Type & Size	Major	Verification	100%		Appd.drg./ Mfr's catalogue		Mfg TC / IR / COC	√	P	V	V	
	Tools and tackles	Verification of type size / rating	Major	Verification	100%		As per PO / BBU		IR / COC	√	P	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
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Reviewed by:			Reviewed by:					Approved by:			

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	Spares (Mandatory / recommended spare / commissioning spares)	Verification of type size / rating	Major	Review Of Internal Inspection Reports / Mfr's TC / COC	100%	100 %	Approved Spare List		IR / COC	√	P	V/W	V/ W	
5.	IN PROCESS : FABRICATED COMPONENTS : GIRDER, END CARRIAGE, TROLLEY, GEAR BOX CASING , FABRICATED ROPE DRUM													
a.	Welding	WPS & PQR	Major	Review of Document	100%		ASME SEC IX 2007	ASME SEC IX 2007	ASME PRO	√	P	V	V	Earlier CUSTOMER Approved WPS and CUSTOMER / BVQ/Lloyds/EIL qualified Welder acceptable.
b.	Weld Fit Up & Edge Preparation	Dimension	Major	Dimension	100%		Mfg. Drg.	Mfg. Drg.	I.R		P	V	V	
c.	Fillet Weld	NDT	Major	DPT on Fillet Weld	100%	10 %	ASME - Sec. V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R.	√	P	V/W	V	DP test of fillet weld for rope drum to be conducted after final machining. Random witness by BHEL
d.	Butt Weld (Girder ,End-carriage, Trolley & Fabricated Rope drum,if applicable)	NDT	Major	Radiography Test / Gamma Ray	\$		ASME - Sec. V	ASME - Sec. VIII,Div-1, Clause- UW-51 & 52	I.R.	√	P	V	V	\$ 100% in Tension Zone, 25% in Compression Zone & 100% for rope drum Seam weld, RT Film shall be reviewed by CUSTOMER & BHEL
				DPT on Butt Weld	100%	10%	ASME - Sec. V	ASME SEC. VIII , Div-1 , Appendix - 8	I.R.	√	P	W	V	10% random witness by BHEL
e.	Heat Treatment (SR) of Rope drum and Gear Box Casing	–	Major	Review of SR chart/Test Report	100%		Drg./ Relavant Std. / CUSTOMER	Drg./ Relevant Std. / CUSTOMER Spec.	SR Chart	√	P	V	V	

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694239/2022/PS-DEM-MAX 	MANUFACTURER/ SUPPLIER NAME & ADDRESS BIDDER/	QUALITY PLAN					SPEC. NO : PE-TS-414-501-A001				DATE: 14-01-2022			
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							Spec.							
f.	Cabin, Platform, Hand railing	Dimension	Major	Dimension	100%		Mfg. Drg	Mfg. Drg	—	—	P	V	V	
g.	Final Inspection of Fabricated Components (Girders, End Carriages & Trolley, end stopper)	Visual & dimensional	Major	Dimensional & Visual Check	100%		Appd. G.A Drg / CRAB	Appd. G.A Drg / CRAB	I.R.		P	V	V	At the Time of Final Insp. Of Crane
6. IN PROCESS INSPECTION OF MACHINED COMPONENTS														
a.	Pinions,Gear & Wheels	1. Dimensional Check	Major	Measurement	100%		Mfg Drg / Crane Data sheet	Mfg Drg / Crane Data sheet	I.R	√	P	V	V	Hardness test report review after applicable Q & T condition
		2. Heat Treatment	Major	Heat Treatment chart	100%		Material specification/ Mfg std/ Mfg drg	Material specification/ Mfg std/ Mfg drg	I.R	√	P	V	V	Heat treatment Chart to be reviewed by BHEL & CUSTOMER
		3. Hardness	Major	Measurement	100%	100 %	Mfg Drg / Crane Data sheet/ IS: 3177	Material specification/ Mfg std/ Mfg drg	I.R	√	P	#W	V	#W - (1) 100% witness for MH/ AH Gear,pinion of entire lot (2) 100% witness for CT & LT Gear, pinion of entire lot
		4. NDT	Major	DPT on teeth	100%		IS:3658-1981 / ASME - Sec. V	NO CRACKS & LINEAR INDICATION	I.R	√	P	V	V	
b.	Difference of Hardness of Pinion & Gear	—	Major	Documents review	100%		IS 3177 / CUSTOMER apprd. Drg. / DS	IS 3177 / CUSTOMER apprd. Drg. / DS	I.R	√	P	V	V	

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

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a.	CONTROL PANEL With VVVF Drive	Identification of all Elect. Components , Cable laying / Dressing/Fe rulling /Terminations Dimensional Functional , HV, IR, interlocks, Protection DOP	Major	Visual, dimensional, Operational & Functional Check , HV,IR, Painting	100%	100%	IS:3177 -1999 / Appd. Drg / Data sheet	IS:3177 -1999 / Appd. Drg / Data sheet	T.C	√	P	W	W	(HV at 2.5 KV Ac for power ckt at 2 KV for control ckt ,DOP by paper insertion method) BOI as per CUSTOMER Approved Makes. Will be Checked at the time of Final Inspection.
		Paint Shade/ Thk/ Adhesion	Major	Visual / DFT Check	100%		APPD Painting Procedure / GA	APPD Painting Procedure / GA	T.C		P	V	V	7 Tank Pretreatment before Painting

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694239/2022/PS-PEM-MAX 	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-414-501-A001	DATE: 14-01-2022
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b.	EOT crane assembly with control panel, Master Controller / Remote Controller / Pendant Station (At Works)	Visual & dimensional	Major	Dimensional ,Span, Diagonal & Wheel Base Dimension, LT Stopper Dimension	100%	100 %	Approved G.A. Drg. / IS 3177 / DS	Approved G.A. Drg. / IS 3177 / DS	I.R.	√	P	W	W	Crane Should be Operable by RRC meant for that Crane only.

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

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NOTE :

- 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.
- 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.
- Performance of electrical & control devices along with the interlocks, protection & sequence to be checked during crane assembly and parked at works.
- 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

5) Acceptance norms for UT (Normal probe to be used of not less than 2 MHz frequency) : Following defects are not acceptable:/ Vendor's UT Procedure approved by BHEL may also be used.

(i) Cracks, flakes, seams and laps

(ii) Defects giving indications larger than 4 mm diameter equivalent flaw.

(iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%.

(iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four time the size of the larger of the adjacent flaws

For hooks, for carrying out UT on the areas where there is loss of back wall echo due to geometry, the calibration shall be done on blocks of same material of similar thickness having Flat Bottom holes of required size as given above.

6) FOR MOTORS, FOLLOWING MODALITIES SHALL BE ADOPTED.

(A) LESS THAN 30KW : ACCEPTANCE OF MOTOR LESS THAN 30 KW IS BASED ON COC OF THE MANUFACTURER & THE CONTRACTOR CONFIRMING AS FOLLOWS:

- IT IS HEREBY CONFIRMED THAT THE ABOVE MENTIONED MOTOR /MOTORS WAS/ WERE MANUFACTURED TAKING CARE OF NTPC SPECIFIC REQUIREMENTS REGARDING AMBIENT TEMP., VOLTAGE & FREQUENCY VARIATION, HOT STARTS, PULL OUT TORQUE, STARTING KVA/KW, TEMP. RISE, DISTANCE BETWEEN CENTRE OF STUD & GLAND PLATE AND TESTED IN ACCORDANCE WITH APPROVED DRAWING /DATA SHEETS.

(B) 30 KW TO BELOW 50 KW

- ACCEPTANCE OF MOTOR RATING BETWEEN 30 KW & 50 KW IS BASED ON NTPC REVIEW OF ROUTINE TEST INSPECTION REPORT AS PER IS 325 ALONG WITH COC OF THE MANUFACTURER & THE CONTRACTOR CONFIRMING AS FOLLOWS:

- IT IS HEREBY CONFIRMED THAT THE ABOVE MENTIONED MOTOR /MOTORS WAS/ WERE MANUFACTURED TAKING CARE OF NTPC SPECIFIC REQUIREMENTS REGARDING AMBIENT TEMP., VOLTAGE & FREQUENCY VARIATION, HOT STARTS, PULL OUT TORQUE, STARTING KVA/KW, TEMP. RISE, DISTANCE BETWEEN CENTRE OF STUD & GLAND PLATE, SPACE HEATER AND TESTED IN ACCORDANCE WITH APPROVED DRAWING /DATA SHEETS.

LEGENDS:

*RECORDS, IDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M:** SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C:** MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N:** CUSTOMER,**P:** PERFORM, **W:** WITNESS, **V:** VERIFICATION, AS APPROPRIATE**MA:** MAJOR, **MI:** MINOR, **CR:** CRITICAL

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Prepared by:			Checked by:					Reviewed by:			
Reviewed by:			Reviewed by:					Approved by:			

IPS-PEM-MAX		QUALITY ASSURANCE AND INSPECTION (MECHANICAL)		एनटीपीसी NTPC हाइड्रो hydro	
CLAUSE NO.					
		E.O.T. CRANE			
1.00.00		HOOKS			
1.01.00		ALL TESTS INCLUDING PROOF LOAD TEST AS PER RELEVANT IS BS / DIN SHALL BE CARRIED OUT.			
1.02.00		MPI/DPT SHALL BE CARRIED OUT AFTER PROOF LOAD TEST.			
2.00.00		STEEL CASTING			
2.01.00		DPT ON MACHINED SURFACE SHALL BE CARRIED OUT.			
3.00.00		GIRDERS, END CARRIAGE, CRAB, GEAR BOX AND ROPE DRUM			
3.01.00		THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.			
3.02.00		NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS:			
		BUTT WELTS IN TENSION: - 100% RT AND 100% DPT			
		BUTT WELTS IN COMPRESSION: - 10% RT AND 100% DPT			
		BUTT WELTS IN ROPE DRUM: - 100% RT AND 100% DPT			
		FILLET WELDS: - RANDOM 10% DPT			
4.00.0		FORGING (WHEEL, GEARS, PINIONS, AXLE, HOOKS & HOOK TUNION)			
		ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE ULTRASONICALLY TESTED.			
4.01.00		DPT/MPI SHALL BE DONE AFTER HARDFACING AND MACHINING.			
4.02.00		WIRE ROPE SHALL BE TESTED AS PER RELEVANT STANDARD.			
4.03.00		REDUCTION GEARS SHALL BE TESTED FOR REDUCTION RATIO, BACHLASH & CONTACT PATTERN. GEAR BOX SHALL BE SUBJECTED TO NO LOAD RUN TEST TO CHECK FOR OIL LEAKAGE, TEMPERATURE RISE, NIOSE AND VIBRATION.			
4.04.00		THE CRANES SHALL BE COMPLETELY ASSEMBLED AT SHOP FOR FINAL TESTING. ALL TESTS FOR DIMENSION, DEFLECTION, LOAD, OVERLOAD, HOISTING MOTION, CROSS TRAVELL ETC. AS PER IS-3177 SHALL BE CARRIED OUT AT SHOP.			
4.05.00		ALL ELECTRIC HOISTS SHALL BE TESTED AS PER IS-3938 AND CHAIN PULLEY BLOCKS SHALL BE TESTED AS PER IS-3832.			
4.06.00		~~LIFTING BEAM TEST~~			
		~~LIFTING BEAM SHALL BE SUBMITTED TO SUITABLE TEST DURING MANUFACTURING~~			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BID DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI		PART-QA SUB-SECTION-QM	
				Page 24 of 32	

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**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
CRANES & HOISTS
3X40 MW RAMMAM STAGE-III
HYDRO ELECTRIC PROJECT**

SPECIFICATION NO.

VOLUME NO. : **II-B**SECTION : **C**REV NO. : **00** DATE : **02.04.2016**

SHEET : 1 OF 3

**TECHNICAL SPECIFICATION
FOR
CRANES
(ELECTRICAL PORTION)**

	ELECTRICAL EQUIPMENT SPECIFICATION FOR CRANES & HOISTS 3X40 MW RAMMAM STAGE-III HYDRO ELECTRIC PROJECT	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION : C
		REV NO. : 00 DATE : 02.04.2016
		SHEET : 2 OF 3

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 **Cranes**.
- 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) Cable from supply feeder to isolating switch shall be in Vendor scope.
- j) Sub-vendors shall be subjected to final approval by customer at contract stage without any technical / commercial implication to BHEL.

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

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

694239/2022/PS-PEM-MAX



**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
CRANES & HOISTS
3X40 MW RAMMAM STAGE-III
HYDRO ELECTRIC PROJECT**

SPECIFICATION NO.

VOLUME NO. : **II-B**SECTION : **C**REV NO. : **00** DATE : **02.04.2016**

SHEET : 3 OF 3

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –1A & 1B)
- b) Technical Requirements for LV Motors.
- c) Datasheets(A&C)
- d) BHEL Quality Plan for Motor, NTPC Quality Plan for Power & Control Cable.
- e) NTPC Quality assurance & Inspection Plan for Motor, Power & Control Cable.
- d) Electrical Load data format (Refer Volume – III)
- e) NTPC Specification for cables

ANNEXURE-1A

REV: 00 DATE: 02.04.2016

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: DOUBLE GRIDER EOT CRANES

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 3X40 MW RAMMAM STAGE-III HYDRO ELECTRIC PROJECT

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

CLAUSE NO.	GENERAL ELECTRICAL SPECIFICATION (E0)			
3.07.00	The earth mat of 132 kV Air Insulated switchyard located near the main power house shall also be interconnected to the Power house earth mat. Underground earth mat of switchyard shall be designed to take care the requirement of switchyard fault level of 31.5kA Cables Cables shall be de-rated for the site ambient and ground temperatures, grouping, soil resistivity and cable laying configuration. Contractor shall furnish detailed cable selection / sizing criteria for Employer's approval. Cables shall be selected to limit maximum voltage drop at equipment terminals, during normal operation and starting conditions, well within permissible values. Voltage grade of cables shall be of earthed grade when used in solidly earthed systems and for resistive earthed system. It shall be unearthed grade when used in non-earthed systems. Fire proof cable penetration sealing system for 1 hour rating shall be provided.			
3.08.00	Motors			
3.08.01	Motors shall be rated for continuous duty (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor			
3.08.02	Wherever the basis for motor ratings are not specified in the corresponding mechanical specification Sub-sections, maximum continuous motor ratings shall be at least 10% above design duty point or equal to the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation.			
3.08.03	In fire hazardous areas, totally flame proof motors confirming to IS shall be provided.			
3.09.00	D.C. Systems			
	The minimum ratings of the batteries and chargers to be supplied shall be as specified elsewhere in the specification. However, batteries shall be sized to meet the following criteria. Sizing calculations shall be submitted. The load to be supplied from the batteries may be calculated based on Electrical scope. The DC system scheme for the project shall be as per the Single Line Diagram (SLD) attached in this specification. a) Battery shall be rated for meeting the total load requirement of three (3) generating units along with common station load, for a period of at least one hundred and twenty (120) minutes. Also following a sudden tripping of all generating units and complete auxiliary A.C. supply failure, battery shall be able to supply the common station loads for 120 minutes and followed by starting loads of one unit. b) Another battery of similar capacity shall be provided to act as 100% standby. c) In normal operation both batteries may work in sharing or independent mode.			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E0	PAGE 5 OF 16

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1.0 INTENT OF SPECIFICATION

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:

IS: 325, IEC: 60034	Three phase Induction motors
IS: 900	Code of practice for installation and maintenance of induction motors
IS: 996, IEC: 60034	Single phase small AC and universal motors
IS: 12615	Energy Efficient motors
IS: 3177, IEC: 60034	Crane duty 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 machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 For the purpose of design of equipment/systems, an ambient temperature of 40 degree centigrade and relative humidity of 95% shall be considered. The equipment shall operate in highly polluted environment.

3.2 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

3.3 The contractor shall provide fully compatible electrical system, equipment, accessories and services. All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

3.4 The auxiliary AC voltage supply arrangement shall be designed to limit voltage variation of +/- 10% under worst operating condition.

3.5 The voltage level for motors shall be as follows:-

a) Upto 0.2KW:	240V, Single Phase AC
b) Above 0.2KW and upto 200KW:	415V, Three Phase AC

3.6 Fault level shall be limited to the parameters as indicated in Data Sheet-A.

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3.7 Motor shall be continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. All Motors selected shall be of ample capacity to suit respective duties. Full load torque of motors shall be higher than the maximum load torque.

3.8 Generally Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment. Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

3.9 In general all motors shall be squirrel cage induction motor suitable for direct-on-line starting without exceeding acceptable winding temperature. Continuous duty LT motors upto 160 KW Output rating (at 40 deg.C ambient temperature), shall be Energy Efficient motors, Efficiency class-Eff1, conforming to IS 12615.

3.10 Crane duty motors shall be squirrel cage type to suit 415 V, AC, 3 phase, 50 Hz, four wire power supply, totally enclosed. The motors shall be suitable for direct on line starting any hoisting / lowering rated load, even in event of frequency control system being out of order.

3.11 DC motors (If applicable) shall be shunt wound.

3.12 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance):

(a) Upto 11 KW:	11
(b) Above 11 KW	10

4.0 Starting Requirements

4.1 For motors with starting time 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 sees. more than starting time.

4.2 For motors with starting time more than 20 secs. and upto 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.

4.3 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. Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

4.4 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Pull-out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% of full load torque for crane duty motors at rated voltage & frequency.

4.5 Starting voltage requirement shall be 85% of rated voltage, refer Data sheet-A.

5.0 Running Requirements

5.1 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.

5.2 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.

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6.0 Stress during bus Transfer

6.1 All motors shall be so designed that maximum inrush currents and locked rotor and pull-out torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

6.2 The motors shall be suitable for bus transfer schemes provided on 415V system without any injurious effect on its life,

6.3 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.

6.4 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

6.5 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

6.6 Noise level for all the motors shall be limited to 85dB (A), Bearing housing vibration shall be limited within the limits prescribed in IEC 60034-14/IS: 12075, Motors shall withstand vibrations produced by driven equipment.

7.0 CONSTRUCTIONAL FEATURES

7.1 Degree of protection for various enclosures as per IS: 4691, IEC60034-05 shall be as follows:-

i) Indoor motors (With fan cooling arrangement for Power House crane, for B.F. valve house crane)	IP 54
ii) Outdoor motors	IP 55
iii) CW motors (in case of screen protected Drip proof)	IP 23
iv) Cable box - indoor area	IP 54
v) Cable box - outdoor area	IP 55

7.2 Temperature rise for Air cooled motors not to exceed the limits in Table-1 of IS-325. Maximum rise at full load by resistance method for both thermal class 130(8) & 155(F) insulation shall not exceed by 70 deg. C over the ambient of 40 deg. C. Further refer Data Sheet-A.

7.3 For water cooled motors 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(8) & 155(F) insulation.

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

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

7.6 Suitable single phase space heaters shall be provided on all motors rated 30KW and above, for Crane duty motors 20 KW & above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.

7.7 All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148.

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7.8 Winding and Insulation:

- (a) Type: Non-hygroscopic, oil resistant, flame resistant
 (b) Starting duty: Two hot starts in succession, with motor initially at normal running temperature
 (c) 415V AC & 220V DC motors: Thermal Class; 130(B) or better

7.9 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

7.10 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

7.11 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

7.12 Motor shall be provided with Class 'F' insulation with time rating of 1 hour for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.

8.0 Terminals and Terminal Boxes

8.1 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".

8.1 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.

8.2 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.

8.3 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.

8.4 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Terminal Shall be arranged such that terminals are easily accessible for inspection and maintenance, adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A. Further Natural ventilation shall not be restricted

8.5 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.

8.6 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

8.7 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.

8.8 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.

8.9 Motor bearings Roller type. Sealed to prevent grease leakage and entry of dust. Shall be of ample strength to withstand heavy shocks and vibration to which subjected under all conditions of operation.

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9.0 General

9.1 Motors provided for similar drives shall be interchangeable, Sturdy and strong to withstand operational shocks and vibrations

9.2 Suitable foundation bolts are to be supplied along with the motors.

9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

9.5 Name plate with all particulars as per IS: 325 shall be provided.

9.6 The colour of finish shall be RAL 5012 (Blue) for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

9.7 For all motors Protection against fungus, vermin, and corrosion shall be provided.

10.0 INSPECTION AND TESTING

10.1 Type test on each type and rating of LT motor of above 50 KW only:

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
4. Locked rotor readings of voltage, current and power input at a suitable reduced voltage.
5. Full load test to determine efficiency power factor and slip.
6. Temperature rise test.
7. Momentary overload test.
8. Insulation resistance test.
9. High voltage test.
10. Test for vibration severity of motor.
11. Test for noise levels of motor.
12. Test for degree of protection and
13. Over speed test.

10.2 All Routine & Acceptance tests on motors as per specification & relevant standard shall be carried out in the presence of customer or customer representative. Charges for the same is deemed to be included in the equipment price

10.3 All materials, components and equipment covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan as enclosed with this specification and which shall be complied.

10.4 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.

10.5 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

10.6 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

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TABLE – 1

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS:

Motor MCR in KWMinimum 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

PHASE TO PHASE! PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for L T motors with lugs installed shall be as follows:

Motor MCR in KWClearance

UPto110KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

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 maximum permissible voltage.



PART-B

SUB-SECTION- E14

LT MOTORS

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI

694239/2022/PS-PFM-MAX

ZZIPS-FEM-MAA				एनटीपीसी NTPC हाइड्रो hydro	
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RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI		PART-B SUB-SECTION – E 14	
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CLAUSE NO.	LT MOTORS (E14)	एनटीपीसी NTPC हाइड्रो hydro
1.00.00	GENERAL REQUIREMENTS	
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 40 deg.Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.	
1.02.00	All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.	
1.03.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services.	
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.	
1.05.00	The auxiliary AC voltage supply arrangement shall be designed to limit voltage variation of +/- 10% under worst operating condition :	
1.06.00	The voltage level for motors shall be as follows :-	
	a) Upto 0.2KW : 240V, Single Phase AC/ 415V Three phase AC	
	b) Above 0.2KW and upto 200KW : 415V, Three Phase AC	
1.07.00	Fault level shall be limited to the parameters as indicated in Chapter Sub Section, E0.	
1.08.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor motors.	
1.09.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.	
1.10.00	Degree of Protection	
	Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :-	
	i) Indoor motors - IP 54	
	ii) Outdoor motors - IP 55	
	iii) CW motors (in case of screen protected Drip proof) - IP 23	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION – E 14 PAGE 2 OF 7

CLAUSE NO.	LT MOTORS (E14)	एनटीपीसी NTPC हाइड्रो hydro
2.00.00	iv) Cable box - indoor area - IP 54 v) Cable box - outdoor area - IP 55 CODES AND STANDARDS 1) Three phase induction motors : IS:325, IEC:60034 2) Single phase AC motors : IS:996, IEC:60034 3) Crane duty motors : IS:3177, IEC:60034 4) DC motors/generators : IS:4722 5) Energy Efficient motors : IS 12615	
3.00.00	TYPE	
3.01.00	AC Motors: (a) Squirrel cage induction motor suitable for direct-on-line starting. (b) Continuous duty LT motors upto 160 KW Output rating (at 40 deg.C ambient temperature) ,shall be Energy Efficient motors ,Efficiency class-Eff1, conforming to IS 12615. (c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.	
3.02.00	DC Motors Shunt wound.	
4.00.00	RATING (a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. (b) Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.	
5.00.00	TEMPERATURE RISE Air cooled motors 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation. Water cooled 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation .	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION – E 14 PAGE 3 OF 7

CLAUSE NO.	LT MOTORS (E14)	एनटीपीसी NTPC हाइड्रो hydro
6.00.00	OPERATIONAL REQUIREMENTS	
6.01.00	Starting Time	
6.01.01	For motors with starting time upto 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.	
6.01.02	For motors with starting time more than 20 secs. and upto 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.	
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.	
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.	
6.02.00	Torque Requirements	
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.	
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.	
6.03.00	Starting voltage requirement shall be 85% of rated voltage.	
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES	
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.	
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS:2148.	
7.03.00	Winding and Insulation	
	(a)Type : Non-hygroscopic, oil resistant, flame resistant	
	(b)Starting duty : Two hot starts in succession, with motor initially at normal running temperature	
	(c)415V AC & 220V DC motors: Thermal Class130(B) or better	
7.04.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION – E 14 PAGE 4 OF 7

ZZIPS-FEM-MAX		एनटीपीसी NTPC हाइड्रो hydro	
CLAUSE NO.	LT MOTORS (E14)		
7.05.00	Noise level for all the motors shall be limited to 85dB(A). Bearing housing vibration shall be limited within the limits prescribed in IEC 60034-14/IS:12075 . Motors shall withstand vibrations produced by driven equipment.		
7.06.00	Motor body shall have two earthing points on opposite sides.		
7.07.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.		
7.08.00	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.		
7.09.00	The motors shall be suitable for bus transfer schemes provided on 415V system without any injurious effect on its life.		
7.10.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) . (a) Upto 110KW: 11.0 (b) Above 110KW 10.0		
8.00.00	TEST		
8.01.00	TESTS FOR LT MOTORS OF RATING 50 KW AND ABOVE: Type test on each type and rating of LT motor of above 50 KW only. 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Locked rotor readings of voltage, current and power input at a suitable reduced voltage. 5. Full load test to determine efficiency power factor and slip . 6. Temperature rise test . 7. Momentary overload test . 8. Insulation resistance test . 9. High voltage test . 10. Test for vibration severity of motor. 11. Test for noise levels of motor .		
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 14 PAGE 5 OF 7

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CLAUSE NO.	LT MOTORS (E14)			
8.02.00	12. Test for degree of protection and 13. Overspeed test. 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.			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 14	PAGE 6 OF 7

694239/2022/PS-PEM-MAX

LV MOTORS**DATA SHEET-A**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 02/04/2016

SHEET 1 OF 1

- 1.0 Design ambient temperature : 40 °C (95% Humidity)
- 2.0 Maximum acceptable kW rating of LV motor : ≤200KW
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Degree of Protection (Indoor/Outdoor) : IP54/IP55
- 5.0 Type of Cooling : TEFC/CACA/TETV
- 6.0 Details of supply system
- a) Rated voltage (with variation) : 415V ± 10%
 - b) Rated frequency (with variation) : 50 Hz (Variation: +3% TO –5%)
 - c) Combined voltage & freq. variation : 10%
 - d) System fault level at rated voltage : 45 kA for 1 sec
 - e) Short time rating for terminal boxes
 - 110kW & Above : 45 kA for 1 sec
(Breaker controlled)
 - Below 110kW (SFU+ Contactor controlled+ OLR) : 45 KA for 0.20 sec.
 - f) LV System grounding : Solidly
- 7.0 Class of insulation : Class 'F', with temp rise limited to class B.
- 8.0 Minimum voltage for starting (As percentage of rated voltage) : 85% of rated voltage
- 9.0 Power cables data : The voltage drop in cable, during motor starting condition, shall be limited to 10% and during full load running condition, it shall be limited to 3% of the rated voltage.
- 10.0 Space heater supply : 240 V, 1Φ, 50 Hz
- 11.0 Rating up to which Single phase motor : Acceptable upto 0.20 kW
- 12.0 Applicable Standard for motors : IS: 325, IEC: 60034 (for 3-ph induction motors) and IS: 3177, IEC: 60034 (for crane duty motors)
- 13.0 Paint shade : RAL 5012 (Blue) for Indoor & Out door

14.0 TESTING**14.1 Type Tests:**

Type test on each type and rating of LT motor of above 50 KW only

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)

694239/2022/PS-PEM-MAX

LV MOTORS**DATA SHEET-A**

SPECIFICATION NO.

VOLUME

II B

SECTION

D

REV NO. 00

DATE 02/04/2016

SHEET 2 OF 1

4. Locked rotor readings of voltage, current and power input at a suitable reduced voltage.
5. Full load test to determine efficiency power factor and slip.
6. Temperature rise test.
7. Momentary overload test.
8. Insulation resistance test.
9. High voltage test.
10. Test for vibration severity of motor.
11. Test for noise levels of motor.
12. Test for degree of protection and
13. Over speed test

14.2 Routine & Acceptance Tests

All Routine & Acceptance tests on motors as per specification & relevant standard shall be carried out the presence of customer or customer representative. Charges for the same is deemed to be included in the equipment price.

694239/2022/PS-PEM-MAX

	MOTOR DATA SHEET – C 3X40 MW RAMMAM STAGE-III HYDRO ELECTRIC PROJECT	SPECIFICATION NO.	
		VOLUME	II B
		SECTION	D
		REV NO. 00	DATE 02/04/16
		SHEET 1	OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

694239/2022/PS-PEM-MAX

	MOTOR DATA SHEET – C 3X40 MW RAMMAM STAGE-III HYDRO ELECTRIC PROJECT	SPECIFICATION NO.	
		VOLUME	II B
		SECTION	D
		REV NO. 00	DATE 02/04/16
		SHEET 2	OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

694239/2022/PS-PEM-MAX

		QUALITY PLAN SHEET 1 OF 2		CUSTOMER : THDCIL		PROJECT 3X40 MW RAMMAM STAGE-III HYDRO ELECTRIC PROJECT			SPECIFICATION :				
				BIDDER/ :		TITLE CRANES & HOISTS			NUMBER :				
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE				
		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	10	11	12		
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-		
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./MFG. SPEC.	MFG. DRG./MFG. SPEC.	-DO-	2	-	-		
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-		
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-		
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1			NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-		NOTE -1 & NOTE-3
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										

694239/2022/PS-PEM-MAX

		QUALITY PLAN SHEET 2 OF 2		CUSTOMER : THDCIL		3X40 MW RAMMAM STAGE-III HYDRO ELECTRIC PROJECT			SPECIFICATION :			
				BIDDER/ : VENDOR		PROJECT TITLE CRANES & HOISTS			NUMBER :			
				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	SECTION			VOLUME III
1	2	3	4	5	6	7	8	9	P	W	V	REMARKS
		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				

Sl. No		Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
1		2	3	4	5	6	C/ N	7	8	9	10				11
Instructions: 1) Cable manufacturer to maintain records to show co- relation of raw materials to finished cables i.e raw material batch/ lot no. should be traceable to the cable drum. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.															
A Raw material/ Brought out Items															
1.01	Aluminum	1.Make	MA	Verify	100%	--		MANUFACTURER APPROVED SOURCES	MANUFACTURE R APPROVED SOURCES	QCR		V	--	--	
		2. Resistivity	MA	Elect	As per Cable Mnfr Std.	--		IS5082	IS5082	--do--		P	--	--	
1.02	PVC / XLPE/compound for insulation	1. Make	MA	Verify	--do--	100%		MANUFACTURER APPROVED SOURCES	MANUFACTURE R APPROVED SOURCES	--do--		V	V	--	
		2. Type/ Grade	MA	Verify	100%	100%		NTPC ADS	NTPC ADS	--do--		V	V	V	
		3. All acceptance test as per manufacturer norms including thermal stability test for PVC insulation	MA	Verify	As per manufacturer norms	As per manufacturer norms		NTPC ADS	NTPC ADS	--do--		V	V	V	Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--		MANUFACTURER APPROVED sources	MANUFACTURE R APPROVED sources	--do--		V	V	V	
		2. Type/ Grade	MA	Verify	--do--	--do--		NTPC ADS	NTPC ADS	--do--		V	V	V	
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--		MANUFACTURER APPROVED sources	MANUFACTURE R APPROVED sources	--do--		V	V	V	
		2. Dimension	MA	Meas	1 sample from each size / lot	--		NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	--do--		P	--	--	
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--		IS 3975	IS 3975	Supplier TC		V	V	--	
1.05	PVC compound for Sheath	1. Make	MA	Verify	As per manufacturer norms	100%		MANUFACTURER APPROVED sources	MANUFACTURE R APPROVED sources	QCR		V	V	--	
		2. Type / Grade	MA	Verify	100%	100%		NTPC ADS	NTPC ADS	QCR		V	V	V	
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms		NTPC ADS	NTPC ADS	QCR		V	V	V	Refer note 1

Page 1 of 11

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERIFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QAL-P-10/F3-R1

		Item: 1.1 KV Power (XLPE & PVC) FRLS Insulated cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)				QP. NO. 0000-999- QOE- S-041							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		4. Thermal Stability	MA	Chem	One sample / Batch	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		5. Oxygen Index	MA	Chem	--do--	--	NTPC ADS/ IS 10810 Part 58	NTPC ADS/ IS 10810 Part 58	--do--		P	--	--	
		6. Acid Gas Emission	MA	Chem	One sample / Batch	--	NTPC ADS / IEC60754	NTPC ADS / IEC60754	QCR		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	--do--		P	--	--	
1.07	Steel Drum	2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
		1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do-		P	--	--	
		B Process & Stage Inspection												
2.01	Wire Drawing	1.Surface finish	MA	Visual	One sample/Settng of each size	--	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR		P	--	--	
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Tensile test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	Refer Sl. No.3.03(iii)
		4. Wrapping test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	--do--
		1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		2.Dia of wire	MA	Meas	--do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--	--	--do--	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do--	--do--	--do--		P	--	--	
5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--			
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do--		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	One sample/Settng of each size	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	QCR		P	--	--	XLPE/ PVC compound shall be preferably loaded in to extruder by suction method.

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FORMAT NO:QS-01-QAI-P-10/F3-R1

		Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)				QP. NO. 0000-999- QOE- S-041							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
1		2.Colour of cores	MA	Visual	One sample/Settin g of each size	-	NTPC ADS	NTPC ADS	QCR		P	--	--	
		3.Thickness	CR	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	--do --		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
		5. Hot Set	CR	Mech	One sample/Settin g of each size	--	IS 7098- Part I	IS 7098- Part I	--do--		P	--	--	Sample is to be taken from both top & bottom end
2.04	Laying up	1. Core sequence	MA	Visual	--do--	--	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	--do--	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Settin g of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	
		3. Direction of lay	MA	Visual	--do--	--	IS 1554 (Part 1) & IS 7098- Part 1	IS 1554 (Part 1) & IS 7098- Part 1	QCR		P	--	--	

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FORMAT NO:QS-01-QAI-P-10/F3-R1

		Item: 1.1 KV Power (XLPE & PVC) FRLS Insulated cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)				QP. NO. 0000-999- QOE- S-041							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agent C.				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)		QCR		P	--	--	
		5 Dia over armouring	MA	Meas.	One sample/Settin g of each size	--	NTPC ADS		--do--		P	--	--	--
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)		--do--		P	--	--	PVC FRLS compound shall be preferably loaded in to extruder by suction method.
		2.Colour of sheath	MA	Visual	One sample/Settin g of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		3. Dia over outer sheath	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum no., IS1554-1 / IS7098-1,Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)		--do--		P	--	--	Drum no. on cable may be embossed/print ed
		6. Sequential marking	MA	Visual	Full length	--	Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible. (A s per NTPC specification)		--do--		P	--	--	
C Finished Cables														
3.01	Type test reports clearance from NTPC Engineering	All type tests as per NTPC specification	CR	Doc.	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (PartI) & IS 7098- Part I	NTPC SPECIFICATION / NTPC ADS / IS 1554 (PartI) & IS 7098- Part I	--do--	✓	P	V	V	

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-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERIFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QA1-P-10/F3-R1

Sl. No		Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
1		2	3	4	5	M	C/ N	7	8	9	D*	M	C	N	11
3.02	Routine Tests	1.High Voltage test at room temperature	CR	Elect	100%	100%		NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certificate	✓	P	W	W	Refer note 2
		2.Conductor Resistance	CR	Elect	100%	100%		NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certificate	✓	P	W	W	Refer note 2
3.03 Acceptance Tests															
3.03 (i)	Construction of finished Cable	1. OD of Cable	MA	Meas.	Each type & size of cables as per sampling plan of IS 1554 (Part I) & IS 7098- Part I			NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		2. Laying of core	CR	Visual	--do--			NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	--do--	✓	P	W	W	
		3. Core Identification	CR	Visual	--do--			--do--	--do--	--do--	✓	P	W	W	
		4. Colour of outer sheath	MA	Visual	--do--			NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		5. Inner sheath thickness	CR	Meas	- do -			--do--	--do--	--do--	✓	P	W	W	
		6. Inner sheath colour	MA	Visual	- do -			- do -	- do -	--do--	✓	P	W	W	
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	--do--			NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI) /IS3975	--do--	✓	P	W	W	
		2. No. of wires/ formed wire	CR	Mech	-- do --			--do--	--do--	--do--	✓	P	W	W	
		3. Tensile test	CR	Mech	--do--			--do--	--do--	--do--	✓	P	W	W	
		4. Elongation test	CR	Mech	--do--			--do--	--do--	--do--	✓	P	W	W	
		5.Torsion test (for round wires only)	CR	Mech	--do--			--do--	--do--	--do--	✓	P	W	W	
		6. Wrapping test	CR	Mech	--do--			--do--	--do--	--do--	✓	P	W	W	
		7. Resistance test	CR	Mech	--do--			--do--	--do--	--do--	✓	P	W	W	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERIFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QAL-P-10/F3-R1

		Item: 1.1 KV Power (XLPE & PVC) FRLS Insulated cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-041								
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		8.Mass of Zinc coating	CR	Meas	Each type & size of cables as per sampling plan of IS 1554 (Part I) & IS 7098- Part I		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI) /IS3975	Test certificate	✓	P	W	W	
		9. Uniformity of Zinc Coating	CR	Chem.	--do--		--do--	--do--	--do--	✓	P	W	W	
		10.Adhesion test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	
3.03 (iii)	Conductor													
		1.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
		2.Tensile test (For aluminum conductor only)	CR	Mech	Each type & size of cables as per sampling plan of IS 1554 (Part I)/7098(Part-1)		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	W	W	Test report of manufacturer to be reviewed as per Sl. No. 2.01 for Tensile test & wrapping test (for Aluminum) in case this test is not applicable for cable under inspection as per IS 8130 cl. 6.2
		3.Wrapping test (For aluminum conductor only)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	P	W	--do--

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FORMAT NO:QS-01-QAI-P-10/F3-R1

		Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)				QP. NO. 0000-999- QOE- S-041							
Sl. No	Compon ent & Operatio ns	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
3.03 (IV)	PVC/XL PE/ Insulatio n & PVC Sheath	1. Thickness of insulation & PVC Sheath	CR	Meas	Each type & size of cables as per sampling plan of IS IS 1554 (Part 1)/IS7098(Part-1)		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	Test Certific ate	√	P	W	W	
		2. Tensile strength & elongation at break of insulation & outer sheath (before ageing)	CR	Mech	Each type & size of cables as per sampling plan of IS IS 1554 (Part 1)/IS7098(Part-1)		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	Test Certific ate	√	P	W	W	Refer Note 3 Also
		3. Tensile strength & elongation at break of insulation & outer sheath (after Ageing)	CR	Mech	Refer Note 3		--do--	--do--	--do--	√	P	W	W	Refer Note 3 ath)
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	--do--	--do--	√	P	W	W	
		5. High voltage test at room temperature	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	--do--	--do--	√	P	W	W	
		6. Hot Set test (for XLPE insulation only)	CR	Phy	--do--		--do--	--do--	--do--	√	P	W	W	
		7. Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		--do--	--do--	--do--	√	P	W	W	

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FORMAT NO: QS-01-QA1-P-10/F3-R1

		Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)				QP. NO. 0000-999- QOE- S-041							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		8.Oxygen index Test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS / IS10810 Part 58	NTPC A.D.S	--do-	✓	P	W	W	
		9.Smoke density rating test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS & ASTM D2843	NTPC ADS	-do--	✓	P	W	W	
		10.Acid gas generation test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS & IEC 60754-1	NTPC ADS	Test Certificate	✓	P	W	W	
		11.Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	
		12.Surface finish & length measurement.	CR	Visual & Meas	One length of each size	One length of each size	(1) Drum no. (2) IS1554-1 /IS7098-1,Cable size, Voltage grade & Words “ FRLS” at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (3) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible	--do--	✓	P	W	W	Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.	
		13. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire	--do-	✓	P	W	W		
4	Packing	1. Sealing	MA	Visual	100%	100%	(1)IS1554(Part-I) & IS 7098-Part I (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by “U” nails.	QCR	✓	P	--	--		
4.01	Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible	QCR	✓	P	V	V		

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FORMAT NO:QS-01-QAI-P-10/F3-R1

		Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)		QP. NO. 0000-999- QOE- S-041								
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
Notes:														
1) If the compound manufacturer is carrying out Ageing test , test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)														
2) (a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre/ Regional Offices :- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre/ Regional Offices, :- Routine Test are to be witnessed by Main Contractor & NTPC. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection.														
3) Refer table on page 10 & 11 of 11 for Sampling & Acceptance criteria.														
4) For PVC insulated LT power cable :- For cables with OD less than equal to 30 mm, any size of cable may be clubbed together. For cables where OD is more than 30 mm, clubbing to be done for cables having similar ODs. For XLPE insulated LT Power cable: Clubbing to be done for cables having similar ODs.														
LEGEND: NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance														

		Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-041							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11

Sampling & Acceptance Criteria				
Criteria	Manufacturer experience prerequisite	Condition	Testing procedure	Remarks
Samples as per relevant IS from every size/ type of cable in the offered lot shall be tested for Tensile Strength & Elongation (before ageing). The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% tolerance (final values should be more than the minimum values indicated in relevant standard) of the Type Test report	In case of Manufacturers/ Supplier who have supplied cables in the past through Corporate Centre / Regional offices	In case of sizes/ type which meet the criteria	1 Sample of PVC insulation & outer sheath per type of cables offered which have met the criteria, will be put on accelerated ageing test (refer IRS specification no. IRS: S-63/2007 Rev 3.0). The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours. 1 Sample of XLPE insulation per type of cables offered which have met the criteria, will be put on ageing test as per IS 7098. After wards the samples shall be tested for Tensile Strength & Elongation. Acceptance norms shall be as per relevant IS. This test shall be witnessed by NTPC.	In case the samples do not meet the requirement in accelerated ageing test then 1 sample of that size/ type will be put on ageing test as per IS.
		In case of size /type which do not meet the criteria	Particular size/ type will be put on ageing test as per IS. This test shall be witnessed by NTPC.	-----

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FORMAT NO:QS-01-QAI-P-10/F3-R1

एनटीपीसी NTPC		Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1, IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-041							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
				In case of Manufacturers/ Supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre / Regional offices	In case of size /type which meet the criteria	1 Sample per type out of all sizes which have met the criteria, will be put on aging test and witnessed by NTPC as per relevant IS				----				
					In case of size/ type which do not meet the criteria	Particular size / type will be put on ageing test as per IS. This test shall be witnessed by NTPC				-----				

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FORMAT NO:QS-01-QAI-P-10/F3-R1

Sl. No		Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks		
1		2	3	4	5	M	C/N	6	7	8	9	D*	M	C	N	10	11
Item: 1.1 KV PVC Insulated FRLS Control cables STANDARD QUALITY PLAN QP. NO. 0000-999- QOE- S-040 (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)																	
Instructions: 1) Cable manufacturer to maintain records to show co- relation of raw materials to finished cables i.e raw material batch/ lot no. should be traceable to the cable drum. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.																	
A Raw material/ Brought out Items																	
1.01	Copper	1. Make	MA	Verify	100%	--		MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	--	--			
		2. Resistivity	MA	Elect	As per cable Mnfr Std.	--		IS 613	IS 613	-do--		P	--	--			
1.02	PVC compound for insulation	1. Make	MA	Verify	--do--	100%		MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	--			
		2. Type/ Grade	MA	Verify	100%	100%		NTPC ADS	NTPC ADS	-do--		V	V	V			
		3. All acceptance test as per manufacturer norms including Thermal Stability test	MA	Verify	As per manufacturer norms	As per manufacturer norms		--do--	--do--	--do--		V	V	V			Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--		MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V			
		2. Type/ Grade	MA	Verify	--do--	--do--		NTPC ADS	NTPC ADS	--do--		V	V	V			
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--		MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V			
		2. Dimension	MA	Meas	1 sample from each size / lot	--		NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	--do--		P	--	--			
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--		IS 3975	IS 3975	Supplier TC		V	V	--			
1.05	PVC compound for Sheath	1. Make	MA	Verify	As per manufacturer norms	100%		MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	QCR		V	V	--			
		2. Type / Grade	MA	Verify	100%	100%		NTPC ADS	NTPC ADS	--do--		V	V	V			
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms		--do--	--do--	--do--		V	V	V			Refer note 1
		4. Thermal Stability	MA	Chem	One sample / Batch	--		NTPC ADS	NTPC ADS	QCR		P	--	--			
		5. Oxygen Index	MA	Chem	--do--	--		NTPC ADS/ IS 10810 Part 58	NTPC ADS	--do--		P	--	--			

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FORMAT NO:QS-01-QAI-P-10/F3-R1

ofc

NTPC		Item: 1.1 KV PVC Insulated FRLS Control cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-040							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
1	2	3	4	5	M	C/ N	7	8	9	D*	M	C	N	11
		6. Acid Gas Emission	MA	Chem	One sample / Batch	--	NTPC ADS / IEC60754	NTPC ADS	QCR		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	--do--		P	--	--	
		2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
1.07	Steel Drum	1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do--		P	--	--	
B Process & Stage Inspection														
2.01	Wire Drawing	1.Surface finish	MA	Visual	One sample/Settng of each size	--	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR		P	--	--	
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		3. Annealing Test	CR	Mech	--do--	Same as 6M	IS8130/NTPC ADS	IS8130/NTPC ADS	--do--		P	V	V	Refer Sl. No. 3.03(iii).
2.02	Bunching / stranding	1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		2.Dia of wire	MA	Meas	--do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--	--	--do--	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do-	--do--	--do--		P	--	--	
		5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--	
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do--		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	--do--	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	--do--		P	--	--	PVC compound shall be preferably loaded in to extruder by suction method.
		2.Colour of cores	MA	Visual	--do--	-	NTPC ADS	NTPC ADS	--do--		P	--	--	

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FORMAT NO:QS-01-QA1-P-10/F3-R1

एनटीपीसी NTPC		Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)				QP. NO. 0000-999- QOE- S-040							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
1	2	3	4	5	6		7	8	9	D*	M	C	N	11
		3.Core identification	MA	Visual	One sample/Setti ng of each size	--	NTPC ADS	NTPC ADS	QCR		P	--	---	Core printing shall be legible & indelible
		4.Thickness	CR	Meas	--do--	--	--do--	--do--	--do--		P	--	--	
		5.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	--do--		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
2.04	Laying up	1. Core sequence	MA	Visual	One sample/Setti ng of each size	--	IS 1554 (Part I)	IS 1554 (Part I)	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	--do--	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	---	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Setti ng of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERIFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QA1-P-10/F3-R1

एनटीपीसी NTPC		Item: 1.1 KV PVC Insulated FRLS Control cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-040							
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
1	2	3	4	5	M	C/ N	7	8	9	D*	M	C	N	11
		3. Direction of lay	MA	Visual	One sample/Setti ng of each size	--	IS 1554 (Part 1)	IS 1554 (Part 1)	QCR		P	--	--	11
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)	--do--		P	--	--		
		5 Dia over armouring	MA	Meas.	One sample/Setti ng of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)	--do--		P	--	--		PVC FRLS compound shall be preferably loaded in to extruder by suction method.
		2.Colour of sheath	MA	Visual	One sample/Setti ng of each size	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Dia over outer sheath	MA	Meas	--do--	--	--do-	--do--	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum no., IS1554 Part -I , Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)	--do--		P	--	--		Drum no. on cable may be embossed/ printed.

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FORMAT NO:QS-01-QA1-P-10/F3-R1

		Item: 1.1 KV PVC Insulated FRLS Control cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-040								
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks	
					M	C/ N				D*	M	C	N		
1	2	3	4	5	6		7	8	9	10				11	
		6. Sequential marking	MA	Visual	Full length	--	Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible. (A s per NTPC specification)		QCR		P	--	--		
C Finished Cables															
3.01	Type test reports clearance from NTPC Engineering	All type tests as per NTPC specification	CR	Doc.	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (PartI)	NTPC SPECIFICATION / NTPC ADS / IS 1554 (PartI)	--do--	✓	P	V	V		
3.02	Routine Tests	1.High Voltage test at room temperature	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	Test certificate	✓	P	W	W	Refer note 2	
		2.Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	--do--	✓	P	W	W		
3.03	Acceptance Tests														
3.03(i)	Construction of finished Cable	1. OD of Cable	MA	Meas.	Each type & size of cables as per sampling plan of IS 1554 (Part I)		NTPC ADS	NTPC ADS	--do--	✓	P	W	W		
		2. Laying of core	CR	Visual	--do--		IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	--do--	✓	P	W	W		
		3. Core Identification	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	Core printing shall be legible & indelible	
		4. Colour of outer sheath	MA	Visual	--do--		NTPC ADS	NTPC ADS	--do--	✓	P	W	W		
		5. Inner sheath thickness	CR	Meas	- do -		--do--	--do--	--do--	✓	P	W	W		
		6. Inner sheath colour	MA	Visual	- do -		- do -	- do -	--do--	✓	P	W	W		
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	Each type & size of cables as per sampling plan of IS 1554 (Part I)		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI)/ IS3975	--do--	✓	P	W	W		
		2. No. of wires/ formed wire	CR	Mech	-- do --		--do--	--do--	--do--	✓	P	W	W		
		3. Tensile test	CR	Mech	--do--		--do-	--do--	--do--	✓	P	W	W		

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FORMAT NO:QS-01-QAI-P-10/F3-R1

एनटीपीसी NTPC		Item: 1.1 KV PVC Insulated FRLS Control cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART I AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-040									
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks	
1	2	3	4	5	M	C/ N	7	8	9	D*	M	C	N	11	
		4. Elongation test	CR	Mech	Each type & size of cables as per sampling plan of IS 1554 (Part I)		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI)/ IS3975	Test certificate	✓	P	W	W		
		5.Torsion test (for round wires only)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W		
		6. Wrapping test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W		
		7. Resistance test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W		
		8.Mass of Zinc coating	CR	Meas	--do--		--do--	--do--	--do--	✓	P	W	W		
		9. Uniformity of Zinc Coating	CR	Chem.	--do--		--do--	--do--	--do--	✓	P	W	W		
		10.Adhesion test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W		
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W		
3.03 (iii)	Conductor	1. Annealing Test	CR	Mech	-do--		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	V	V	Refer Sl. No. 2.01	
		2.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W		
3.03 (iv)	PVC Insulation & PVC Sheath	1.Thickness of insulation & sheath	CR	Meas.	--do--		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W		
		2.Tensile strength & elongation at break of insulation & outer sheath (before ageing)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	W	W	Refer Note 3 also	
		3.Tensile strength & elongation at break of insulation & outer sheath (after Ageing)	CR	Mech	Refer Note 3		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	Refer Note 3	
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part I)		--do--	--do--	--do--	✓	P	W	W		
		5.High voltage test at room temperature	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W		
		6.Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		--do--	--do--	--do--	✓	P	W	W		
		7.Oxygen index Test on outer sheath	CR	Chem	--do--		NTPC ADS / IS10810 Part 58	NTPC A.D.S	--do--	✓	P	W	W		
		8.Smoke density rating test on outer sheath	CR	Chem	--do--		NTPC ADS & ASTM D2843	NTPC ADS	--do--	✓	P	W	W		

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FORMAT NO:QS-01-QA1-P-10/F3-R1

Sl. No		Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
1		2	3	4	5	M	C/ N	7	8	9	D*	M	C	N	11
			9. Acid gas generation test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS & IEC 60754-1	NTPC ADS	Test certificate	✓	P	W	W	
			10. Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	
			11. Surface finish & length measurement.	CR	Visual & Meas	One length of each size	One length of each size	(1). Drum no. (2) IS 1554 -Part-I (3) Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (4) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible	--do--	✓	P	W	W		Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.
			12. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire	--do--	✓	P	W	W		
4		Packing	1. Sealing	MA	Visual	100%	100%	(1)IS1554(Part-I) (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails.	QCR	✓	P	--	--		
4.01		Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible	Sealing shall be visible	--do--	✓	P	V	V	

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FORMAT NO:QS-01-QA1-P-10/F3-R1

		Item: 1.1 KV PVC Insulated FRLS Control cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)		QP. NO. 0000-999- QOE- S-040				
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Record Format	Agency	Remarks
Notes:										
	1)	If the compound manufacturer is carrying out Ageing test , test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)								
	2)	(a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre/ Regional Offices :- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre/ Regional Offices, :- Routine Test are to be witnessed by Main Contractor & NTPC. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection.								
	3)	Refer table on page 8 of 8 for Sampling & Acceptance criteria.								
	4)	The test shall be carried out on every size & type of control cable offered for inspection as an acceptance test. This test will be carried out using composite sampling i.e. irrespective of sizes of cables of a particular type, may be tested together as per calculations in line with the IEC (all sizes will be covered)								
	LEGEND:	NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance								

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FORMAT NO:QS-01-QA1-P-10/F3-R1

		Item: 1.1 KV PVC Insulated FRLS Control cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 AND NTPC TECHNICAL SPECIFICATION)			QP. NO. 0000-999- QOE- S-040			
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Record Format	Agency	Remarks

SAMPLING & ACCEPTANCE CRITERIA

Criteria	Manufacturer experience prerequisite	Condition	Testing procedure	Remarks
Samples as per relevant IS from every size of cable in the offered lot shall be tested for Tensile Strength & Elongation (before ageing). The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% tolerance (final values should be more than the minimum values indicated in relevant standard) of the Type Test report	In case of Manufacturers/ Supplier who have supplied cables in the past through Corporate Centre / Regional offices	In case of sizes which meet the criteria	1 Sample per type out of sizes which have met the criteria, will be put on accelerated ageing test (refer IRS specification no. IRS: S-63/2007 Rev 3.0). The samples shall be aged in air oven at temperature of 130°C+/- 2°C for 5 hours. After wards the samples shall be tested for Tensile Strength & Elongation. Acceptance norms shall be as per relevant IS. This test shall be witnessed by NTPC.	In case the samples do not meet the requirement in accelerated ageing test then 1 sample of that size will be put on ageing test as per IS.
		In case of size which do not meet the criteria	Particular size will be put on ageing test as per IS. This test shall be witnessed by NTPC.	----
	In case of Manufacturers/ Supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre / Regional offices	In case of size which meet the criteria	1 Sample per type out of all sizes which have met the criteria, will be put on aging test and witnessed by NTPC as per relevant IS	----
		In case of size which do not meet the criteria	Particular size will be put on ageing test as per IS. This test shall be witnessed by NTPC	----

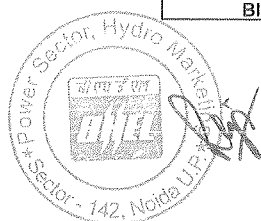
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FORMAT NO:QS-01-QA1-P-10/F3-R1

CLAUSE NO.		QUALITY ASSURANCE AND INSPECTION								एनटीपीसी NTPC स्टेड डीडी	
INDUCTION MOTOR & SYNCHRONOUS MACHINE (E-14)											
TESTS/CHECKS											
TEMS/COMPONENTS		Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MP/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	
Plates for stator frame, end shield, spider etc.		Y	Y	Y	Y					Y	
Shaft		Y	Y	Y	Y	Y	Y			Y	
Magnetic Material		Y	Y	Y	Y	Y		Y			
Rotor Copper/Aluminium		Y	Y	Y	Y		Y	Y		Y	
Stator copper		Y	Y	Y	Y			Y		Y	
SC Ring		Y	Y	Y	Y	Y	Y	Y	Y	Y	
Insulating Material		Y		Y	Y			Y			
Tubes for Cooler		Y	Y	Y	Y	Y				Y	
Sleeve Bearing		Y	Y	Y	Y	Y				Y	
Stator/Rotor, Exciter Coils		Y	Y	Y				Y	Y		
Castings, stator frame, terminal box and bearing housing etc.		Y	Y	Y	Y	Y			Y		
Fabrication & machining of stator, rotor, terminal box		Y	Y			Y				Y	
Wound stator		Y	Y					Y	Y		
Wound Exciter		Y	Y					Y	Y		
Rotor complete		Y	Y					Y			
Exciter, Stator, Rotor, Terminal Box assembly		Y	Y					Y			
Accessories, RTD, BTD, CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.		Y	Y	Y							
Motor (IS 325 / 4722/ 9283)		Y	Y	Y							

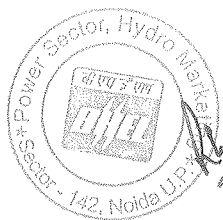
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9				TECHNICAL SPECIFICATION SECTION-VI			PART-QA SUB-SECTION-QE		Page 37 of 53	



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CLAUSE NO.		QUALITY ASSURANCE AND INSPECTION							एन सी पी सी NTPC stage 3 hydro	
INDUCTION MOTOR & SYNCHRONOUS MACHINE (E-14)										
TESTS/CHECKS ITEMS/COMPONENTS		Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS-325/IS-4722 / 9283	Vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Plates for stator frame, end shield, spider etc.										
Shaft										
Magnetic Material		Y		Y						
Rotor Copper/Aluminium										
Stator copper				Y						
SC Ring										
Insulating Material				Y						
Tubes for Cooler			Y							
Sleeve Bearing			Y							
Stator/Rotor, Exciter Coils										
Castings, stator frame, terminal box and bearing housing etc.										
Fabrication & machining of stator, rotor, terminal box										
Wound stator										
Wound Exciter										
Rotor complete					Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly										
Accessories, RTD, BTD, CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.										
Motor (IS 325 / 4722 / 9283)							Y	Y	Y	Y1
Note : 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality 2. Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalisation. However, no QP for LT motor upto 50KW. 3. Makes of all major bought out items will be subject to NTPC approval. Y1 = for HT Motor / Machines only.										

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI	PART-QA SUB-SECTION-QE	Page 38 of 53



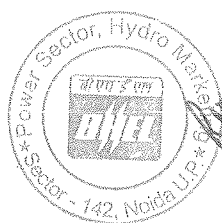
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CLAUSE NO.	QUALITY ASSURANCE AND INSPECTION																
L.T POWER CABLES (E-11)																	
(1.1 KV PVC & XLPE CABLES)																	
Attributes / Characteristics	Item / Components / Sub System Assembly	Make, Rating, Type & TC	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Hot set test (XLPE)	Lay length / Sequence	Armour coverage, Cross over, looseness, Gap between two armour wire/strip	Sequential marking/surface finish /cable length	Tensile strength, elongation before & after ageing of insulation & outer sheath	Thermal Stability of insulation and outer sheath *	Anti termite treatment on wooden drums	Constructional / requirement as per NTPC Spec.	Routine and acceptance test as per Relevant Standard and NTPC specification	FRLS Test
Aluminum (IS-8130)		Y	Y	Y	Y	Y											
PVC Compound (IS-5831)		Y		Y		Y						Y					
XLPE Compound (IS-7098 Part-I)		Y		Y		Y		Y				Y					
FRLS PVC Compound (IS-5831) ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-I		Y		Y								Y					
Armour wire/strip (IS-3975)		Y	Y	Y													
Insulated Core			Y				Y	Y					Y				
Laid up core			Y						Y								
PVC Inner sheath			Y														
Armouring			Y							Y							
Outer sheath			Y								Y	Y	Y				Y
Finish cable (IS-1554 & 7098 – Part-1) ASTM-D-2843/ IS 10810 (Part- 58) IEC-754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-332 Part –3 Cat-B		Y	Y							Y	Y	Y	Y		Y	Y	Y
Wooden drum (IS-10418) / Steel drum			Y											Y			

Note: 1. This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedure along with relevant supporting documents.
2. Not applicable for XLPE insulation

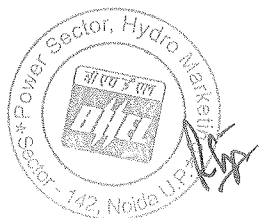
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI	PART-QA SUB-SECTION-QE	Page 30 of 53

CLAUSE NO.	QUALITY ASSURANCE AND INSPECTION			
		ROUTINE TESTS		
		Routine tests shall be carried out on each drum of finished cables for all types & sizes. Following shall constitute routine tests:		
	1)	Conductor Resistance test		
	2)	High voltage test at room temperature		
		ACCEPTANCE TESTS		
		Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1 & IS 7098 Part-I		
	A)	For Conductor		
	1)	Annealing test	For copper conductor only	
	2)	Tensile test	For aluminium conductor only	
	3)	Wrapping test	For aluminium conductor only	
	4)	Resistance test		
	B)	For Armour Wires / Formed Wires (If applicable)		
	1)	Measurement of Dimensions		
	2)	Tensile Tests		
	3)	Elongation Test		
	4)	Torsion Test	For Round wires only	
	5)	Wrapping Test		
	6)	Resistance Test		
	7)	Mass of Zinc coating test	For G S wires / Formed wires only	
	8)	Uniformity of Zinc coating	For G S wires / Formed wires only	
	9)	Adhesion test	For G S wires / Formed wires only	
	10)	Freedom from defects		
	C)	For PVC / XLPE insulation & PVC Sheath		
	1)	Test for thickness		
	2)	Hot set test	For XLPE insulation only	
	3)	Tensile strength & Elongation before ageing		
	D)	For completed cables		
	1)	Insulation resistance test (Volume resistivity method)		
	2)	High voltage test at room temperature		
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI		PART-QA SUB-SECTION-QE
				Page 31 of 53



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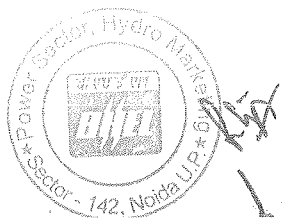
CLAUSE NO.	QUALITY ASSURANCE AND INSPECTION		एन टी पी सी NTPC स्टेज III hydro
	E) Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:- 1) Tensile strength & elongation after ageing on PVC / XLPE insulation and PVC outer sheath 2) Thermal stability test on PVC insulation and outer sheath 3) Oxygen index test on outer sheath 4) Smoke density rating test on outer sheath as per ASTM –D 2843 5) Acid gas generation test on outer sheath as per IEC – 754 (Part 1) 6) Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable 7) Fire resistance test as per SS 4241475 (F3 Category) on completed cable F) Following tests shall be carried on one length of each size of offered lot: 1) Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires		
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO : CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-QA SUB-SECTION-QE Page 32 of 53



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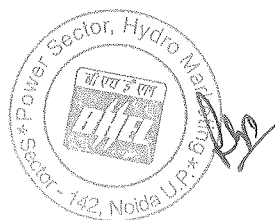
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CLAUSE NO.		QUALITY ASSURANCE AND INSPECTION													एन सी पी सी NTPC 21553 hydro	
L.T CONTROL CABLES (E-11)																
(1.1 KV PVC CABLES)																
Attributes / Characteristics																
Item / Components / Sub System Assembly	Make, Type, Rating, T.C	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Lay length/Sequence	Armour coverage, cross over, looseness, gap between armour wire	Sequential finish/cable length marking/surface	Tensile strength, elongation before & after ageing of insulation &outer sheath sheath	Thermal stability of insulation and outer sheath	Anti termite treatment on wooden drums	Constructional feature as per NTPC Spec.	Routine & Acceptance test as per relevant standard & page 2 & 3 of this table	FRLS Test	
Copper Conductor (IS-8130)	Y	Y	Y	Y	Y											
PVC Compound (IS-5831)	Y		Y		Y					Y						
FRLS PVC Compound IS-5831 ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1	Y		Y							Y					Y	
Armour wire/strip (IS-3975)	Y	Y	Y													
Insulated Core		Y				Y	Y				Y					
Laid up core		Y					Y									
PVC Inner sheath		Y														
Armouring		Y						Y								
Outer sheath		Y							Y	Y	Y				Y	
Finish cable (IS-1554- 1) ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1 Swedish Chimney: SEN SS 424-1475(F3 category) Flammability test IEC-332 Part-3 Cat-B	Y	Y						Y	Y	Y	Y		Y	Y	Y	
Wooden drum(IS : 10418) / Steel drum		Y										Y				
.Note : 1. This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents.																
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9							TECHNICAL SPECIFICATION SECTION-VI				PART-QA SUB-SECTION-QE			Page 33 of 53		



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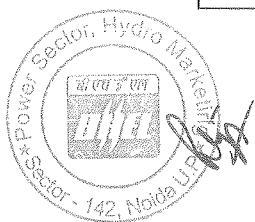
CLAUSE NO.	QUALITY ASSURANCE AND INSPECTION	एनडीपीसी NTPC STEEL Hydro
CONTROL CABLE ROUTINE TESTS Routine tests shall be carried out on each drum of finished cables for all types & sizes. Following shall constitute routine tests: 1) Conductor Resistance test 2) High voltage test at room temperature ACCEPTANCE TESTS Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1 A) For Conductor 1) Annealing test For copper conductor only 2) Resistance test B) For Armour Wires / Formed Wires (If applicable) 1) Measurement of Dimensions 2) Tensile Tests 3) Elongation Test 4) Torsion Test For Round wires only 5) Wrapping Test 6) Resistance Test 7) Mass of Zinc coating test For G S wires / Formed wires only 8) Uniformity of Zinc coating For G S wires / Formed wires only 9) Adhesion test For G S wires / Formed wires only 10) Freedom from defects		
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-QA SUB-SECTION-QE Page 34 of 53



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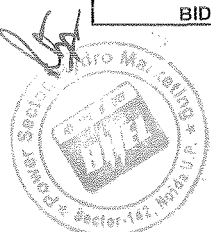
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CLAUSE NO.	QUALITY ASSURANCE AND INSPECTION	
	C) For PVC insulation & PVC Sheath 1) Test for thickness 2) Tensile strength & Elongation before ageing	
	D) For completed cables 1) Insulation resistance test (Volume resistivity method) 2) High voltage test at room temperature E) Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:- 1) Tensile strength & elongation after ageing on PVC insulation and PVC outer sheath 2) Thermal stability test on PVC insulation and outer sheath 3) Oxygen index test on outer sheath 4) Smoke density rating test on outer sheath as per ASTM –D 2843 5) Acid gas generation test on outer sheath as per IEC – 754 (Part 1) 6) Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable 7) Fire resistance test as per SS 4241475 (F3 Category) on completed cable F) Following tests shall be carried on one length of each size of offered lot: 1) Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-QA SUB-SECTION-QE Page 35 of 53



191763

CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)			
1.00.00	STANDARDS AND REGULATIONS			
1.01.00	All materials in cables shall comply with the latest editions of relevant Indian Standards, Indian Electricity Rules, Indian Electricity Act and other applicable statutory provisions, rules and regulations.			
1.02.00	Unless otherwise specified the design, manufacture and performance of all the equipment and material provided under this specification shall generally conform to the latest issues of the following standards:			
	IS:1554 (Part-I)	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V		
	IS:3961	Recommended current ratings for cables		
	IS:8130	Conductors for insulated electric cables and flexible cords		
	IS:5831	PVC insulation and sheath of electric cables		
	IS:7098 (Part-I&II)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto 33kV		
	IS:3975	Low carbon Galvanised steel wires, formed wires and tapes for armouring of cables		
	IS:8130	Conductors for insulated electrical cables and flexible cords		
	IS:10418	Drums for electric cables		
	IS:10810	Methods of test for cables		
	IS:4905	Methods for random sampling		
	IEC:502	Power cables with extruded insulation & their accessories for rated voltages 1kV to 36kV		
	IEC:540 & 540A	Test methods for insulation and sheaths of electric cables and cord		
	IEC:332	Test on electric cables under fire conditions		
	IEC:754	Test on gases evolved during combustion of electric cables		
	ASTM-D-2843	Standard test method for density of smoke from the burning or decomposition of plastics		
	IS:10810 Part-58	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics		
	Any other applicable standard			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO : CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 11	PAGE 2 OF 12



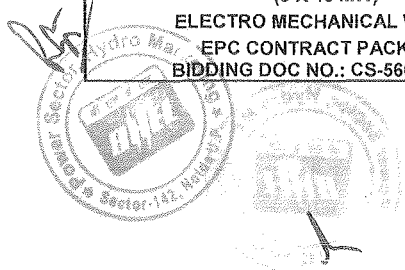
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CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)	एनटीपीसी NTPC हाइड्रो
2.00.00	TECHNICAL REQUIREMENTS	
2.01.00	The cable shall be suitable for laying on racks, in ducts, trenches, conduits and under ground (buried) installation with chances of flooding by water.	
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady State and transient operating conditions as specified elsewhere in this specification.	
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.	
2.04.00	XLPE insulation shall be suitable for continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg. C and short circuit conductor temperature of 160 deg C.	
2.05.00	The cable cores shall be laid up with the filters between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.	
2.06.00	For single core armoured cables, armouring shall be of aluminium wires. For multicore armoured cables, armouring shall be of galvanized steel as follows:-	
	Calculated nominal dia of cable under armour	Size and Type of armour
	i) Upto 13mm	1.4mm dia GS formed wire / 1.6mm dia. GS wire
	ii) Above 13 upto 25mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
	iii) Above 25 upto 40mm	1.4mm thick GS formed wire / 2.5mm dia GS wire
	iv) Above 40 upto 55mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
	v) Above 70mm	1.4mm thick GS formed wire / 4.0mm dia GS wire
2.07.00	The aluminium used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of 0.028264 ohm-sq.mm/mtr. at 20 deg.C. The types and sizes of aluminium armouring shall be same as indicated above for galvanized steel.	
2.08.00	The gap between armour wire/formed wire shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of GS wires/formed wires.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI
		PART-B SUB-SECTION – E 11
		PAGE 3 OF 12

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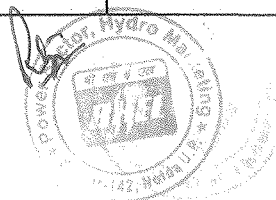
CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)	नदीपीसी NTPC सह उत्पाद
2.09.00	For power and control cable outer sheath shall be of PVC black and grey in colour respectively. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. a) Oxygen index of min. 29 (Test method as per IS 10810 part-58).	
2.10.00	b) Acid gas emission of max. 20% (to IEC-754-I) c) Smoke density rating shall not be more than 60% during Smoke Density test as per ASTM-D-2843. For HT Cables, cores shall be identified by colouring of insulation or by providing coloured tapes over the cores with Red, Yellow & Blue colours.	
2.11.00	For LT Power / Control Cables, cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted : 1 core - Red or Yellow or Blue or Black 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red Yellow, Blue & Black For reduced neutral conductor, the core shall be black.	
2.12.00	For Control Cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the core shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50mm.	
2.13.00	In addition to manufactures identification on cable as per IS, following marking shall also be provided over Outer sheath: a) Cables size and voltage grade – To be embossed b) Word 'FRLS' at every 5 metre – To be embossed c) Sequential marking of length of the cable in metres at every one metre – To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI
		PART-B SUB-SECTION – E 11
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CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)	
2.14.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 60332 Part – 3.	
2.15.00	Allowable tolerance on the overall diameter of the cables shall be +/-2 mm maximum over the declared value in the technical data sheets.	
2.16.00	In plant repairs to the cable shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.	
3.00.00	CABLE SELECTION AND SIZING	
3.01.00	HT Cables	
3.01.01	HT Cables shall be sized based on the following considerations: - Rated current of the equipment - The voltage drop in cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage - Short circuit withstand capability	
3.01.02	Derating Factors Derating factors for various conditions of installation including the following shall be considered while selecting the cable sizes : - Variation in ambient temperature for cables laid in air - Grouping of Cables - Variation in ground temperature and soil resistivity for buried cables	
3.01.03	For HT Cables, the cross-sectional area of the metallic screen strip/tape shall be considered in design calculations.	
3.02.00	LT Power Cables	
3.02.01	LT Power Cables shall be sized based on the following considerations: - Rated current of the equipment - The voltage drop in cable, during motor starting condition, shall be limited to 10% and during full load running condition, it shall be limited to 3% of the rated voltage - Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION – E 11 PAGE 5 OF 12

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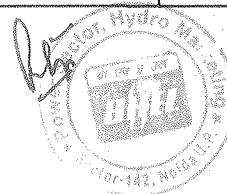
CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)			एन टी सी NTPC										
3.02.02	Derating Factors Derating factors for various conditions of installation including the following shall be considered while selecting the cable sizes :													
	a) Variation in ambient temperature for cables laid in air b) Grouping of Cables c) Variation in ground temperature and soil resistivity for buried cables													
3.02.03	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated.													
3.03.00	Control Cables Control cables shall be sized based on the following considerations: a) The minimum conductor cross section shall be 1.5sq.mm. b) The minimum no.of spare cores in control cables shall be as follows : <table><tr><td>No of cores in cable</td><td>Min.No. of spare cores</td></tr><tr><td>2C, 3C</td><td>Nil</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-12C</td><td>2</td></tr><tr><td>14C & above</td><td>3</td></tr></table>				No of cores in cable	Min.No. of spare cores	2C, 3C	Nil	5C	1	7C-12C	2	14C & above	3
No of cores in cable	Min.No. of spare cores													
2C, 3C	Nil													
5C	1													
7C-12C	2													
14C & above	3													
3.04.00	Cable lengths shall be considered in such a way that straight through cable joints are avoided.													
3.05.00	Cable shall be of armoured type if laid in switchyard (potheadyard) area or directly buried.													
4.00.00	CONSTRUCTIONAL FEATURES													
4.01.00	33 / 11 kV grade Power Cables Cables shall conform to IS: 7098 Part – II. These cables shall have multistranded, compacted circular aluminum conductors. The conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied alongwith the XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth interfaces. The metallic screen of each core shall consist of copper wires or copper tape with minimum overlap of 20%. However for single core armoured cable the armouring may constitute the metallic part of the screening. The metallic screen shall be capable of carrying the earth fault current as per system requirement. The eccentricity of the core shall not exceed 10% and ovality not to exceed 2%. Method of curing for 33 kV grade cables shall be dry													
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO : CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 11	PAGE 6 OF 12										



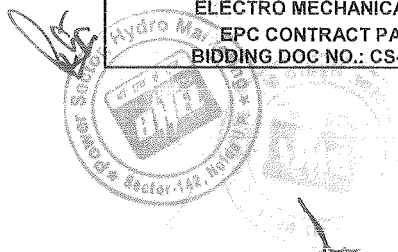
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CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)	नदीघाटी NTPC बिड़र hydro	
	curing / gas curing and method of curing for 11kV grade cables shall be dry curing / gas curing / steam curing. The eccentricity of insulation shall be calculated as $\frac{t_{\max} - t_{\min}}{t_{\max}} \times 100$ and the ovality shall be calculated as $\frac{d_{\max} - d_{\min}}{d_{\max}} \times 100$ Where t-max /t-min is the maximum / minimum thickness of insulation and d-max/d-min is the maximum / minimum diameter of the core.		
4.02.00	LT Power Cables a) 1.1kV Grade XLPE power cables shall have compacted aluminium conductors XLPE insulated, PVC inner sheathed (as applicable), armoured / unarmoured, FRLS PVC outer sheathed conforming to IS :7098. (part-1) b) 1.1kV Grade PVC power cables shall have aluminum conductor (compacted type for sizes above 10sq.mm), PVC insulated, PVC innersheathed (as applicable) armoured / unarmoured, FRLS PVC outersheathed conforming to IS :1554 (Part-I).		
4.03.00	Control Cables 1.1kV Grade Control cables shall have stranded copper conductor multicore PVC insulated, PVC inner sheath, armoured / unarmoured, FRLS/ PVC outer sheathed conforming to IS :1554.(Part-I).		
5.00.00	CABLE DRUMS		
5.01.00	Cable shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS :10418.		
5.02.00	Each drum shall carry manufacturer's name, Employer's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.		
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 11
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CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)			एनटीपीसी NTPC POWER CORP.
6.00.00	TESTS			
6.01.00	Type tests			
6.01.01	33/11kV Cables			
	Type tests on one size of each type (voltage grade) of cable:			
	S.No.	Type test	Remarks	
	Conductor			
	1.	Tensile test		
	2.	Wrapping test		
	3.	Resistance test		
	For Armour Wires / Formed Wires			
	4.	Measurement of Dimensions		
	5.	Tensile Test		
	6.	Elongation test		
	7.	Torsion test	For round wires only	
	8.	Wrapping test	For aluminum wires/ formed wires only	
	9.	Resistance test		
	10.	a) Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.	
		b) Adhesion test	For GS wires/formed wires only	
	For XLPE insulation & PVC Sheath			
	11.	Test for thickness		
	12.	Tensile strength and elongation test before ageing and after ageing		
13.	Ageing in air oven			
14.	Loss of mass test	For PVC outer sheath only.		
15.	Hot deformation test	For PVC outer sheath only.		
16.	Heat shock test	For PVC outer sheath only.		
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 11	PAGE 8 OF 12

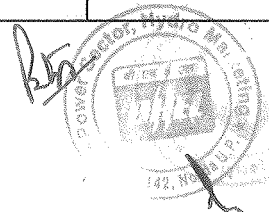


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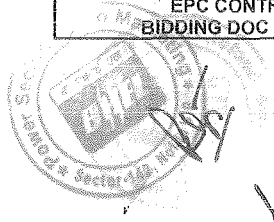
CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)		एन टी सी NTPC हाइड्रो hydro
6.01.02	S.No.	Type test	Remarks
	17.	Shrinkage test	
	18.	Thermal stability test	For PVC outer sheath only.
	19.	Hot set test	For XLPE insulation only.
	20.	Water absorption test	For XLPE insulation only
	21.	Cold Bend Test	For PVC outer sheath only
	22.	Cold Impact Test	For PVC outer sheath only
	23.	Oxygen index test	For PVC outer sheath only.
	24.	Smoke density test	For PVC outer sheath only.
	25.	Acid gas generation test	For PVC outer sheath only.
	26.	Flammability test as per IEC-332	For completed cable only.
	Part-3 (Category - B)		
	Electrical Tests on Completed Cables		
	Type tests on each type (voltage grade) and each size of the cable:		
	27.	Insulation resistance test (Volume Resistivity method)	
	28.	High voltage test	
	29.	Partial discharge test	
	30.	Bending test	
	31.	Dielectric power factor test	
		a) As a function of voltage	
		b) As a function of temperature	
	32.	Heating cycle test	
	33.	Impulse withstand test	
	LT Power Cables		
	Type tests on one size each of LT XLPE and LT PVC Power cable.		

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 11	PAGE 9 OF 12

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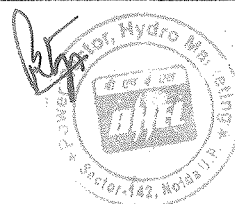
CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)	
	S.No. Type test Remarks	
	Conductor	
	1. Annealing test	For copper conductor only
	2. Tensile test	For aluminum conductor only
	3. Wrapping test	For aluminum conductor only
	4. Resistance test	
	For Armour Wires / Formed Wires	
	5. Measurement of Dimensions	
	6. Tensile Test	
	7. Elongation test	
	8. Torsion test	For round wires only
	9. Wrapping test	For aluminum wires/ formed wires only
	10. Resistance test	
	11. (a) Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
	(b) Adhesion test	For GS wires/formed wires only
	For XLPE/PVC Insulation & PVC Sheath	
	12. Test for thickness	
	13. Tensile strength and elongation test before ageing and after ageing	
	14. Ageing in air oven	
	15. Loss of mass test	For PVC insulation and sheath only.
	16. Hot deformation test	For PVC insulation and sheath only.
	17. Heat shock test	For PVC insulation and sheath only.
	18. Shrinkage test	
	19. Thermal stability test	For PVC insulation and sheath only.
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION – E 11 PAGE 10 OF 12



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CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)		नदीचौरी NTPC हाइड्रो
6.01.03	S.No.	Type test	Remarks
	20.	Hot set test	For XLPE insulation only.
	21.	Water absorption test	For XLPE insulation only.
	22.	Cold Bend Test	For PVC outer sheath only
	23.	Cold Impact Test	For PVC outer sheath only
	24.	Oxygen index test	For outer sheath only.
	25.	Smoke density test	For outer sheath only.
	26.	Acid gas generation test	For outer sheath only.
	27.	Flammability test as per IEC-332	For completed cable only.
	Part-3 (Category - B)		
	Electrical Tests on Completed Cables		
	28.	Insulation resistance test (Volume Resistivity method)	
	29.	High voltage test	
	Control Cables		
	Type tests on one size of Control cable:		
	S.No.	Type test	Remarks
	Conductor		
	1.	Annealing test	For copper conductor only
	2.	Resistance test	
	For Armour Wires / Formed Wires		
	3.	Measurement of Dimensions	
	4.	Tensile Test	
	5.	Elongation test	
	6.	Torsion test	For round wires only
	7.	Wrapping test	For aluminum wires/ formed wires only
	8.	Resistance test	
	9.. (a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
	(b)	Adhesion test	For GS wires/formed wires only
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9			TECHNICAL SPECIFICATION SECTION-VI
			PART-B SUB-SECTION – E 11
			PAGE 11 OF 12

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CLAUSE NO.	HT CABLES, LT POWER CABLES AND CONTROL CABLES (E11)	
	S.No. Type test Remarks For PVC insulation & PVC Sheath 10. Test for thickness 11. Tensile strength and elongation test before ageing and after ageing 12. Ageing in air oven 13. Loss of mass test For PVC insulation and sheath only. 14. Hot deformation test For PVC insulation and sheath only. 15. Heat shock test For PVC insulation and sheath only. 16. Shrinkage test 17. Thermal stability test For PVC insulation and sheath only. 18. Cold Bend Test For PVC outer sheath only 19. Cold Impact Test For PVC outer sheath only 20. Oxygen index test For outer sheath only. 21. Smoke density test For outer sheath only. 22. Acid gas generation test For outer sheath only. Electrical Tests on Completed Cables 23. Insulation resistance test (Volume Resistivity method) 24. High voltage test. 25. Flammability test as per IEC-332 Part-3 (Category - B) For completed cable only. Note: For LT Power Cables & Control Cables for Surface Pothead yard, please refer Sub section E17 of the Technical Specification, Section-VI, Part-B.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI	PART-B SUB-SECTION – E 11 PAGE 12 OF 12



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06A

694239/2022/PS-PEM-MAX



**RAMMAM STAGE-III HYDRO ELECTRIC
PROJECT (3 X 40 MW)
DOUBLE GIRDER EOT CRANES FOR
POWER HOUSE (125/25 T)**

SPECIFICATION NO.: PE-TS-414-501-A001

SECTION: I

SUB SECTION: IC

REV: 00

DATE: 14-01-2022

Page: 1 of 1

**SECTION – IC
DATA SHEET – A & INPUT DRAWINGS**

	RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANES FOR POWER HOUSE (125/25 T)		SPECIFICATION NO.: PE-TS-414-501-A001	
			SECTION: I	
			SUB SECTION: IC	
			REV: 00	DATE: 14-01-2022
			Page: 1 of 1	

DATA SHEET A

Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS	
1.0.0		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.	
1.1.0		Number of cranes	One (1)	
1.2.0		Crane classification	M5 duty overall, For Crane travel –Mechanism class M5, For Trolley travel –Mechanism class M5, For 125T hoist - Mechanism class M4, For 25T hoist - Mechanism class M6, For 5T hoist - Mechanism class M6.	
1.3.0		Suitable for outdoor or indoor duty	Indoor	
1.4.0		Capacity and lift		
1.4.1		Main hoist	SWL = Safe working load	
	a.	Rated SWL – tonnes	125T	
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL	
1.4.2		Aux. hoists		
	a.	Rated SWL – tonnes	25T	
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL	
1.4.3		Electric hoists		
	a.	Rated SWL – tonnes	5T (2 nos., one on each bridge girder)	
	b.	Test load SWL – tonnes	Rated SWL and over load test : 125% of SWL	
1.5.0		Span	As per crane clearance diagram (Refer drawing no PE-DG-414-501-A001)	
1.6.0		Operation from	Cabin & Radio remote control operated.	
2.00		CRANE PERFORMANCE		
2.1.0		Crane speed with full load	Full speed M/Min	Creep speed M/Min
	a.	Main hoist	1.0	10% of main speed (thru' VVVF drives)
	b.	Aux. hoist	5.0	10% of main speed (thru' VVVF drives)
	c.	Trolley travel (CT)	10	10% of main speed (thru' VVVF drives)
	d.	Longitudinal bridge travel	20	10% of main speed (thru' VVVF drives)



**RAMMAM STAGE-III HYDRO ELECTRIC
PROJECT (3 X 40 MW)
DOUBLE GIRDER EOT CRANES FOR
POWER HOUSE (125/25 T)**

SPECIFICATION NO.: PE-TS-414-501-A001

SECTION: I

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Page: 1 of 1

		(LT)		
	e.	Electric hoist -Hoisting	4.5	10% of main speed (thru' VVVF drives)
	f.	Electric hoist – CT motion	12	NA
2.2.0		Max Acceleration values	LT motion (bridge travel)	CT motion (trolley travel)
			0.2 m/s ²	0.2 m/s ²
2.3.0		Lift in Metres		
	a.	Main Hoist	As per crane clearance diagram (Refer drawing no PE-DG-414-501-A001)	
	b.	Aux Hoist		
2.4.0		Hook Approaches from centre line of rail		
	a.	Main hook (cabin end)	As per crane clearance diagram (Refer drawing no PE-DG-414-501-A001 Rev 02)	
	b.	Aux. Hook -cabin-end		
	c.	Main hook (DSL end)		
	d.	Aux. Hook-DSL end		
2.5.0		Hand Rail Pipes	32 mm NB Medium class of IS: 1161 having top and bottom rail at height of 1000 mm and 450 mm respectively and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick)	
3.0.0		COMPONENT DETAILS		
3.1.0		Trolley		
	a.	Type	Fabricated	
	b.	Material	Rolled Structural steel as per IS 2062.	
	c.	Whether jacking pads for lifting trolley provided or not	Yes	
3.2.0		Rope drums		
	a.	Material (Indicate IS)	Rolled steel, welded construction.	
	b.	Flange / flangeless	Flanged	
	c.	Numbers provided	One for each hoist motion.	
	d.	Type of grooves	Identical Right hand and Left hand	
3.3.0		Rope details		
	a.	Construction	Extra flexible plough steel/alloy steel , 6X 36, 6 X 37, Right Hand Ordinary (RHO) lay construction.	
	b.	Standard conforming to	IS: 2266	



**RAMMAM STAGE-III HYDRO ELECTRIC
PROJECT (3 X 40 MW)
DOUBLE GIRDER EOT CRANES FOR
POWER HOUSE (125/25 T)**

SPECIFICATION NO.: PE-TS-414-501-A001

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	c.	Grade	1960 N/mm ²	
	d.	Factor of safety	6	
3.4.0		Sheaves details		
	a.	Material	Manufactured from cast steel or welded steel construction.	
3.5.0		Gear box details		
3.5.1		All Motions		
	a.	Type of mounting of gear box	Horizontal / Vertical	
	b.	Classification	Suitable for M5 duty	
	c.	Type of gears & pinions	Machine cut hardened and profile ground, worm, herringbone or helical or spur or bevel type.	
	d.	Type of lubrication	Grease / splash	
	h.	Materials (worms/ pinions)	Forged carbon steel or alloy steel	
	i.	Casings	Casing shall be fabricated from tested quality cast steel or welded steel plates and duly stress relieved. The casing shall be effectively sealed against oil leakage.	
	j.	Noise level at 1 mtrs	85 dBA	
	k.	Standard conforming to	IS: 4460	
3.6.0		Lifting hooks	MH	AH/ Electric hoist
	a.	Type	Ramshorn	Shank, plain
	b.	Material	Forged annealed alloy or carbon steel	
	c.	Standard conforming to	IS: 5749	IS: 15560
	d.	Hook can swivel	Yes	
	e.	Safety latch on hook provided	Yes	
	f.	Locking device on swivelling hook	Provided	
3.7.0		Drive system for hoisting		
	a.	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box.	
3.8.0		Rails		
	a.	Type / section	Rails sections as per IS: 3443. Rail to rail jointing shall be by end clamping arrangement.	
	b.	Standard conforming to	IS: 3443	

	RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANES FOR POWER HOUSE (125/25 T)		SPECIFICATION NO.: PE-TS-414-501-A001	
			SECTION: I	
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3.9.0		Motors	
3.9.1		Hoist Motions	
	a.	Type	Three phase squirrel cage induction motors, operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits.
	b.	Enclosure	TEFC (Totally enclosed fan cooled)
	c.	Numbers furnished	One per motion
	d.	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +/-5% occurring separately or combined voltage and frequency variation of 10%.
	e.	Class of protection	IP – 55
	g.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited class B.
	h.	Number of starts/ hour	150/300 starts / hr
	i.	Overload protection for motors provided	In built feature of VVVF drives.
	j.	Space heater requirements	For motors of rating 30 KW and above
3.9.2		Travel Motions	Trolley travel Bridge travel
	a.	Type	Three phase squirrel cage induction motors operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits.
	b.	Enclosure	TEFC
	c.	Numbers furnished	One or two Minimum 25% of the no. of bridge wheels
	d.	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage % of variation of +/-10% and frequency variation of +3%/-5% occurring separately or any combination values of voltage and frequency variations within the above limits.
	e.	Class of protection	IP – 55
	g.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited class B.
	h.	Number of starts/ hour	150 starts / hr
	i.	Space heater requirement	For motors of rating 30 KW and above
3.10.0		Control for Hoisting /CT/LT operations	
	a.	Speed control	Thru' VVVF with minimum 6 pulse design for hoisting and 4 pulse for CT/LT motions

	RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANES FOR POWER HOUSE (125/25 T)		SPECIFICATION NO.: PE-TS-414-501-A001	
			SECTION: I	
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			Page: 1 of 1	

	b.	Starting torque of VVVF	200 %.
	c.	Starting current	Less than 150 % of rated current.
	d.	Temperature	VVVF system shall be capable of withstanding upto 40 ° C without derating.
3.14.0		Fire Extinguisher	
	a.	Type and size	4.5 Kg CO2 type
	b.	Location	One in cabin and Three on bridge
3.15.0		Ventilation	A non-oscillating ventilation fan of 240 V AC, single phase and with suitable guard shall be provided in the cabin. The fan shall have 300 mm sweep and equipped with toggle switch and an independent regulator.

Note : Other requirements for the crane.

- 1) Mechanical overload protection shall be ensured for hoist mode.
- 2) Load cell for indication of load shall be provided.
- 3) All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.



12.	SPEED REGULATION	BY VVVF DRIVE
11.	HOOK APPROACH: MONORAIL HOISTS	SHALL BE DECIDED DURING DETAILED ENGINEERING 
10.	HOOK APPROACHES: AUX HOIST 	2500 MM FROM B-LINE 3900 MM FROM D-LINE 5250 MM FROM C.L. OF COL 1 3400 MM FROM C.L. OF COL 16
9.	HOOK APPROACHES: MAIN HOIST 	3900 MM FROM B-LINE 2500 MM FROM D-LINE 5250 MM FROM C.L. OF COL 1 3400 MM FROM C.L. OF COL 16
8.	LIFT OF ELECTRIC HOIST	28.5 METER
7.	LIFT OF MAIN HOIST & AUX HOIST	29.5 METER FOR BOTH
6.	ELECTRIC HOIST HOISTING SPEED/ TRAVEL SPEED	4.5/0.45 (CREEP) M/Min 12 M/Min
5.	LT SPEED/CREEP SPEED	20/2.0 M/Min
4.	CT SPEED/CREEP SPEED	10/1.0 M/Min
3.	AH HOISTING/CREEP SPEED	5/0.5 M/Min
2.	MH HOISTING/CREEP SPEED	1/0.1 M/Min
1.	DESIGN STANDARD	IS 3177 & IS 807. IS 3938 for electric hoist
SL NO.	TECHNICAL SPECIFICATION	

1) DRAWING IS NOT TO THE SCALE.
2) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
REFERENCE DRG:
CROSS SECTION DRG NO: 5602-906-H115-PVM-F-001



KEY PLAN

DRG NO.					5602-003-H143-PVM-W-039														
CUSTOMER					NTPC HYDRO LIMITED														
STATUS JOB NO.					CONTRACT 414					RAMMAM STAGE-III HYDROELECTRIC PROJECT (3X40 MW)									
PRINT SCALE										BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI					DEPT CODE A	DRN DESN CHD APPD	NAME PKK PKK RN GB	SIGN	DATE 29/10/15 29/10/15 29/10/15 29/10/15
PD	REV.	DATE	ALTD	CHD	APPD	SUB-CONTRACTOR													
01		02/02/16	PKK	RN	GB	TITLE CRANE CLEARANCE DIAGRAM OF POWER HOUSE 125/25T DOUBLE GIRDER EOT CRANE WITH 5T ELECTRIC HOISTS													
02		15/04/16	PKK	RN	GB								DEPT.	SCALE	DRAWING NO PE-DG-414-501-A001				
													SIGN DATE		SHEET 1 OF 1			REV. 2	

FIRST ANGLE PROJECTION

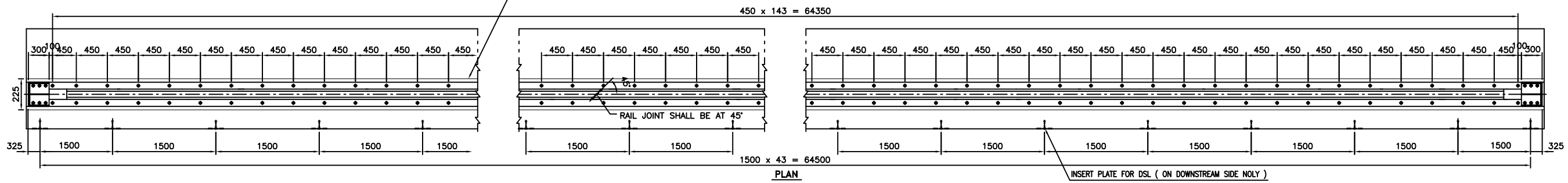
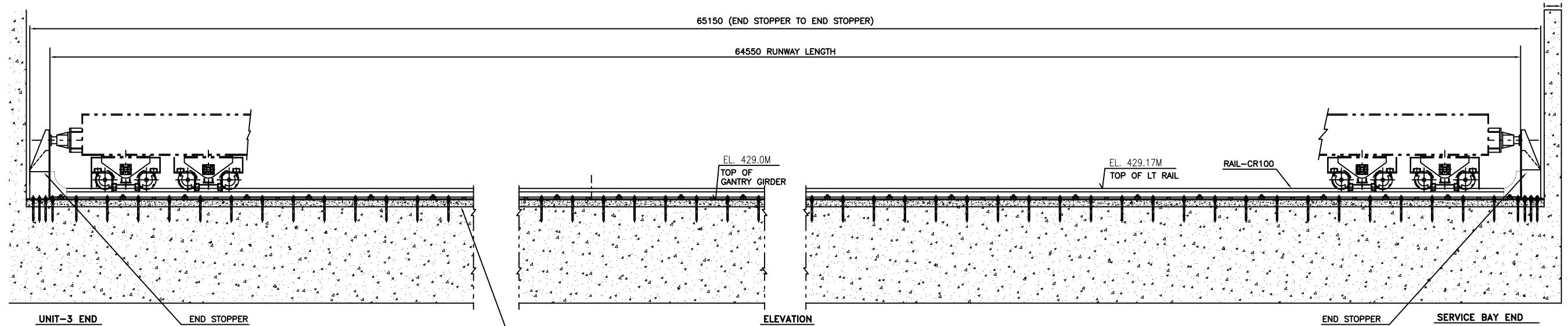
ALL DIMENSIONS ARE IN MM

PE-DG-414-501-A005
DRAWING No.

CUSTOMER'S DRAWING No.

65150 (END STOPPER TO END STOPPER)

64550 RUNWAY LENGTH



NOTES :-

- 1) ALL DIMENSIONS ARE IN MM.
- 2) INSERT PLATE FOR DSL (43 Nos.) SHALL BE MOUNTED ON DOWN STREAM SIDE ONLY.
- 3) FOUNDATION BOLTS TO EMBEDDED AT THE TIME OF BEAM (GANTRY GIRDER) CAST. THE SOLE PLATE IS FITTED WITH THE FOUNDATION BOLTS.
- 4) DIMENSIONS AS INDICATED FOR THE LENGTH OF FOUNDATION BOLTS/ ANCHORS, DIMENSION OF SOLE PLATE, PITCHING OF FOUNDATION BOLTS, INSERT PLATE OF DSL AND POSITION OF INSERT PLATE OF DSL ARE TENTATIVE AND SHALL BE FINALISED AFTER PLACEMENT OF ORDER WITH CRANE'S SUPPLIER.
- 5) DETAILED FIXING ARRANGEMENT OF ALIGNING BLOCKS & RAIL CLAMPS SHALL BE FURNISHED AFTER PLACEMENT OF ORDER.
- 6) GROUTING OF FOUNDATION BOLTS BLOCK OF SOLE PLATE OF RAIL, SHALL BE IN NTPC SCOPE.

NTPC DRG. NO.:
5602-003-H143-PVM-B-090

CUSTOMER:
NTPC HYDRO LIMITED

PACKAGE: DG EOT CRANES- 125/ 25/ 5/ 5 T CAP., SPAN 20.4 M
FOR MACHINE HALL

PROJECT: -
RAMMAM STAGE-III HYDROELECTRIC PROJECT (3X40 MW)

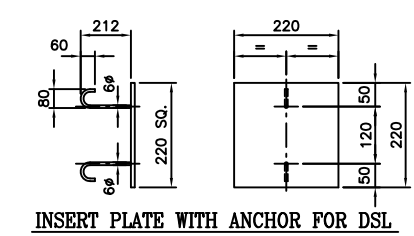
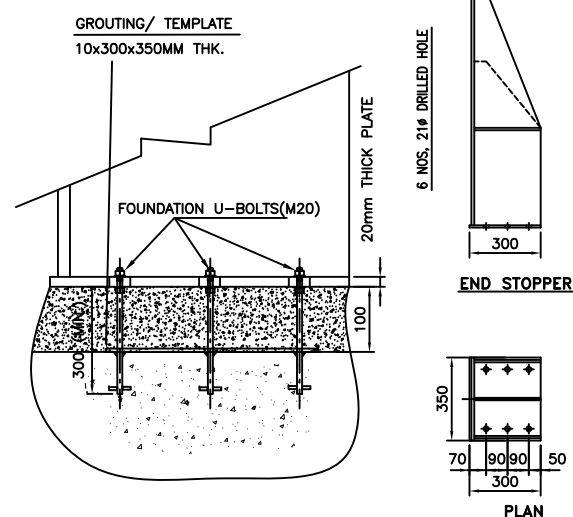
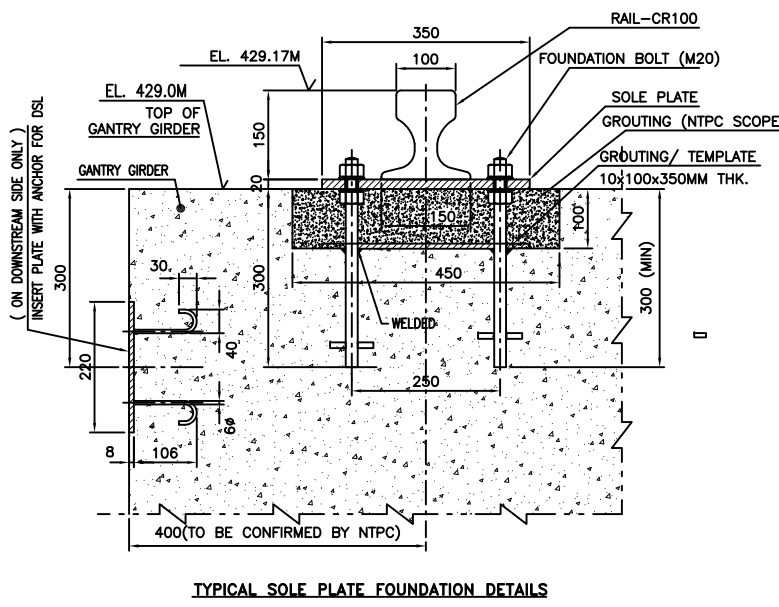
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	CHD	RN	ENGINEERING MANAGEMENT,	Sd/-	29.03.2016
	APPD	GB	NOIDA.	Sd/-	29.03.2016

TITLE:- PH EOT: TENTATIVE ARRANGEMENT FOR FIXING OF LT
RAIL SOLE PLATE & INSERTS OF DSL & END STOPPERS

DRAWING No.				PE-DG-414-501-A005			
SHEET 01 OF 01				REV 00			

COMPUTER FILE NAME: PE-DG-414-501-A005

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TO					
No. OF					
REV.	DATE	ALTD	CHD	APPD	

ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

DRAWING NO.

CUSTOMER'S DRAWING NO.

TITLE BLOCK

3

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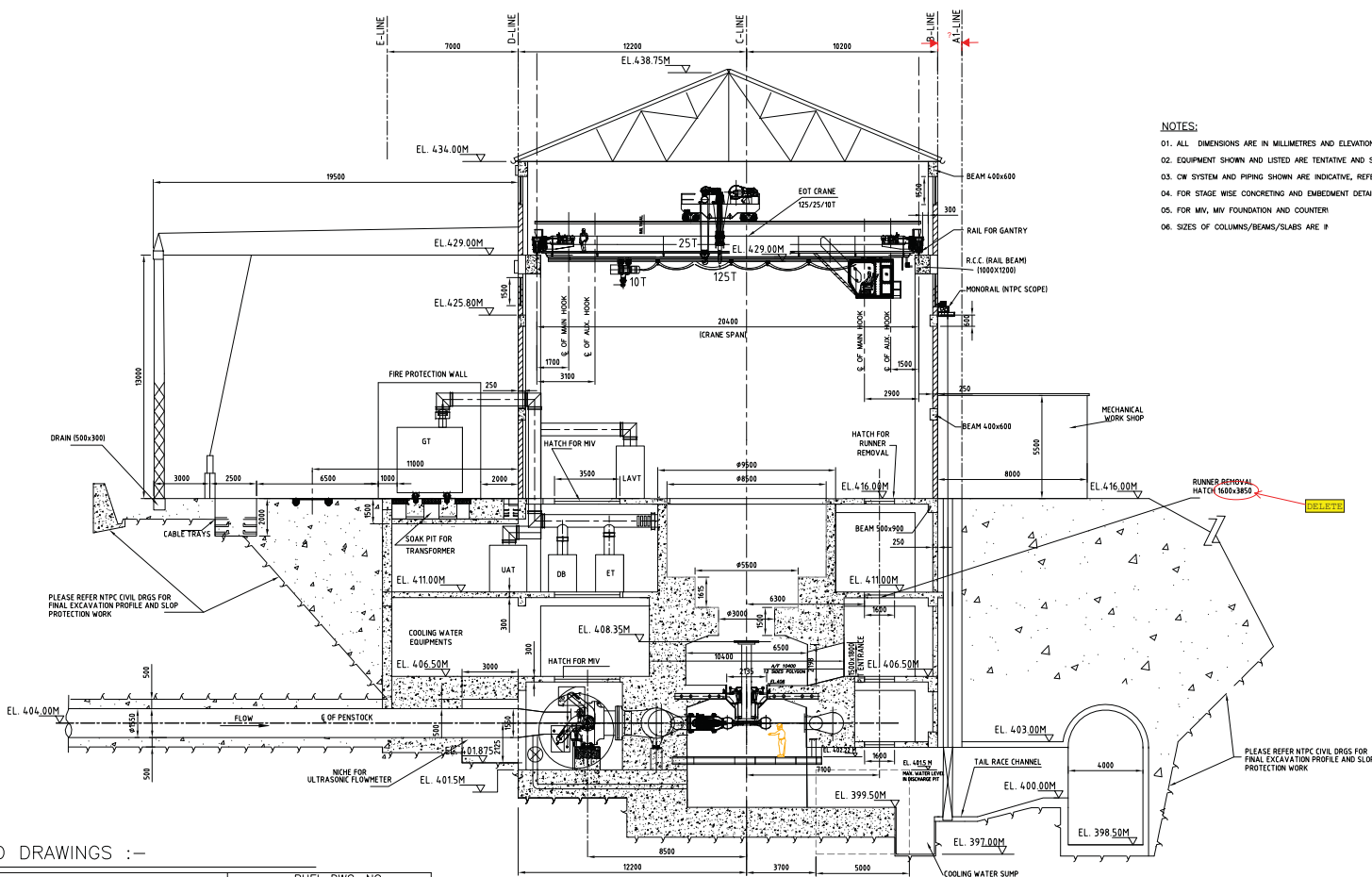
PRINT SCALE

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CUST. DRG NO.											
CUSTOMER		NTPC HYDRO LIMITED									
STATUS JOB NO.		CONTRACT 414		RAMMAM STAGE-III HYDROELECTRIC PROJECT (3X40 MW)							
MAIN-CONTRACTOR				BHARAT HEAVY ELECTRICALS LTD POWER SECTOR, PROJECT ENGINEERING PROJECT, NOIDA							
SUB-CONTRACTOR				JRN DESN CHD APPD		NAME		SIGN		DATE	
TITLE											
DRAWING NO		PE-DG-414-501-A001									

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)



NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. CW SYSTEM AND PIPING SHOWN ARE INDICATIVE, REFER COOLING WATER AND HVAC DRAWINGS FOR COMPLETE DETAILS.
04. FOR STAGE WISE CONCRETING AND EMBEDEDMENT DETAILS REFER TURBINE DRAWINGS OF BHEL.
05. FOR MIV, MIV FOUNDATION AND COUNTERS REFER TURBINE DRAWINGS OF BHEL.
06. SIZES OF COLUMNS/BEAMS/SLABS ARE AS PER DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.

LINKED DRAWINGS :-

SL. NO.	DESCRIPTION	BHEL DWG. NO. (NTPC DWG. NO.)
01	LONGITUDINAL SECTION OF POWER HOUSE	12000019861 (5602-906-H115-PVM-F-007)
02	PLAN AT EL. 399.00	12000019852 (5602-906-H115-PVM-F-002)
03	PLAN AT EL. 401.50 (MIV FLOOR)	12000019853 (5602-906-H115-PVM-F-003)
04	PLAN AT EL. 406.50 (TURBINE FLOOR)	12000019854 (5602-906-H115-PVM-F-005)
05	PLAN AT EL. 411.00 (GENERATOR FLOOR)	12000019855 (5602-906-H115-PVM-F-008)
06	PLAN AT EL. 416.00 (MACHINE HALL FLOOR)	12000019856 (5602-906-H115-PVM-F-009)
07	LAYOUT OF POWER HOUSE AUX. BLOCK	12000019158 (5602-906-H115-PVM-F-104)
08	FIRST STAGE PIPES AND EMBEDMENTS DRG.	02010419801 (5602-906-H115-PVM-F-002)
09	CRANE CLEARANCE DIAGRAM	PE-DG-414-501-A001 (5602-003-H143-PVM-W-039)

CROSS SECTION OF POWER HOUSE
THROUGH WATER CONDUCTOR SYSTEM (UNIT-I)

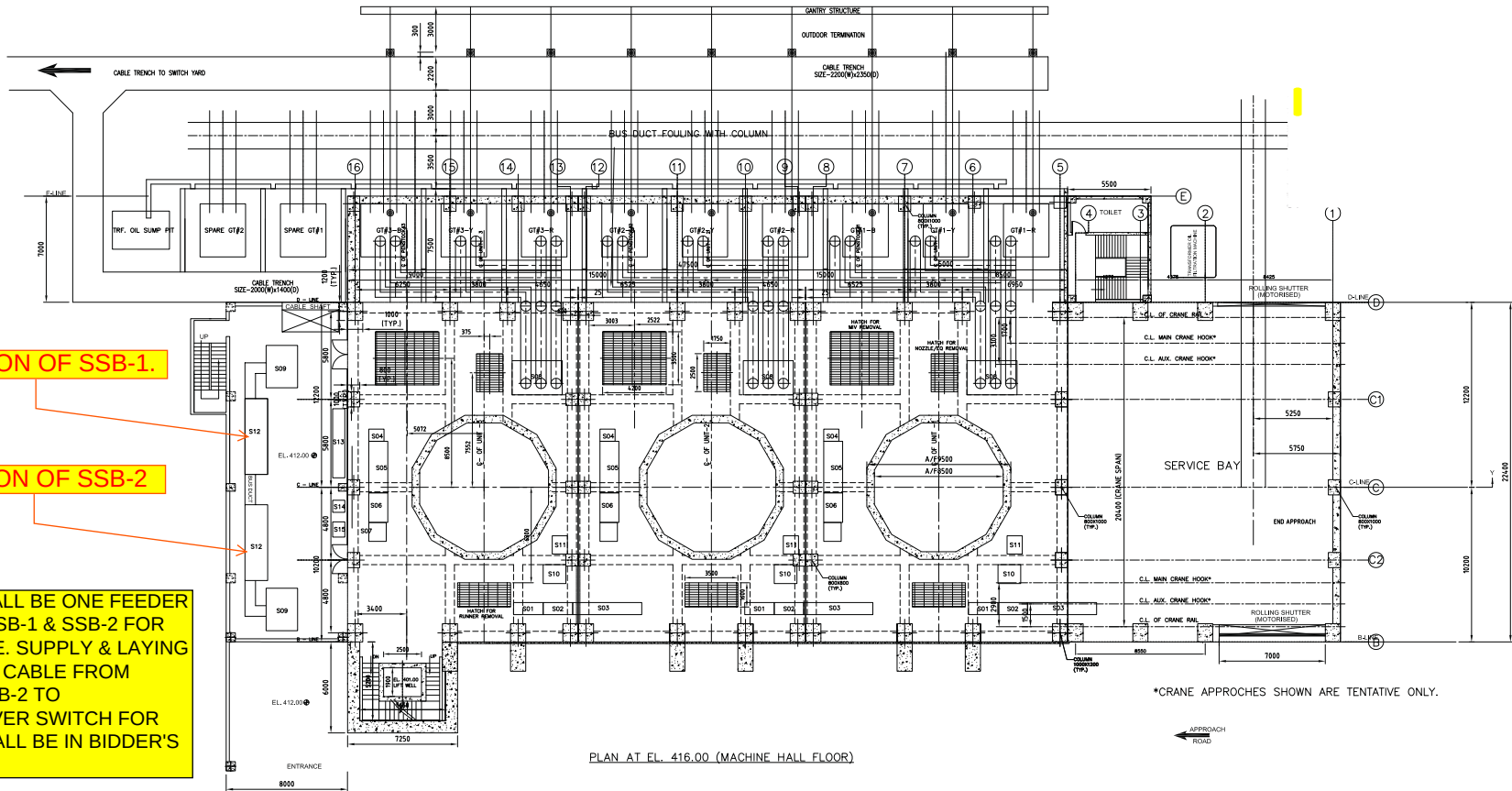
REV.	DATE	ALTERED CHECKED APPD.	REV.	DATE	ALTERED CHECKED APPD.	T.KHAN S.SAHU R.S
01	28.02.16					
ZONE			ZONE			AS PER NTPC COMMENTS

CUSTOMER:		एन.टी.पी.सी. लिमिटेड NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE)	
CONSULTANT:			
PROJECT: RAMMAM STAGE - III HYDROELECTRIC PROJECT [3X40MW]			
		DEPT. CODE DRN T.KHAN HSE CKD S.SAHU 415 APPD R.S SUB-VENDOR DRG. NO.	
TITLE POWER HOUSE GENERAL ARRANGEMENT TYPICAL CROSS SECTION		DATE 20.09.15 20.09.15 20.09.15 PO REF NO. OF ITEMS	
SUB-VENDOR NAME		BHEL DRG. NO. 12000019851	
WEIGHT (kg)		SCALE 1:125	
SHEET NO. 01		NO. OF SHT. 01	

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

9586100001.12000019856



*CRANE APPROACHES SHOWN ARE TENTATIVE ONLY.

LIST OF EQUIPMENTS (TENTATIVE)

S.No	DESCRIPTION	SIZE (mm)	LOCATED AT	WEIGHT (KGS.)	QTY / UNIT	TOTAL QTY.	DRG. No.	REMARKS
S01	GAUGE PANEL	1950 800 2415	EL. 416	—	1	3	EDN	
S02	TEMPERATURE MEASUREMENT PANEL	1950 800 2415	EL. 416	500	1	3	EDN	
S03	UNIT CONTROL BOARD (OUT OF 8 PANELS) ELECTRONIC PANEL(S), RELAY PANEL(S) CONTROL & METERING PANEL(S) TERMINATION PANEL(S)	4555 800 2415	EL. 416	—	1	3	EDN	
S04	ALARM ANNUNCIATOR PANEL	1000 800 2415	EL. 416	—	1	3	EDN	
S05	THYRISTOR & TRIPPING CUBICLE	3404 1250 2995	EL. 416	3500	1	3	EDN	
S06	REGULATION CUBICLE	1951 1250 2295	EL. 416	1000	1	3	EDN	
S07	FIELD SUPPRESSION CUBICLE	1150 1250 2295	EL. 416	1500	1	3	EDN	
S08	LAMP CUBICLE	3300 2250 2835	EL. 416	—	1	3	—	
S09	AC BREAKER CUBICLE	1900 1250 2295	EL. 416	1500	1	3	EDN	
S11	ENG. CUBICLE	1200 1000 2320	EL. 416	900	1	3	HPE. GOV	
S12	COMMON AUX. LOCAL CONTROL BOARD	4555 800 2415	EL. 416	3500	—	2	EDN	
S14	LOCAL HM. PANEL	800 800 2415	EL. 416	750	1	3	EDN	
S15	COMMON AUX. ALARM ANNUNCIATOR PANEL	1000 800 2415	EL. 416	3500	1	3	EDN	

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
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- CW SYSTEM AND PIPING SHOWN ARE INDICATIVE, REFER COOLING WATER AND HVAC DRAWINGS FOR COMPLETE DETAILS.
- SIZES OF COLUMNS/BEAMS/SLABS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
- BUS DUCT ROUTING SHOWN IS INDICATIVE ONLY. FOR DETAILS REFER 'DELTA FORMATION OF IPBD' DRAWING.

REV.	DATE	ALTERED CHECKED APPD.	REV.	DATE	ALTERED CHECKED APPD.
ZONE			ZONE		

CUSTOMER:		एन.टी.पी.सी. लिमिटेड NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE)	
CONSULTANT:			
PROJECT: RAMMAM STAGE - III HYDROELECTRIC PROJECT [3X40MW]			
BHARAT HEAVY ELECTRICALS LTD. BHOPAL		DEPT. CODE: DRN T.KHAN HSE CKD S.SAHU 415 APPD.R.S SUB-VENDOR DRG. NO. PO REF	
TITLE: POWER HOUSE FLOOR PLAN AT EL.416.00		NTPC DRG. NO. 5602-906-H115-PVM-F-009 BHEL DRG. NO. 12000019856 SHEET NO. 01 NO. OF SHT. 01	
SUB-VENDOR NAME		WEIGHT (kg)	SCALE 1:200



PART - C

GENERAL TECHNICAL REQUIREMENTS

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT
(3 X 40 MW)
ELECTRO MECHANICAL WORKS
EPC CONTRACT PACKAGE
BIDDING DOC NO.: CS-5602-003-9

TECHNICAL SPECIFICATION
SECTION-VI

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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 specifications and requirements brought out in Section-VI, the Technical Specification 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 Employer to determine that the products proposed are equivalent to those named.			
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Contractor's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor 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 will 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 Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer along with the bid to enable the Employer to determine the acceptability of these proposals.			
4.00.00	COMPLETENESS OF FACILITIES			
4.01.00	Contractors may note that this is a turnkey contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.			
4.02.00	All equipments furnished by the Contractor 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 of the equipment and for the safety of the operating personal, 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.			
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5.00.00 5.01.00 5.02.00	CODES & STANDARDS 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. l) Any other statutory codes / standards / regulations, as may be applicable. Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply : a) Japanese Industrial Standards (JIS) b) American National Standards Institute (ANSI) c) American Society of Testing and Materials (ASTM) d) American Society of Mechanical Engineers (ASME) e) American Petroleum Institute (API) f) Standards of the Hydraulic Institute , U.S.A.	
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g) h) i) j) k) l) m) n) o) p) q) r) s) t) u) v) w) x) y) z) aa) 5.03.00	International Organisation for Standardisation (ISO) Tubular Exchanger Manufacturer's Association (TEMA) American Welding Society (AWS) National Electrical Manufacturers Association (NEMA) National Fire Protection Association (NFPA) International Electro-Technical Commission (IEC) Expansion Joint Manufacturers Association (EJMA) Heat Exchange Institute (HEI) International Telecommunication Union (ITU) European Norms (EN) Association Francaise de Normalisation (AFNOR) Deutsche Industrienormen (DIN) Verein Deutscher Elektriker (VDE) Verein Deutscher Ingenieure (VDI) British Standards (BS) American Iron and Steel Institute (AISI) Institute of Electrical Engineers (IEE) Institute of Electrical and Electronic Engineers (IEEE) American Society of Heating, Refrigerating and Air-Conditioning Engineers Consultative committee for International Telegraphy or Telephony (CCITT) Groupe d'etude, Cahier des Charges Hydrauliques (CCH) Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Contractor shall furnish, along with the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Contractor shall furnish specifically the variations and deviations from the standards mentioned under 5.01.00 and 5.02.00 together with the complete word to word translation of the standard that is normally not published in English.	
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5.04.00	As regards highly standardized equipments such as Hydro Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VDI 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	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.	
5.07.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform is given in the Annexure-I to this section.	
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE	
6.01.00	The functional guarantees of the equipment under the scope of the Contract are given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.	
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor 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 Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated 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.	
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7.02.00	Maintenance and Availability Considerations Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Contractor shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Contractor shall also furnish details of availability records in the reference plants stated in his experience list. Contractor 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 shall be specified in terms of running 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 contractor 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 contractor for lifting the equipment and accessories covered under the specification.	
8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR	
8.01.00	Contractors may note that this is a turnkey contract. 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 to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation as per the scope defined in various sections of the Technical-Specifications. The Contractor shall furnish engineering data in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.	
8.02.00	The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-II to this Part-C, Section-VI of the Technical Specification.	
8.03.00	Engineering Information Submission Schedule Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Employer. For this, the Contractor shall furnish a detailed list of engineering information along with 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. i) Information that shall be submitted for the approval to the Employer before proceeding further, and	
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8.03.01	ii) Information that would be submitted for Employer's information only. The Engineering Information Schedule shall be updated month wise. 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. The review of these data by the Employer will cover only general conformance of the data to the specifications and documents interfaces with the equipment provided under specifications. This review by the Employer may not indicate 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. This review and /or approval by the Project Manager shall not be construed by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents. All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Documents and the entire works covered under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Employer in writing. The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following: A) Basic Engineering Documentation Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 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. ii) Sizing criteria of all the systems, sub-systems / equipments/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins. iii) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups. iv) Operation Philosophy and the control philosophy of the Main Plant and other plants. v) General Layout plan of the power station incorporating all facilities in Contractor's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in Contractor's scope.	
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B)	vi)	Basic layouts and cross sections of the main plant building (various floor elevations) and other areas including interface-areas included in the scope of the Contractor.	
	vii)	Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.	
		The successful Contractor shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs), which shall then be mutually discussed & finalised with the Employer.	
		Detailed Engineering Documents	
	i)	General layout plan of the station.	
	ii)	Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.	
	iii)	Flow diagrams, Process & Instrumentation Diagrams	
	iv)	Piping composite layout drawings.	
	v)	Purchase specifications/ technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.	
	v	i)	Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries.
	vii)	Transient & hydraulic analysis of piping and system wherever applicable.	
	viii)	Comprehensive list of all terminal points which interface with Employer's facilities giving details of location, end connection details, forces, moments etc.	
	ix)	Power supply single line diagram, block logics, control schematics, electrical schematics, etc.	
	x)	Protection system diagrams and relay settings.	
	xi)	Cables schedules and interconnection diagrams.	
	xii)	Cable routing plan.	
	xiii)	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	
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8.04.00	loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xiv) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points. xv) Sequence and protection interlock schemes. xvi) Type test reports, insulation co-ordination study report and power system stability study report. x vii) Control system configuration diagrams and card circuit diagrams and maintenance details. xviii) Detailed software manuals & source software listing. xix) Detailed flow chart for digital control system. xx) Mimic diagram layout. xxi) Model study reports wherever applicable. xxii) Functional & guarantee test procedures and test reports. xxiii) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. xxiv) For equipment foundation, separate composite general arrangement drawings for equipment foundation shall be furnished by the Contractor including the location of pockets/bolts/inserts/embedments/pedestals and extent of grouting, point of application of loads etc. The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter along with the date vide which the submissions are made. Engineering Drawings (a) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-II of Part-C. The soft copies to be supplied shall be either in CDs, DVD or through direct transfer via E-mail, etc. The drawings submitted for approval could be in the image form. (b) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate 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 equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.	
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	(c) Each drawing submitted by the Contractor (including those of sub vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number and the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawings shall be in English. All the dimensions should be in metric units. (d) The drawings submitted by the Contractor (or their sub vendor's) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful Contractor so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract. The Contractor 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 Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Similarly, all the drawings / documents submitted by the Contractor during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission. (e) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents / data / drawings by the Employer will cover only general conformance of the data / drawings / documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and / or approval by the Employer / Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. (f) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. (g) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment / system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipments / system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specifications.	
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8.05.00	(h) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions. (i) Drawing must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor 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 contractor 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 Employer's scope and submit all necessary drawings / documents for the same. (j) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager / Employer 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 Project Manager in writing.	
	Instruction Manuals The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments 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 finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-II. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) 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.	
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	d) Critical checks and permissible deviation/tolerances. e) List of tool, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection. h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection B) 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 Employer 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. 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 Employer. 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 Employer 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.			
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	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. 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 Employer.	
8.06.00	Plant Handbook and Project Completion Report	
8.06.01	Plant Handbook The Contractor shall submit to the Employer a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including i) Design and performance data. ii) Process & Instrumentation diagrams. iii) Single line diagrams. iv) Sequence & Protection Interlock Schemes. v) Alarm and trip values. vi) Performance Curves. vii) General layout plan and layout of main plant building and auxiliary buildings viii) 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 Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.	
8.06.02	Project Completion Report The Contractor shall submit a Project Completion Report at the time of handing over the plant.	
8.07.00	Engineering Progress and Exception Report	
8.07.01	The Contractor shall submit every month an Engineering progress and Exception 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	
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	b) Drawings which were not submitted as per agreed schedule.	
8.07.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.	
8.08.00	Clearance of Employers' Drawings: During detailed Engineering contractor will check the interface of relevant structural general arrangement drawings, foundation drawings, RCC drawings and architectural plan/elevation drawings furnished by the Employer for various areas and forward his consolidated observations/comments within three (3) weeks from the date of forwarding the drawings by the Employer.	
9.00.00	TECHNICAL CO-ORDINATION MEETING	
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI/NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.	
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.	
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor 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.	
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after its first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.	
9.03.00	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.	
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the	
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	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 Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.	
11.00.00	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 Employer. Each base plate shall 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.	
12.00.00	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.	
13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS	
13.01.00	The Contractor's scope includes all the first fill including the necessary quantity for the flushing of oils, lubricants, servo fluids, gases 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 Contractor. Contractor shall also supply necessary quantity for the first change of consumables such as oils, lubricants, servo fluids, gases, essential chemical etc. This additional quantity shall be supplied in separate Containers.	
13.02.00	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 Employer along with lubrication requirements.	
14.00.00	LUBRICATION	
14.01.00	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.	
15.00.00	MATERIAL OF CONSTRUCTION	
15.01.00	All materials used for the construction of the equipment shall be new and shall be in	
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	accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.	
16.00.00	RATING PLATES, NAME PLATES & LABELS	
16.01.00	Each main and auxiliary item of plant 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 Employer.	
16.02.00	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 Employer or as detailed in appropriate section of the technical specifications.	
16.03.00	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.	
16.04.00	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.	
16.05.00	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	
17.00.00	TOOLS AND TACKLES The Contractor 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 Contractor along with 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 Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished/repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.	
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18.00.00	WELDING	
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.	
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES	
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with colour and coding scheme given in Annexure-III enclosed.	
19.02.00	Surface Treatment and Coatings Please refer Annexure-IV of this sub-section.	
20.00.00	PROTECTION	
20.01.00	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 pipings 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.	
21.00.00	QUALITY ASSURANCE PROGRAMME	
20.01.00	The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised 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 contractor shall generally cover the following: i) His organisation structure for the management and implementation of the proposed quality assurance programme ii) Quality System Manual iii) Design Control System iv) Documentation and Data Control System v) Qualification data for Contractor's key Personnel.	
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	vi) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. vii) System for shop manufacturing and site erection controls including process, fabrication and assembly. viii) Control of non-conforming items and system for corrective actions and resolution of deviations. ix) Inspection and test procedure both for manufacture and field activities. x) Control of calibration and testing of measuring testing equipments. xi) System for Quality Audits. xii) System for identification and appraisal of inspection status. xiii) System for authorising release of manufactured product to the Employer. xiv) System for handling, storage and delivery. xv) System for maintenance of records, and xvi) 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.	
21.02.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE	
21.02.01	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 contractor 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 contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Contractor and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.	
21.02.02	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	
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	specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor'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. floppy 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.	
21.02.03	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.	
21.02.04	The Contractor 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 Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.	
21.02.05	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 Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).	
21.02.06	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.	
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21.02.07	The contractor shall submit to the Employer Field Welding Schedule for field welding activities. The field welding schedule shall be submitted to the Employer 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.	
21.02.08	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 Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.	
21.02.09	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor'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 Employer.	
21.02.10	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.	
21.02.11	Any other statutory requirements as applicable for the equipments/systems shall also be complied with.	
21.02.12	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.	
21.02.13	No welding shall be carried out on cast iron components for repair.	
21.02.14	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.	
21.02.15	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-1A (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 correlation of the test report with the job. All plates of thickness 40mm and above & all bar stock/Forging 40mm and above dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.	
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21.02.16	The Contractor shall list out all major items/ equipments/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor 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 Contractor and finalized with the Employer, shall be subject to Employer's approval. The contractor'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 Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress report on sub-contractor details submission / approval shall be furnished. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.	
21.02.17	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor 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 Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. 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 Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.	
21.02.18	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.	
21.02.19	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor'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	
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	parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments 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.	
21.02.20	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer 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 Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.	
21.02.21	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.	
21.02.22	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.	
21.03.00	Environmental Stress Screening All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following.	
21.03.01	The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. Or In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure. Elevated Temperature Test Cycle During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as 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.	
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21.03.02	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° C above the ambient temperature at 50° C. In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement. Burn in Test Cycle The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test. The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature 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. During the Burn in 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° C above the ambient temperature. The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer 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.	
21.04.00	QA DOCUMENTATION PACKAGE The Contractor 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.	
21.04.01	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.	
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21.04.02	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. Typical contents of QA Documentation is as below:- i) Quality Plan ii) Material mill test reports on components as specified by the specification and approved Quality Plans. iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. iv) 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. v) Heat Treatment Certificate/Record (Time- temperature Chart) vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure. vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. viii) Certificate of Conformance (COC) wherever applicable. i) MDCC	
21.04.03	Similarly, the contractor 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.	
21.04.04	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.	
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	i) 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. ii) 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. iii) 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.	
21.05.00	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.	
21.06.00	PROJECT MANAGER'S SUPERVISION	
21.06.01	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 GCC of Vol.I, the Contractor shall proceed to comply with the Project Manager's decision.	
21.06.02	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: i) Interpretation of all the terms and conditions of these documents and specifications: ii) Review and interpretation of all the Contractor's drawing, engineering data, etc.	
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	iii) 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. v) Inspect, accept or reject any equipment, material and work under the contract. vi) Issue certificate of acceptance and/or progressive payment and final payment certificates vii) Review and suggest modifications and improvement in completion schedules from time to time, and viii) Supervise Quality Assurance Programme implementation at all stages of the works.	
21.09.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES	
21.09.01	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.	
21.09.02	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer 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 Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.	
21.09.03	The Contractor shall give the Project Manager/Inspector ten (10) working days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within ten(10) working days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor 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.	
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21.09.04	The Project Manager or Inspector shall within ten (10) working days from the date of inspection as defined herein give notice in writing to the Contractor, 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 Contractor 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.			
21.09.05	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect ten (10) working days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within ten (10) working days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.			
21.09.06	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, 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 authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.			
21.09.07	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.			
21.09.08	To facilitate advance planning of inspection in addition to giving inspection notice as above, the Contractor 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.			
21.09.09	All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/ measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Employer. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.			
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21.10.00	ASSOCIATED DOCUMENTS:	
21.10.01	Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R1	
21.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1	
22.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also apply: i) Working platforms should be fenced and shall have means of access. ii) Single core electrical cables shall not be used. Only 3 Core cable for single phase supply and 4 Core for 3 phase supply shall be used. iii) Ladders in accordance with Employer'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.	
23.00.00	NOISE LEVEL AND VIBRATION For noise level please refer Annexure-VII of this part. For vibration please refer Annexure –VIII of this part.	
24.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES	
24.01.00	(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 Employer and the Contractor 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 Contractor's quality assurance programme as well as those included in Clause No. 30.00.00 of Part-D, Section-VI and elsewhere in the Technical Specifications. (b) The Contractor'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, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant. (c) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.	
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24.02.00	d) 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 Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer. e) The Contractor 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. f) Contractor shall furnish the commissioning organisation chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization. The chart should contain: (i) Bio-data including experience of the commissioning engineer. Initial Operation a) Subsequent to 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. 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. The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect. c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. d) 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 Contractor. 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	
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24.03.00	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 Contractor to the full satisfaction of the Employer 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. *Shall be appropriately adjusted for any generation loss attributable to the Employer. Guarantee Tests a) The final test as to prove the Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to conduct such test. b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantees. c) For performance/ demonstration tests instrumentations of accuracy class, subject to the approval of the Employer shall be used. The numbers and location of the instruments shall be as per the specified test codes. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost. e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail in Part A and Part B of Section-VI.	
24.04.00	Taking Over Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer 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 Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.	
25.00.00	TRAINING OF EMPLOYER'S PERSONNEL In addition to the requirements given in Section General Condition of contract (GCC), Section-IV regarding training of Employer's personnel, the following shall also apply.	
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25.02.00	General The Contractor shall provide suitable instructors, training material and facilities (instruments, apparatus, simulators, documents, drawings, protective clothing, rooms, office supplies, etc.) for the Personnel made available by the Employer for training. One month before the training start, the Employer will send the list of the trainees and any comments on the training program proposed by the Contractor. This program shall be adapted to the design and nature of the Works, and the needs of trainees. Trainees shall be suitably trained in the various aspects of design, manufacture, installation/ erection, operation and maintenance, relevant to the training, of works similar to the Works The Contractor shall supervise and provide direction to, and be liable for the acts or omissions, other than negligent or wilful misconduct of such personnel, of the Employer's trainees. The Contractor shall provide the training described hereafter in accordance with any further specific requirements stated in the Employer's Requirements. The Contractor shall assist the Employer in obtaining any visas and other formalities for entering or leaving the territory on which the training is being provided. The Contractor shall bear responsibility for ensuring the safety of the trainees during their stay in the country of the training. On their part, the trainees shall comply with the laws, regulations and customs of the country in which training is being held. In the event of illness or accident, the Contractor shall take all steps to provide the trainees with the appropriate medical care.	
25.03.00	Training of Employer's Personnel The Contractor shall provide training to Employer's personnel to meet operational and maintenance requirements of various Systems/equipments supplied under this package. This shall include trainee in the areas as enclosed at Annexure-V & VI. The scope of service under training of Employer's engineers shall include a training module covering the following: a) Training During Engineering/ Manufacturing Phase This shall cover all disciplines viz, Mechanical, Electrical, C&I & QA etc. and shall include all the related areas like Design familiarisation, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. The training in areas of Operation and Maintenance shall take place preferably during end of manufacture/ tests.	
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	b) Training During the Erection / Installation / Site Work Independently from the supervision and inspection functions of the Employer's Representative, the Contractor shall authorise the Employer's Personnel to follow the erection / installation / site work at his site. The Employer's Start-up Personnel shall take no part in the equipment erection and/or installation operations, which shall be exclusively carried out by the Contractor and under his entire responsibility. This on site training shall cover each phase of erection / installation / site work and shall be of sufficient duration. The Contractor shall supply the information or measurements concerning the erection requested by the Employer's Representative or/and by the Employer's personnel. c) Training during the Tests on Completion phase, Operation & Maintenance The scope of service under training of Customer's engineers shall necessarily include, training of upto twelve (12) Employer's personnel for the power plant in the areas of Operation & Maintenance. The Contractor shall provide on-the-job training in the operation and maintenance of the Works to the Employer's Operating Personnel. Such training shall start at least 30 days prior to commencement of Tests on Completion and continue until Taking Over. Its scope and quality shall be such so that the operation and maintenance phase of the project can be carried out to ensure sustained guaranteed performance of the equal availability of the units as offered. The training should provide the trainees with comprehensive understanding of all operational and maintenance aspects of the Works. Such training shall also include safety and environmental protection aspects applicable to the Works. 25.04.00 Exact details, extent of training and the training schedule shall be finalised based on the Contractor's proposal. In all the above cases, whenever the training of Employer's personnel is arranged at the works of the manufacturers, it shall be noted that the lodging and boarding of the Employer's personnel shall be Contractor's scope. The Contractor shall make all necessary arrangements towards the same. 26.00.00 PACKAGING AND TRANSPORTATION All the equipments 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. 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 Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency	
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	concerned in India well before effecting despatch of equipment. Before despatch 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 & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.	
27.00.00	ELECTRICAL ENCLOSURE	
27.01.00	All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature of 40 degree C and a maximum relative humidity of 100%.	
28.00.00	JUNCTION BOXES	
	The junction boxes shall be made of minimum 2 mm thick sheet steel. Gland plates shall be removable type and made of 3 mm thick sheet steel. The boxes shall be provided with detachable cover or hinged door with captive screws. Top of the box shall be arranged to slope towards the rear of the box. The box shall be hot dip galvanised and shall be provided with suitable neoprene gaskets to achieve requisite degree of protection. Adequate spacing shall be provided to terminate the external cables. The boxes shall be suitable for mounting on various types of steel structures. The terminal blocks provided shall be of 1100 V grade, rated for 10 A for control cables. Suitable numbering for terminal blocks shall be done. In case of junction box for power cable, the box shall be rated for maximum current carrying capacity. Terminal blocks shall be of one piece, Klippon RSF-1 or ELMEX CSLT-1 type with insulating barriers.	
29.00.00	INSTRUMENTATION AND CONTROL	
	All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.	
29.01.00	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: 1. Temperature - Degree centigrade (deg. C) 2. Pressure - Kilograms per square centimetre (Kg/cm²). 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. 3. Draught - Millimetres of water column (mm wc).	
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5.	4. Vacuum - Millimeters of mercury gauge (mm Hg) or water column (mm Wcl). 5. Flow (Liquid) - LPS/LPM/LPH 6. Flow base - 760 mm Hg. 15 deg.C 7. Density - Grams per cubic centimetre.	
29.02.00	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 plan-in connection at rear.	
29.03.00	Instruments for sensing, transmission and measuring system shall be of electronic type with signal transmission in current mode of 4 -20 mA DC. For interrogation of potential free contacts, 48 V DC power supply shall be employed.	
29.04.00	For sequence interlocks and equipment/ unit protection, independent and separate direct acting switches shall be provided. Indicating type process switches shall not be acceptable. Wherever blind switches are provided, separate gauges for local indication shall be provided to facilitate easy operation/ maintenance.	
29.05.00	The contacts of switch devices (process switches, limit switches) etc., unless higher rating is required for specific application, shall be rated continuously for 5A at 240 V AC, 50 Hz (breaking inductive circuits) and 0.5 A at 220V DC. Each switching element including the contacts from limit and torque switches of valve actuators shall be provided with two electrically independent single pole double throw (SPDT) snap acting contacts. All spare contracts of the switch devices shall be wired to the nearest junction box/ terminal box.	
29.06.00	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 tropicalised & components shall be of industrial grade or better.	
29.07.00	All equipment/ systems located in the field shall be suitable for continuous operation without loss of function, departure from specifications or damage, at the ambient temperature of 40 deg. C and relative humidity of 95%.	
29.08.00	All equipment/ systems located in air conditioned area as specified elsewhere shall also be designed and constructed to operate for short periods of plant operation when air-conditioning equipment malfunctions (without loss of function, departure from specifications requirements or damage) at the maximum ambient temperature of 40 deg C and relative humidity of 95% RH.	
30.00.00	PROTECTION CLASS OF CABINETS / PANELS, ENCLOSURES ETC. a) All panels desks cabinets & enclosures furnished shall at least comply with the requirements of protection classes as indicated below:	
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	1. In-door air -conditioned (A.C.) areas - IP22 2. In-door Non A.C. areas: (a) Ventilated enclosures - IP42 (b) Non- Ventilated - IP54 3. Out-door - IP55 b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 55. c) The design of panels, Cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg C above the ambient under the worst conditions. The Contractor shall furnish during detailed engineering the necessary design calculation for Employer's review. d) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturbance to the working personnel.	
30.01.00	Permanently fastened, stainless steel, name plate stamped with the Employer's tag number and other necessary details shall be furnished on all gauges, control valves, flow devices, switch devices, temperature elements, solenoid valves, and all other devices, panels, cabinets, enclosures, console inserts etc. after Employer's approval.	
31.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor'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.	
32.00.00	SURGE PROTECTION FOR SOLID STATE EQUIPMENT All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out, the test certificates, etc. shall be submitted by the Contractor.	
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33.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Contractor for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. 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. 33.01.00 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 Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Contractor. The standard which is to be adopted, will be intimated to the Contractor. i) Temperature test pockets with stub and thermowell ii) Pressure test pockets	
34.00.00	SYSTEM DOCUMENTATION The Contractor shall provide drawings, system overview & description, hardware/software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C&I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Technical Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified under Sub-section C&I, Part -B, Section-VI Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage. 34.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the Contractor in standard formats as approved by the Employer.	
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34.02.00	Electronic Module/Component Details The Contractor shall have to furnish all technical details 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 and peripheral.			
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	ANNEXURE-I			
	LIST OF STANDARDS			
	Abbreviations have been used for denoting International and National Standardisation Organizations.			
	The Names and Address of reputed Organisations is given below.			
	ASA	American Standards Association American National Standards Institute 1340 Broadway, New York, Y. N. 10018. U.S.A.		
	ASTM	American Society to Testing and Materials 1916, Race Street, Philadelphia, Pennsylvania-19103, U.S.A.		
BS		British Standards, British Standards Institution, 101, Pentonville Road, London N 19 ND. U.K.		
	CEE	Commission on rule for the approval of Electric Equipment (Netherland), Netherlands Normalisate - Institute, Polkwege, Rijswijk (ZH)-2016, Netherland		
DIN		Deutscher Normenausschuss Beuth Verlag GmbH Auslieferung Burggra Fenstrape, 4-7 10009 Berlin 30, Germany.		
	IEC	International Electrotechnical Commission Bureqa Central De la Commission Electrotechnique Internationale, 1, Rue De Veremba Geneve Switzerland		
IS		Indian Standards, Manak Bhavan, 9 Bahadur Shah Safar Marg, New Delhi-1.		
	ISO	International Organization for Standardization Danizh Board for Standardization DANSK STANDARDESRING SRAAT AUREHOEGVEJ-12 DK 2900 JELLEPRUP, DENMARK.		
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VDE	JIS	Japanese Standards Institution Japanese Standards Association, 124 Asasaka 4 Chome, Tokya 107, Japan.		
	SAA	Standards Association of Australia Marks Committee, SAA, P.O. Box 458, North-Sydney, Australia.		
		German Standards VDE. Verlag GmbH, 1000 Berlin 12 Bissmarc-Ketrabe 33, Germany.		
	LIST OF CODES			
	Indian Standards	Title	International and Internationally recognised standard	
	EOT CRANES			
	IS-1383 & (Part 1,2,3,4 & 5)	-	Cranes Classification	
	IS - 3177/ BS : 466	-	Code of Practice for Electric overhead travelling cranes and gantry cranes other than steel work crane.	
	IS - 807/ BS : 2573	-	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists.	
	IS - 5749/ BS : 3017	-	Forged Ramshorn hooks.	
IS - 2266/ BS : 302	-	Specifications for steel wire ropes for general engineering purposes.		
IS – 6938	-	Code of Practice for design of rope drum and chain hoists for hydraulic gates.		
IS - 325/BS : 2960	-	Three phase induction motors.		
IS - 13947 (Part 4/sec 1)	-	Contactors and motor starters - Electromechanical contactors & motor starter.		
IS – 3815	-	Point hooks with shanks for general engineering purpose.		
IS – 1030	-	Carbon steel castings for general engineering purposes.		
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	IS – 1875 - Carbon steel billets, bloom, slabs and bars for forgings. IS – 210 - Grey Iron castings. IS - 4460 (Part 1,2,3) - Gears - spur & helical gears - calculation of load capacity. FIRE DETECTION, SAFETY AND FIRE PROTECTION SYSTEM <u>Overall scope of the work</u> NFPA 851 : Recommended practice for fire protection for hydroelectric generating plants. NFPA 72 : National Fire Alarm Code NFPA 72 E : National Fire Alarm Code NFPA 70 : National Electrical Code NFPA 101 : Life Safety Code IS 1646 : Code of practice for Fire safety for buildings (General): Electrical installation IS 5571 : Guide for Selection of Electrical equipment in hazardous areas <u>Fire Alarm & Detection System</u> IS 2189 : Selection, Installation and maintenance of automatic fire detection and fire alarm system - Code of Practice IS 11360 : Specification for smoke detectors for use in Automatic electric fire alarm system.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro
	IS 2175 : Heat sensitive fire detectors for use in automatic fire alarm system. IS 2148 : Electrical apparatus for explosive gas atmospheres-flameproof enclosures “d”. IS 694 : PVC insulated cables for working voltages upto and including 1100 volts – Specification. IS 4237 : General requirement for switchgear & control gear. <u>Water Based Fire Protection System.</u> NPFA 13 : Installation of sprinkler systems NFPA 14 : Installation of standpipe and hose systems NFPA 15 : Water spray fixed system NFPA 25 : Fire Pumps & Controllers TAC doc. : Recommendation for fire protection of transformers IS 3034: : Fire safety of industrial buildings: Electrical generating & distributing stations - Code of practice. 1993 IS 10221 : Code of Practice for Coating and Wrapping of underground mild steel pipelines. IS 952 : Specification for Fog nozzles for fire brigade use IS-8034 : Specification for submersible pump sets. IS 3844 : Code of practice for installation & maintenance of internal fire hydrants hose reels on premises. IS 780 : Sluice valves for water work purposes			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI	PART-C	PAGE 42 OF 95

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro
	IS 5312 : Swing check type reflux (non return) valve for water works purposes- Specification. IS 903 : Fire hose delivery couplings , branch pipes, nozzles and spanner – Specification. IS 9972 : Specification for Automatic sprinkler heads for Fire protection system. IS 7760 : Specification for steel glass front cabinets. IS 901 : Specification for couplings double male and double Female instantaneous pattern for fire fighting. IS 5290 : Landing valves – Specification. IS 4927 : Unlined flax canvas hose for fire Fighting – Specification. IS 884 : Specification for first aid hose reel for fire fighting. <u>Portable Fire Extinguishers</u> NFPA 10 : Portable fire extinguishers IS 2190 : Selection, Installation & Main tenance of first aid fire extinguishers - Code of practice. IS 2171 : Portable Fire Extinguishers, dry powder (cartridge type) - Specification IS 2878 : Fire extinguisher, Carbon dioxide type (portable and trolley mounted) – Specification. IS 933 : Specification for Portable Fire extinguisher Foam Type. IS 13849 : Portable fire ex tinguisher Dry powder Ty pe (Stored Pressure)- Specification			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI	PART-C	PAGE 43 OF 95

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro
	IS 940 : Portable fire ex tinguisher, wa ter ty pe (gas cartridge) - Specification NFPA 2001 : Standard on clean agent fire extinguishing system VENTILATION AND AIR CONDITIONING SYSTEM Standard Title IS 4720 Code of practice for ventilation of surface hydel power station IS 3103 Code of practice of ventilation for industrial ventilation IS 4894 Centrifugal fans IS 2312 Propeller type AC ventilating fans IS : 7613 Air filters DIN-2425 Pumps and motors BS 2831 Methods of test for air filt ers used in air conditioning and general ventilation BS 3928 Sodium flame test for air filters other than for air supply to I.C Engines and Compressors. IS 655 Metal Air Ducts IS 277 Specification for Galvanised Steel Sheets IS 737 Specification for Wrought Aluminium or A luminium Alloys Sheet and Strip IS : 3624 Pressure & vacuum gauges IS 659 Safety code for Air conditioning IS 5111 Measurement of testing refrigerant compressor IS 3069 Glossary of terms, sy mbols and units relating to thermal insulation material IS 4671 Expanded polystyrene for thermal insulation purpose ARI Standard Sound level measurement			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI	PART-C	PAGE 44 OF 95

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC हाइड्रो hydro	
	575-87 ASTM B-88Refrigerant piping IS : 702Hot Bitumen Insulation IS : 1042Code for flow measurement ASHRAE15-1994Safety code for Mechanical Refrigeration IS : 661Code of practice for insulation IS : 14164Mode of Measurement of insulation ELECTRIC PASSENGER LIFT IS-4289Flexible cables for lifts and other flexible connections. IS-14665, Part-1,2,3&4Electric Traction lift. GENERAL IS:800Code of practice for use of structural steel in general building construction BS 449:1969 BS 5950 ASA A57, 1-1952 IS:807Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc.No. BU/4 Rev 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960 IS:875Code of practice for design loads (other than earthquake) for buildings and structures National Building code of Canada (1953)-Part-IV			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI	PART-C	PAGE 45 OF 95

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro
Part-I		Leading standards	Design section 4.1 (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	
	IS:1239	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)	
	IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965	
	IS:2825	Code for unfired vessels		
	IS:1520	Horizontal centrifugal pumps for clear cold and fresh water		
	IS:1600	Code for practice for performance of constant speed IC Engines for general purpose		
	IS:1601	Specification for performance of constant speed IC Engines for general Purpose		
	IS:1893	Criteria for earthquake resistant design of structures		
	IS1978-1971	Line Pipe	API Standards 5L April 1969.	
	IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954	
	IS:2312	Propellant type Ventilation fans		
IS:3346	Method for the determin- ation of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials)		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
IS:3401	ASTM C 167-1974 ASTM C 177-1963 Silica gel IS:3588 Specification for electrical axial flow fans IS:3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre) IS:3677 Unbonded rock and slag wool for thermal insulation IS:3815 Point hook with shank for general engineering purposes BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS) IS:3895 Specification for monocry-stallines semiconductor rectifier cells and stacks IS:3963 Roof extractor unit IS:3975 Mild steel wires, strips and tapes for armouring cables IS:4503 Shell and tube type heat Exchanger IS:4540 Specification for monory-stallines rectifire assembly equipment IS:4671 Expanded polystyrene for thermal insulation purpose IS:4736 Hot dip zinc coating on steel tubes IS:5456 Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI PART-C PAGE 47 OF 95

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
BS:848 (P	IS:5749 Forged ramshorn hooks Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958	
	IS:6392 Steel pipe flanges BS 4504 : 1969	
	IS:6524 Part-I Code of practice for design of tower cranes Static and rail mounted BS 2799 : 1956	
	IS:7098 Cross linked Polyethylene insulated PVC sheathed cables Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
	IS:7373 Specification for wrought aluminium and aluminium sheet and strips	
	IS:7938 Air receivers for compressed air installation	
	ISO:1217 Displacement compressor-Acceptance test	
	ASHRAE-33 Methods of testing for rating of forced circulation air cooling and air heating coils.	
	ASHRAE-52-76 Air cleaning device used in general ventilation for removing particle matter.	
	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers.	
	ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors.	
	ARI-450-6 Standard for water cooled refrigerant condensers.	
	ARI-550 Standard for centrifugal water chilling packages.	
	ARI-410 Standard for forced circulation air cooling and air heating coils	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	BS:400 Low carbon steel cylinders for the storage & transport of permanent gases.	TECHNICAL SPECIFICATION SECTION –VI PART-C PAGE 48 OF 95

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
ACT-105 ANSI-31.5 23-1 API:618	BS:401 Low carbon steel cylinders for the storage & transport of liquified gases.	
	CTI Code Acceptance test code for Water Cooling Tower.	
	Refrigerant piping	
	ASME-PTC-958 Atmospheric Water Cooling Equipment	
	AMCA A-21C Test Code for air moving devices	
	Reciprocating Compressor for general refinery services.	
	HYDRAULIC INSTITUTE STANDARDS.	
	HYDRANT SYSTEM MANUALS OF TAC.	
	TAC MANUALS OF SPRAY SYSTEM	
	NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.	
	INDIAN EXPLOSIVES ACT.	
	INDIAN FACTORIES ACT.	
	STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.	
	Properties, Storage and Handling of Common Building Materials	
	IS: 808 Rolled steel Beam channel and angle sections.	
	IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C.	
	IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B.	
	IS: 1367 Technical supply conditions for Threaded fasteners.	
	IS: 2062 Specification for steel for general structural purposes.	
	IS: 8500 Medium and high strength structural steel.	
	Sheeting Works	
	IS:277 Galvanised steel sheets (plain or corrugated).	
	IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
	IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool. IS: 8869 Washers for corrugated sheet roofing. IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. IS: 12866 Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced). IS: 14246 Specification for continuously pre-painted galvanised steel sheets and coils. Fabrication and Erection of Structural Steel Work IS: 2016 Specification for plain washers. IS: 814 Specification for covered Electrodes for Metal Arc Welding for weld steel. IS: 1852 Specification for Rolling and Cutting Tolerances for Hot rolled steel products. IS: 3502 Specifications for chequered plate. IS: 6911 Specification for stainless steel plate, sheet and strip. IS: 3757 Specification for high strength structural bolts IS: 6623 Specification for high strength structural nuts. IS: 6649 High Tensile friction grip washers.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro
	IS: 800Code of practice for use of structural steel in general building construction. IS: 816Code of pra ctice for use of Metal Arc Welding for General Construction. IS: 4000Code of practice for assembly of structural joints using high tensile friction grip fasteners. IS: 9595Code of procedure of Manual Metal Arc Welding of Mild Steel. IS: 817Code of practice for Training and Testing of Metal Arc Welders. IS: 1811Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes). IS: 9178Criteria for Design of steel bins for storage of Bulk Materials. IS: 9006Recommended Practice for Welding of Clad Steel. IS: 7215Tolerances for fabrication steel structures. IS: 12843Tolerance for erection of structural steel. IS: 4353Recommendations for submerged arc welding o f mild steel and low alloy steels. SP: 6 ISIHand book for structural Engineers. (Part 1 to 7) IS: 1608Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. IS: 1599Method of Bend Tests for Steel products other than sheet, strip, wire and tube IS : 228Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. IS : 2595Code of Practice for Radio graphic testing. IS : 1182Recommended practice for Radiographic E xamination of fusion welded butt joints in steel plates. IS : 3664Code of practice for Ultra sonic Testing by pulse echo method. IS : 3613Acceptance tests for wire flux combination for subme rged A rc Welding.			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION –VI	PART-C	PAGE 51 OF 95

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
	IS : 3658 Code of practice for Liquid penetrant Flaw Detection. IS : 5334 Code of practice for Magnetic Particle Flaw Detection of Welds. Water Supply, Drainage and Sanitation IS : 458 Specification for concrete pipes. IS : 554 Dimensions for pipe threads, where pressure tight joints are made on thread. IS : 651 Specification for salt glazed stoneware pipes. IS : 774 Flushing cisterns for water closets and urinals. IS : 775 Cast iron brackets and supports for wash basins and sinks. IS : 778 Copper alloy gate, globe and check valves for water works purposes. IS : 781 Cast copper alloy screw down bib taps and stop valves for water services. IS : 782 Caulking lead. IS : 783 Code of practice for laying of concrete pipes. IS : 1172 Basic requirements for water supply, drainage and sanitation. IS : 1230 Cast iron rain water pipes and fittings. IS : 1536 Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage. IS : 1537 Vertically cast iron pressure pipes for water, gas and sewage. IS : 1538 Cast iron fittings for pressure pipe for water, gas and sewage. IS : 1703 Ball valves (horizontal plunger type) including float for water supply purposes. IS : 1726 Cast iron manhole covers and frames. IS : 1729 Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories. IS : 1742 Code of practice for building drainage. IS : 1795 Pillar taps for water supply purposes.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro
	IS : 1879 Malleable cast iron pipe fittings. IS : 2064 Code of practice for selection, installation a nd maintenance of sanitary appliances. IS : 2065 Code of practice for water supply in building. IS : 2326 Automatic flushing cisterns for urinals. IS : 2470 Code of practice for installation of septic tanks. (Part-I & II) IS : 2501 Copper tubes for general engineering purposes. IS : 2548 Plastic seat and cover for water-closets. IS : 2556 Vitreous sanitary appliances (vitreous china). (Part 1 to 15) IS : 2963 Non-ferrous waste fittings for wash basins and sinks. IS : 3114 Code of practice for laying of cast iron pipes. IS : 3311 Waste plug and its accessories for sinks and wash basins. IS : 3438 Silvered glass mirrors for general purposes. IS : 3486 Cast iron spigot and socket drain pipes. IS : 3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter). IS : 3989 Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. IS : 4111 Code of practice for ancillary structure in sewerage system. (Part I to IV) IS : 4127 Code of practice for laying of glazed stone-ware pipes. IS : 4764 Tolerance limits for sewage effluents discharged into inland-surface waters. IS : 4827 Electro plated coating of nickel and chromium on copper and copper alloys. IS : 5329 Code of practice for sanitary pipe work above ground for buildings.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC हाइड्रो hydro	
	IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.		
	IS : 5822	Code of practice for laying of welded steel pipes for water supply.		
	IS : 5961	Cast iron grating for drainage purpose.		
	IS : 7740	Code of practice for road gullies.		
	IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.		
	IS : 8934	Cast copper alloy fancy pillar taps for water services.		
	IS : 9762	Polyethylene floats for ball valves.		
	IS : 10446	Glossary of terms for water supply and sanitation.		
	IS : 10592	Industrial emergency showers, eye and face fountains and combination units.		
	IS : 12592	Specification for precast concrete manhole covers and frames.		
	IS : 12701	Rotational moulded polyethylene water storage tanks.		
	SP: 35	Hand book on water supply and drainage.		
	-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.		
	Painting and Allied Works			
	IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.		
	IS:1477	Code of practice for painting of ferrous metals in buildings.		
Part-I		Pretreatment.		
Part-II		Painting.		
	IS:1650	Specification for colours for building and decorative finishes.		
	IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.		
	IS:2338	Code of practice for finishing of wood and wood based materials.		
Part-I		Operations and workmanship		
Part-II		Schedules		
	IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC हाइड्रो hydro	
(P)	Part-I	Operations and workmanship.		
	Part-II	Schedule.		
		IS:2524	Code of practice for painting of nonferrous metals in buildings.	
	Part-I	Pretreatment.		
	Part-II	Painting.		
		IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.	
		IS:2933	Specification enamel paint, under coating and finishing.	
		IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.	
		ISO : 8501-1	Sand blasting.	
		ISO:8601-1	Surface preparation of steel or ferrous equipment.	
		IS:5410	Specification for cement paint	
		IS:5411	Specification for plastic emulsion paint-for exterior use	
		IS:6278	Code of practices for white washing and colour washing.	
		IS:10403	Glossary of terms relating to building finishes.	
		Miscellaneous		
	(Relevant parts)	IS:802	Code of practice for use of structural steel in overhead transmission line towers.	
	IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.		
	IS:10430	Criteria for design of lined canals and liner for selection of type of lining.		
	IS:11592	Code of practice for selection and design of belt conveyors.		
	IS:12867	PVC handrails covers.		
Publication	CIRIA	Design and construction of buried thin-wall pipes.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
	REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture , inspection, te sting & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE , ANSI, ASME , NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements - Instrument and appa ratus for tem perature measurement - ASME PTC 19.3 (1974). - Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. - Temperature measurement by electr ical Resista nce thermometers - IS: 2806. - Thermometer - element - Platinum resistance - IS: 2848. Pressure Measurements - Instruments an d apparatus for pressure measurement-A SME PTC 19.2 (1964). - Electronic transmitters BS: 6447. - Bourdon tube pressure and vacuum gauges - IS: 3624 - 1966. - Process operated switch devices (Pr. Switch) BS-6134. Flow Measurements Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II. Measurement of fluid flow in closed conduits - BS-1042. Electronic Measuring Instrument & Control Hardware/ Software - Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS: 9319. - Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. - Compatibility of analog signals for el ectronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro	
20.	4.	Dynamic response testing of process control instrumentation ISA - S 26 (1968).			
	5.	Surge Withstand Capability (S WC) tests - A NSI C 37.90 a/IE EE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.			
	6.	Printed circuit boards - IPC TM - 650, IEC 326 C.			
	7.	General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.			
	8.	Edge socket connectors - IEC 130-11.			
	9.	Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.			
	10.	Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).			
	11.	Direct acting electrical indicating instrument - IS: 1248 - 1968 (R).			
	12.	Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.			
	13.	Information Processing Systems - Local Area Networks - Part 2: Logical Link Control - IEEE-802.2 - 1989.			
	14.	Standard for Local Area Networks: Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.			
	15.	Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.			
	16.	Standard for Local Area Networks: Token - Passing Bus Access Method - IEEE-802.4 - 1985.			
	17.	Standard for Local Area Networks: Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.			
	18.	IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.			
	19.	Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.			
	20.	Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.			
	21.	Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.			
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22.	Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3: Radiated Electromagnetic Field Requirements - IEC 801-3-1984. Instrument Switches and Contact 1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000. 2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600. Enclosures 1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) throu gh 110.22 (Type 4 to 13). 2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972). 3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962. Apparatus, enclosures and installation practices in hazardous area 1. Classification of hazardous area - NFPA 70 - 1984, Article 500. 2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973. 3. Intrinsically safe apparatus - NFPA 493 1978. 4. Purged an d pressurised enclosure for electrical eq uipment in hazardous location - NFPA 496-1982. 5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977. Annunciators 1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979. 2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472 3. Damp heat cycling test - IS:2106 4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78			
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	Protections 1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989. 2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS: 6875 (Part-I) - 1973. 3. Turbine water damage prevention - ASME TDP-1-1980. 4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991. UPS System 1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973. 2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983. 3. Surge withstand capability test - ANSI C 37.90 1 -1989. 4. Performance testing of UPS - IEC 146. 5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991. 6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985. 7. Printed Circuit Board - IPC TM 650, IEC 326C. 8. General Requirements & tests for printed wiring boards, IS: 74 05 (Part-I) 1973. Control Valves 1. Control valve sizing - Compressible & Incompressible fluids - IS A S 75.01-1985. 2. Face to face dimensions of control valves - ANSI B 16.00 - 1973. 3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2). 4. Codes for pressure piping - ANSI B 31.1 5. Control Valve leak class - ISA RP 39.6	
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	Process Connection & Piping - Codes for pressure piping "power piping" - ANSI B 31.1. - Seamless carbon steel pipe ASTM - A - 106. - Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. - Material for socket welded fittings - ASTM - A - 105. - Seamless ferritic alloy steep pipe - ASTM - A - 335. - Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234. - Composition bronze of ounce metal castings - ASTM - B - 62. - Seamless Copper tube, bright annealed - ASTM - B - 168. - Seamless copper tube - ASTM - B - 75. - Dimension of fittings - ANSI - B - 16.11. - Valves flanged and butt welding ends - ANSI - B - 16.34. Instrument Tubing - Seamless carbon steel pipe - ASTM - A 106. - Material of socket weld fittings - ASTM - A105. - Dimensions of fittings - ANSI - B - 16.11. - Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1. Cables - Thermocouples extension wires/cables - ANSI MC 96.1 - 1992. - Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE: 0815. - Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions through 2/83. - Insulation & Sheathing compounds for cables: VDE 0207 (Part-4, 5 & 6). - Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.	
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14.	6. Rules for Testing insulated cables and flexible cables: VVDE - 0472			
	7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)			
	8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.			
	9. Oxygen index and temperature index test - ASTM D - 2863.			
	10. Smoke density measurement test - ASTM D - 2843.			
	11. Acid gas generation test - IEC - 754 - 1.			
	12. Swedish Chimney test - SEN - 4241475 (F3).			
	13. Teflon (FEP) insulation & sheath test - ASTM D - 2116.			
	Thermocouple compensating cables - Testing requirements & sampling plan IS: 8784.			
	15. PVC insulated electric cables for working voltage upto and including 1100 V - IS: 1554 (Part-I).			
	Cable Trays, Conduits			
	1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.			
	2. -do- Test Standards. NEMA VE-1-1979.			
	3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78.			
Public Address System				
1. Specifications for loud speakers - IS: 7741 (Part-I, II and III)				
2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301				
3. Specification for Public Address Amplifiers - IS: 10426.				
4. Code of practice for outdoor installation of PA system - IS: 1982.				
5. Code of practice for installation for indoor amplifying and sound distribution system - IS: 1881.				
6. Basic environmental testing procedures for electronic and electrical items - IS: 9000.				
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro		
	7. Characteristics and methods of measurements for sound system equipment - IS: 9302 8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS: 732 9. Rigid steel conduits for electric wiring - IS: 9537 (Part-I and II) 10. Fittings for rigid steel conduits for electrical wiring - IS: 2667 11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS: 2147. Vibration Monitoring System 1. API 670 - 1994 2. BS: 4675 Part-2			
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	ANNEXURE-II				
	<u>NUMBER OF COPIES OF DRAWING AND DOCUMENTS</u>				
	Sl. No.	DESCRIPTION NO.	OF PRINTS	NO. OF ROMs/Soft Copies	CD- NO. OF MANUALS (SETS)
	1.	PLANT DEFINITION MANUAL	- 3	CD-ROMs	10
	2.	Drawings "FOR APPROVAL"	6	1 CD-ROM or Soft Copies by E-Mail	-
	3.	Drawings "FOR INFORMATION"	4	1 CD-ROM or Soft Copies by E-Mail	-
	4.	Drawings "FINAL DRAWING"	10	3 CD-ROMs	-
	5.	Drawings "AS BUILT"	10	3 CD-ROMs	-
	6.	DATA SHEETS, DESIGN CALCULATIONS, PURCHASE SPECIFICATIONS, etc. and Other type of documents.			
	i)	For Approval	4	3 CD-ROMs/Soft Copies by E-Mail	-
	ii)	FINAL	10	3 CD-ROMs	-
	iii)	Analysis reports of equipments / structures components / systems employing software packages as detailed in the specifications			
		a) Input	4 3CD-ROMs		-
		b) Output	4 3CD-ROMs		-
		c) Drawings / Sketches	4 3CD-ROMs		-
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	Sl. No.	DESCRIPTION NO.	OF PRINTS	NO. OF ROMs/Soft Copies	CD- NO. OF MANUALS (SETS)	
	7.	Erection manual "DRAFT"	-	1 CD-ROM or Soft Copies by E-Mail	4	
	8.	Erection manual "FINAL"	-	3CD-ROMs	10	
	9.	Operation & Maintenance manual "DRAFT"	1	1 CD-ROM or Soft Copies by E-Mail	4	
	10.	Operation & Maintenance manual "FINAL"	-	3CD-ROMs	10	
	11.	Plant Hand Book "DRAFT"	1	1 CD-ROM or Soft Copies by E-Mail	4	
	12.	Plant Hand Book "FINAL"	3	3 CD-ROMs	10	
	13.	Commissioning and Performance Procedure manual "DRAFT"	1 3	CD-ROMs/Soft Copies by E-Mail	4	
	14.	Commissioning and Performance Procedure manual "FINAL"	1 3	CD-ROMs	10	
	15.	Performance and Functional Guarantees test report	8 3	CD-ROMs		
	16.	Progress Reports	8	3 CD-ROMs/Soft Copies by E-Mail		
	17.	Project completion report	15	3 CD-ROMs	-	
	18.	QA programme including Organisation for implementation and Q A system manual (with revision servicing)	15 3	CD-ROMs	-	
	19.	Vendor details in respect of proposed vendors, including Contractor's evaluation report.	1 -		-	
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	Sl. No.	DESCRIPTION NO.	OF PRINTS	NO. OF ROMs/Soft Copies	CD-	NO. OF MANUALS (SETS)
	20.	Manufacturing QP's, Field QPs, Field welding schedules and their reference documents like test procedures, WP S, POR etc.				
		i) For review / comment	3	-		-
		ii) For final approval	4	1 CD-ROM		
	21.	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals				
		i) Draft	-	-		4 sets
		ii) Final	-	2 CD-ROMs		4 sets
	22.	Monthly Vendor Approval and QP approval status	2	1 CD-ROM or Soft Copies by E-Mail		
	23.	QA Documentation package for items / equipment manufactured and despatched to site.	2 2	CD-ROMs		
	24.	QA Documentation Package for field activities on equipment / system at site.	2 2	CD-ROMs		
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		ANNEXURE-III									
1.00		EQUIPMENTS									
		GROUND COLOUR			IDENTIFICATION TAG/BAND						
Sl. No.	Equipment	Colour	RAL	Colour	ISC No.	Equi- valent RAL No.	Remarks				
		TG SET									
1. Turbine		Blue	5012	White		9010	Legend in black letters				
2. Main	generator	Blue 5012		White		9010	Legend in black letters				
3.		Pumps									
	Lube oil	Grey	9002	White		9010	Legend in black letters				
4. Va	Ives, gates, filters	Grey 9002		White		9010	Legend in black letters				
5. Turbine	Oil System	Grey	9002	White		9010	Legend in black letters				
6.	Hand rails	Blue	5012				Wherever required otherwise SS or GI				
7.	Pipe supports	Black	9011								
8.	Gratings (non- galvanised)	Black 9011									
9.	Air ducts	Grey	9002	White		9010	Legend in				
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9				TECHNICAL SPECIFICATION SECTION –VI			PART-C		PAGE 66 OF 95		

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		GROUND COLOUR		IDENTIFICATION TAG/BAND			
Sl. No.	Equipment	Colour	RAL	Colour	ISC No.	Equi- valent RAL No.	Remarks
							black letters.
10.	FANS	Grey	9002	White		9010	Legend in Black Letters.
11. St	structural steel work fabricated at site	Grey	9002				
HP AND LP COMPRESSED AIR SYSTEM							
12. Compressors	with inter and after coolers	Blue	5012	White		9010	Identifying legends to be used.
13. Heater/Driver s		Grey	9002	White		9010	-
14.	Air receivers	Blue	5012	White		9010	Legend in black letters
MISCELLANEOUS EQUIPMENTS							
15. Cranes		Golden Yellow	1004	White		9010	
	- Mono Rails & chain pulley systems	Golden Yellow	1004				
16. Hooks		Signal Red	3001				
17.	Tanks	Grey	9002	white			Legend in Black letters
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		GROUND COLOUR		IDENTIFICATION TAG/BAND			
Sl. No.	Equipment	Colour	RAL	Colour	ISC No.	Equi- valent RAL No.	Remarks
18. Doors	industrial type	Blue	5012				
19. Hyd	raulic power unit	Golden Yellow	1004 Signal	Red	537	3001	
20.	Fencing	Black					
21. Lighting	poles	Aluminium					
	ELECTRICAL COMPONENTS						
22.	MAIN GENERATOR						
	- Lub system oil	Grey 9002		White		9010	Legend in Black Letters
	- Seal Oil System						
	- Stator Water Sys.	Grey 9002		White	9010		Legend in Black Letters
23.	DIESEL GENERATOR SET						
	- Diesel Engine	Grey	9002	White		9010	
	- Generator	Grey	9002	White		9010	
24.	L.T. TRANSFORMERS						
	- Indoor	Blue	5012				Legend in Black Letters
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		GROUND COLOUR		IDENTIFICATION TAG/BAND					
Sl. No.	Equipment	Colour	RAL	Colour	ISC No.	Equi- valent RAL No.	Remarks		
	- Outdoor	Blue	5012				Legend in Black Letters		
25. 33	KV class transformers	Blue 5012		Signal Red	537 3001				
26 G	enerator bus duct	Blue 5012		Signal Red	537 3001				
27. Ba	ttery charger	Grey 9002		White		9010			
28. Mimic	flow diagram								
	220 KV	Purple Violet	4007 White			9010			
	33.0 KV	Olive Green	6003 White			9010			
	11.0 KV	Zink Gleb	1018	White		9010			
	415 V	Lehm Braun	8003 White			9010			
	220V DC	Tief Orange	2011						
	Gen Fld.	Tiefschw artz	9005						
29.	MOTORS								
	- Indoor	Blue	5012						
	- Outdoor	Blue	5012						
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		GROUND COLOUR		IDENTIFICATION TAG/BAND			
Sl. No.	Equipment	Colour	RAL	Colour	ISC No.	Equi- valent RAL No.	Remarks
30.	LT SWITCHGEAR (INDOOR)						
-	LT Switchgear Exterior	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	- MCC	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	- D.C. Distribution board	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	L.T. busduct outside of enclosures	Blue	5012				
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		GROUND COLOUR		IDENTIFICATION TAG/BAND			
Sl. No.	Equipment	Colour	RAL	Colour	ISC No.	Equi- valent RAL No.	Remarks
31.	33 KV SWGR cubicle	Grey & Blue	9002 5012				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
	- CR Panels	Grey	9002				
	- Surge protection cubicle	Grey	9002				
32. DDCMIS	PLC system cabinets, computer system cabinets, Termination, Marshalling, Relay Panels etc.	Blue & Grey	5012 & 9002				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
33. AI	Locally mounted C&I systems panel/ cabinets	Blue & Grey	5012 & 9002				Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012)
34 Junction	boxes	Grey 9002					
35 LIE	/LIR	Grey	9002				
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		GROUND COLOUR		IDENTIFICATION TAG/BAND			
Sl. No.	Equipment	Colour	RAL	Colour	ISC No.	Equivalent RAL No.	Remarks
36 Remote	I/O cabinets	Grey 9002					
37 Intercom	Equipment						
-	Hand sets unit	Grey	9002				
	- Hand sets plant	Grey 9002					
38 -	Metal containers/ cable junction boxes	Grey	9002	White		9010	-
39.	LIGHTING EQUIPMENT/PANELS						
	- Exterior	Grey	9002				
40.	INSULATING OIL TREATMENT PLANT						
	- Tanks and the equipment	Grey	9002	White		9010	Legend in Black Letters
41.	IDENTIFICATIONS PLATES						
	Mechanical equipment's and piping						
-	Background	White	9010				
	- Border	Black	9011				
	- Lettering	Black	9011				
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2.00	Note: 1) For mechanical equipments ground colour indicated against each equipment shall be followed in case equipment is not insulated/cladded.								
	2) However if enclosure is provided for the mechanical equipments, then the indicated ground colour for mechanical equipment shall be followed								
	PIPELINES								
			Ground Colour		Identification Tag/ Band Colour				
	S. No.	Medium	Colour	RAL	COLOUR	ISC No	RAL #	Legend	Remarks
	1.	WATER							
	a. Untreated or Raw/ service	Grey	9002	Sea Green	217		RW/SW		
	b. Treated	Grey	9002	Sea Green	217		PW		
	2.	AIR							
	a. Instrument	Grey	9002	Sky blue	101		IA		
	b. Service/ Plant	Grey	9002	Sky blue	101		PA		
	3.	OILS							
	a. High speed diesel	Grey	9002	Light brown	*	410		HSD	* Hazard Mark
b. Lubricating oil	Grey	9002	Light brown		410		LO	* Hazard Mark	
c. Hydraulic	Grey	9002	Light		410		HYD.O		
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		Ground Colour		Identification Tag/ Band Colour					
S. No.	Medium	Colour	RAL	COLOUR	ISC No	RAL #	Legend	Remarks	
	power brown								
d. Control fluid		Grey 9002		Light brown	410		CR.O		
e. Transformer oil		Grey 9002		Light brown	410		TR.O		
4.	FIRE INSTALLATIONS	Fire Red	536 (ISC) 3001 (RAL)	White		9010	FIRE	Legend in Red Letters over White Background	
Note : 1.		Ground colour indicated against each piping shall be followed in case piping is not insulated /cladded.							
2		For any equipment not covered above, colour codification shall be furnished by employer during detail engineering.							
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1.00.00	ANNEXURE-IV <u>SURFACE TREATMENT AND COATINGS</u> Object: The present specifications apply to equipment and spare part surface coating. They define surface coating, the types of recommended coating, and the associated guarantees. In any case, the Contractor shall submit to the Employer his coating schemes. CORROSION PROTECTION The Contractor shall take all necessary favorable measures to protect equipment from all abnormal corrosion and, taking into account project specific risks. In particular, the Contractor shall choose the materials most suited to this project and shall submit a modification request to the Employer when the materials indicated in the specifications are considered unable to guarantee its behaviour against corrosion.			
	1.01.00 Equipment in Contact with Reservoir Water. For all equipment on the water conveyance circuit (trashracks, valves, pipes, pump turbines instruments), the use of uncoated carbon steel is prohibited, even where corrosion allowance is planned. If he considers it necessary, the Contractor may apply stainless steel cladding to some carbon steel parts, or manufacture these parts in solid stainless steel.			
	1.01.01 Outdoor Exposed Equipment. Among these equipment can be distinguished: those figuring as the subject of a particular specification, and for which the nature of materials and corrosion protection is clearly defined, those which, unlike the above, are not functional in nature and so are not subject to the same attention regarding problems of corrosion: parapets, gratings, lighting poles, etc. Even this second category of equipment shall be subject to particular attention with regard to choice of materials and corrosion protection. In general, attention shall be paid to taking constructive measures or acquiring standard equipment, whatever the function, to avoid any water build-up. Such constructive measures are, for example: for constructive using structural sections (dam gates, stop logs), that all horizontal sheet metal sections have drainage holes at regular intervals, for auxiliary structures, embedding holes shall be completely filled with concrete, taking care to avoid any break in corrosion protection where concrete is exposed to the air.			
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2.00.0	GENERAL The Contractor shall provide a complete and reliable surface treatment of the equipment furnished for corrosion protection. Surface protection shall comprise: A surface preparation phase with mechanical cleaning, grit blasting or chemical cleaning, a surface treatment phase with either metallizing and application of one or two priming coats suited to the type of metal surface, or application of priming coat, an application phase with several coatings of products, including final colored coat. Surface protection shall be performed either in the Contractor's shops or on site with the necessary precautions taken. Finishing touch-ups shall be performed on site upon completion of erection.			
3.00.00	SURFACE PREPARATION. All surfaces to be coated shall first be mechanically or chemically cleaned.			
3.01.00	MECHANICAL CLEANING. Surfaces shall be mechanically cleaned using one of the following methods: shot-blasting or grit blasting, scraping, stripping, mechanical brushing.			
3.01.01	SHOT-BLASTING OR GRIT BLASTING. If mineral abrasives are used, they shall be selected in compliance with the prevailing regulations concerning workers' safety. The required care levels of surface states after cleaning are defined by the illustrations in standard ISO 8501, or equivalent. The required care shall be as follows: ◆ preparation of steel surfaces to be imbedded set in concrete = Level 1, ◆ preparation of steel surfaces to receive definitive protection = Level 2.5, ◆ preparation of steel surfaces to receive metallized protection = Level 3. The roughness of the cleaned surfaces shall be $Ra = 12.5 \mu m$, except for surfaces that shall be metallized later, for which the roughness shall be $Ra = 6.3 \mu m$.			
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3.01.02	SCRAPING, STRIPPING, MECHANICAL BRUSHING. This type of cleaning shall concern: ◆ Parts to be set in concrete, which shall not be coated. These parts shall be brushed immediately prior to concreting. ◆ Repair of defective surface coating. In this case, cleaning by scraping, stripping or brushing shall only be performed if shot-blasting or grit blasting is impossible. The required care shall be as follows: ◆ St 2 for surfaces which shall subsequently receive a definitive coating. ◆ St 1 for surfaces to be set in concrete with no surface protection. After cleaning, all surfaces shall be thoroughly dusted.	
3.01.03	SURFACE PROTECTION REPAIR Before surface protection is repaired, the old protection shall be partially or entirely removed. A new defects liability period shall start as soon as the zone in question has been repaired. The old coating shall be completely removed by shot-blasting or grit blasting, in compliance with the specifications in 3.01.01. If this process is impossible, the old coating shall be removed by scraping, stripping or mechanical brushing, in compliance with the specifications in 3.01.02.	
4.00.00	CHEMICAL CLEANING All traces of pollution shall be removed with solvents (degreasing, neutralisation). The surfaces shall then be rinsed and dried (with special cleaning paper). The Contractor shall submit, for the Employer's approval, a list with the characteristics of the solvents that he intends to use.	
5.00.00	SURFACE TREATMENT Immediately after surface preparation, the Contractor shall employ one of the following three surface treatment processes:	
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6.00.00	METALIZING Metalizing shall be performed within 2 hours after preparation. The chemical composition of the metal used shall be: 85 % Zinc - 15 % Aluminum. The thickness shall be 120 μm. Application shall be by spray gun in compliance with ISO standard R 2053. After metalizing, pores shall be plugged by applying a wash primer, or, if the equipment is intended for immersion, by applying a thin coat of zinc epoxy (max. 20 μm).	
7.00.00	HOT GALVANIZING This coating performed by quenching shall have the following characteristics: ◆ minimum unit mass : 5g/dm², ◆ average thickness : 70 μm This process shall be used when metalizing cannot be performed under satisfactory conditions.	
8.00.00	PRIMING COAT APPLICATION This coating shall have the following characteristics: ◆ product : zinc epoxy coat, ◆ thickness : minimum 40 μm.	
9.00.00	APPLICATION OF THE PROTECTION The Contractor shall carefully control relative humidity and temperature before and during applying any coating. In any case, the relative humidity shall not exceed 80%. All traces of condensation shall be eliminated before protection is applied. If the relative humidity remains between 50 and 80%, the first coat shall be applied four (4) hours after the surface preparation. The undercoats or finish coats shall be applied in compliance with the drying time required between each application. Each coat shall be of a different color.	
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10.00.00	TOUCH-UPS If more than 20 % of the total surface area of a given zone shall be touched-up, the Contractor shall replace the surface treatment over the entire surface.								
11.00.00	PROTECTION OF THE SURROUNDING SURFACES The Contractor shall take every measure to protect the surrounding equipment and surfaces from product spattering, and from any damage caused by the surface preparation that he performs. Equipment or surfaces that are soiled or deteriorated in spite of these measures shall be repaired or cleaned, or if this is impossible, replaced at the Contractor's expense.								
12.00.00	CARBON STEEL - STAINLESS STEEL CONNECTION When carbon steel and stainless steel parts are connected, the surface coating shall be prolonged by 50 cm on the stainless steel part.								
13.00.00	TYPES OF COATING The coatings to be applied, except when expressly stipulated otherwise in the equipment specifications, shall be defined as follows:								
14.00.00	CARBON STEEL SURFACES IN CONTACT WITH WATER <table border="1"><thead><tr><th>System chosen</th><th>Thickness</th></tr></thead><tbody><tr><td>• 1 zinc epoxy priming coat</td><td>40 µm</td></tr><tr><td>• 2 or 3 coats of epoxy-coal pitch finishing paint</td><td>2 x 225 or 3 x 150 µm</td></tr></tbody></table> The system's minimum thickness shall be 450 µm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.			System chosen	Thickness	• 1 zinc epoxy priming coat	40 µm	• 2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 µm
System chosen	Thickness								
• 1 zinc epoxy priming coat	40 µm								
• 2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 µm								
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15.00.00	CARBON STEEL SURFACES IN CONTACT WITH AIR AND INSTALLED OUTSIDE								
	<table><tr><th>System chosen</th><th>Thickness</th></tr><tr><td> 1 epoxy priming coat </td><td>40 µm</td></tr><tr><td> 2 or 3 coats of epoxy-coal pitch finishing paint </td><td>2 x 225 or 3 x 150 µm</td></tr></table> The system's minimum thickness shall be 450 µm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.				System chosen	Thickness	1 epoxy priming coat	40 µm	2 or 3 coats of epoxy-coal pitch finishing paint
System chosen	Thickness								
1 epoxy priming coat	40 µm								
2 or 3 coats of epoxy-coal pitch finishing paint	2 x 225 or 3 x 150 µm								
16.00.00	CARBON STEEL SURFACES UNDER COVER THAT STILL RISK CONDENSATION								
	<table><tr><th>System chosen</th><th>Thickness</th></tr><tr><td> - Zinc epoxy priming coat </td><td>40 µm</td></tr><tr><td> 2 coats colored solvated epoxy pitch </td><td>2 x 150 µm minimum</td></tr></table> The system's minimum thickness shall be 300 µm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.				System chosen	Thickness	Zinc epoxy priming coat	40 µm	2 coats colored solvated epoxy pitch
System chosen	Thickness								
Zinc epoxy priming coat	40 µm								
2 coats colored solvated epoxy pitch	2 x 150 µm minimum								
17.00.00	CARBON STEEL SURFACES UNDER COVER WITH NO RISK OF CONDENSATION								
	<table><tr><th>System chosen</th><th>Thickness</th></tr><tr><td> - Zinc epoxy priming coat </td><td>50 µm</td></tr><tr><td> 2 coats colored solvated epoxy pitch </td><td>2 x 100 µm minimum</td></tr></table> The system's minimum thickness shall be 200 µm. The complete protection shall be applied in the shop, except when expressly waived by the Employer, and on site intervention shall be limited to touch-ups.				System chosen	Thickness	Zinc epoxy priming coat	50 µm	2 coats colored solvated epoxy pitch
System chosen	Thickness								
Zinc epoxy priming coat	50 µm								
2 coats colored solvated epoxy pitch	2 x 100 µm minimum								
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18.00.00	CARBON STEEL SURFACES IN CONTACT WITH OIL										
	<table><tr><th>System chosen</th><th>Minimum thickness</th></tr><tr><td> 2 coats of epoxy-polyamide paint containing aluminum </td><td>2 x 75 µm minimum</td></tr></table>		System chosen	Minimum thickness	2 coats of epoxy-polyamide paint containing aluminum	2 x 75 µm minimum					
System chosen	Minimum thickness										
2 coats of epoxy-polyamide paint containing aluminum	2 x 75 µm minimum										
19.00.00	The Contractor shall ensure that the paint chosen is compatible with the oil in contact. The complete protection shall be applied in the shop.										
	TEMPORARY PROTECTION OF GROOVES										
	The grooves, along with an area from 100 to 150 mm on either side of them, shall receive a temporary protective coating, according to the following system:										
	<table><tr><th>System chosen</th><th>Minimum thickness</th></tr><tr><td> 1 coat of weldable epoxy-zinc paint </td><td>40 µm</td></tr></table>		System chosen	Minimum thickness	1 coat of weldable epoxy-zinc paint	40 µm					
System chosen	Minimum thickness										
1 coat of weldable epoxy-zinc paint	40 µm										
20.00.00	The complete protection shall be applied in the workshop.										
	TEMPORARY PROTECTION FOR MACHINED SURFACES										
	The surfaces shall be degreased, rinsed and dried before application of the temporary protective coatings.										
	<table><tr><th>System chosen</th><th>Minimum thickness</th></tr><tr><td>Solvented corrosion resistant paint</td><td></td></tr><tr><td> 2 coats for oxidizing surfaces </td><td>2 x 35 µm</td></tr><tr><td> 1 coat for non-oxidizing surfaces </td><td>1 x 35 µm</td></tr></table>		System chosen	Minimum thickness	Solvented corrosion resistant paint		2 coats for oxidizing surfaces	2 x 35 µm	1 coat for non-oxidizing surfaces	1 x 35 µm	
System chosen	Minimum thickness										
Solvented corrosion resistant paint											
2 coats for oxidizing surfaces	2 x 35 µm										
1 coat for non-oxidizing surfaces	1 x 35 µm										
21.00.00	The protection shall be applied in the shop and eliminated on site before erection, using a rag impregnated with a solvent compatible with the materials temporary protected.										
	CONDENSATION PROTECTION										
	The Employer and the Contractor shall mutually agree on the products to be used.										
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC हाइड्रो hydro										
22.00.00	SPARE PARTS The spare part s' surface coating shall be applied in compliance with the prese nt specifications. All temporary surface protections (until the spare parts are used) shall be designed to last for 15 years storage of the parts.												
23.00.00	COLOR OF THE FINISH COAT The Employer shall define the color of the finish coat.												
24.00.00	PROTECTION THICKNESS Protection thickness shal l be checked in compliance with th e following specifications:												
24.01.00	Number of measurement points The number of measurement points is defined in the following table: <table><tr><th>Size of the surface to be tested (reference zone, in m² or in linear meter))</th><th>Number of measuring points recommended</th></tr><tr><td>< 10</td><td>10 to 20</td></tr><tr><td>10 to 100</td><td>20 to 50</td></tr><tr><td>1 00 to 1000</td><td>50 to 100</td></tr><tr><td>1 000 to 10000</td><td>100 to 200</td></tr></table>			Size of the surface to be tested (reference zone, in m² or in linear meter))	Number of measuring points recommended	< 10	10 to 20	10 to 100	20 to 50	1 00 to 1000	50 to 100	1 000 to 10000	100 to 200
Size of the surface to be tested (reference zone, in m² or in linear meter))	Number of measuring points recommended												
< 10	10 to 20												
10 to 100	20 to 50												
1 00 to 1000	50 to 100												
1 000 to 10000	100 to 200												
24.02.00	Tolerance on system minimum thickness Spot measurements less than the min imum thickness shall be accepted if b oth following conditions are fulfilled: ♦ the average of all the measurements performed on the reference zone is equal to or greater than the required minimum value, and ♦ no measurement point is less than 80% of the required minimum value. In case of non-compliance with the criteria listed here above, the Contractor shall be obliged to touch up surface protection, either locally or completely. The touch-up procedure shall be submitted to the Employer.												
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25.00.00	PRODUCT CHARACTERISTICS DATA SHEET For each product, the Contractor shall provide a characteristics data sheet specifying: ◆ the manufacturer's references, ◆ product characteristics, ◆ application conditions. The Contractor shall submit a model data sheet to the Employer. This sheet shall then be used for all surface protection works.			
26.00.00	PAINT/COATING QUALITY CONTROL SHEET During coating operations, the Contractor shall follow quality control procedure as agreed between the Employer and the Contractor:			
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	ANNEXURE - V			
	TRAINING FOR ELECTRO-MECHANICAL PERSONNEL			
SI No.	Description of Training	Training Duration	Place of Training	Number of Trainees from Employer
1.00.00	Training During Engineering / Manufacturing Phase			
1.01.00	TURBINE, GOVERNING & AUXILIARIES			
1.01.01	Design & Quality Assurance (a)Turbine, Governing & Auxiliaries • System description, Specific Design and engineering & Quality Assurance concepts for the offered equipment. Selection criterion for the Turbine, Governing and auxiliaries. (b) Turbine Hydraulic characteristics • Significance of Model & Model Testing • Visit to Hydraulic Lab • Explanation of Model Test Report (Efficiency , Runway speed and Hydraulic Transient) (c) Mechanical Characteristics • Construction & Quality Assurance of Turbine Components (d) Study of Manufacturing & Quality Assurance Process • Shop Tour • Manufacturing Process of Key Components	10 Days	Manufacturers works	5
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SI No.	Description of Training	Training Duration	Place of Training	Number of Trainees from Employer	
1.01.02	Operation & Maintenance • Brief description of Turbine, Governing & Auxiliary Systems • Shop Tour • Instruction to Assembly and Disassembly of Unit. • Operation & Maintenance Practices • Trouble shooting	10 Days	Manufacturers works	5	
1.02.00	GENERATOR, GENERATOR EXCITATION SYSTEM INCLUDING AVR AND AUXILIARIES				
1.02.01	Design & Quality Assurance • Design, Dimensioning, Testing & Quality Assurance aspects of Generating System, Insulation system, Cooling medium and arrangement, Winding and core support system and other auxiliary systems. • Familiarization with different sub-systems & their process controls. • Study of Manufacturing Process & Quality Assurance aspects for Core, Winding, and Assembly. • Shop Tour • Testing & Inspection Facilities familiarization. • Functioning at reference plants	10 Days	Manufacturers works	5	
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SI No.	Description of Training	Training Duration	Place of Training	Number of Trainees from Employer			
1.02.02	Operation & Maintenance - Brief description of Generator, excitation system, AVR & Auxiliary Systems - Shop Tour - Instruction to Assembly and Disassembly of equipments - Operation & Maintenance Practice	10 Days	Manufacturer's works	5			
1.03.00	SUBSTATION AUTOMATION SYSTEM - Design & Quality Assurance aspects of various sub-systems, - Relay configuration, control configuration, setting calculations & Testing	5 Days	Manufacturer's works	4			
2.00.00	TRAINING DURING ERECTION/ INSTALLATION/ SITE WORK - Lecture Hall Training by Contractor's Experts (besides demonstration at site)		SITE AND LECTURE HALL AT RAMMAM STAGE-III PROJECT				
	Imparting On the job Training (including training on Assembly & dismantling) at site to employer's Project Manager(s), associated during Erection, Installation / site work						
	(a) Turbine & Mechanical Aux.	10 Days		8			
	(b) Generator, Excitation System & Electrical Aux.	10 Days		8			
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SI No.	Description of Training	Training Duration	Place of Training	Number of Trainees from Employer	
(c)	) Switchyard	2 Days		5	
	(d) Substation Automation System	2 Days		5	
3.00	TRAINING DURING TESTING & COMMISSIONING - Lecture Hall Training by Contractor's Experts besides demonstration at site (including training on Assembly & dismantling, O&M and Trouble Shooting.		SITE AND LECTURE HALL AT RAMMAM STAGE-III PROJECT		
	(a) Turbine & Mechanical Aux.	10 Days		8	
	(b) Generator , Excitation System & Electrical Aux.	10 Days		8	
	(c) Switchyard	3 Days		5	
	(d) Substation Automation System	3 Days		5	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro		
2.02.00	◆ LCU maintenance ◆ Telecommunication maintenance ◆ Historical data server maintenance ◆ Log station maintenance ◆ Plant Computer Maintenance ◆ Closed Circuit Television maintenance ◆ Public Address System maintenance It shall cover: ◆ Operation from the power house Control Room, ◆ Operation from the Spillway Control Room, ◆ Operation from the switchyard Control Room, ◆ Operation from local control boards, at each location, ◆ Operation from drive control boards, ◆ Operation from each Operator Workstation, ◆ Monitoring from remote operator workstation in the Employer's OS control room. ◆ Engineering functions of the engineering station Operation training shall be provided on site during commissioning. Hardware and equipment training The Contractor shall provide SCADA System hardware maintenance training and equipment training at the Contractor's premises. This training shall include at least the following: ◆ Basic studies: • processor, • hardware configuration, • electronic board and bus configuration, • tests,			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro		
2.03.00	• network, • functional architecture. ♦ Detailed studies: • plant computer, • operator workstation, • engineer station, • Local supervision station, • local control units, • internal communication network, • interface devices • synchronization devices of the unit on the grid, • UPS, • clock synchronization and distribution equipment Software maintenance training The Contractor shall provide real time software maintenance training at the Contractor's premises. This training shall include at least the following: ♦ Basic studies: • operating system, • operating system nucleus, • data base kernel, • diagnostic programs, • application programs. ♦ Detailed studies: • modification of the data base, • modification of views, • system fault management,			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC हाइड्रो hydro
3.00.00	• start/stop , • communication ♦ Process description: • normal operation, • process fault management. • Emergency operation			
	DURATION AND TRAVEL			
	The duration and number of trips indicated in the table hereafter are to be considered as minimum.			
		Location	Number of trainees	Duration of training
	Training in operation & maintenance	RAMMAM STAGE-III PROJECT SITE	10 10	days
Hardware and Equipment Training -Basic studies -Detailed studies -Equipment	Manufacturer's Premises	5	10 days	
Software Maintenance Training - Basic studies - Detailed studies - Process description	Manufacturer's Premises	5 10	days	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC हाइड्रो hydro
	ANNEXURE-VII <u>NOISE</u> <u>OBJECT:</u> THE PRESENT SPECIFICATION DEFINES ACCEPTABLE NOISE LEVELS IN THE POWER STATION, ASSOCIATED PREMISES AND OUTSIDE THE POWER STATION ENCLOSURES.	
1.00.00	GENERAL The Contractor shall be responsible for the noise emitted by his equipment within its immediate environment and the areas around it.\ Generally, the Contractor shall attempt to reduce the noise emitted by his equipment, whatever its nature (impact, transmitted, echo, etc.), and shall analyse at an early stage the effects of installing noise reduction devices on neighbouring civil works structures or equipment. This shall apply to all type of normal operation, including the transient states between one operating mode and another.	
2.00.00	SOUND LEVELS The noise emitted by the equipment shall be evaluated according to sound pressure levels expressed in decibels in compliance with IEC/IS or equivalent.	
2.01.00	Outside Installations' noise impact on the environment shall be limited. If necessary, the Contractor shall fit his equipment with noise reduction devices, such as covers or silencers.	
2.02.00	Within Premises	
2.02.01	Control Room, Offices Noise levels shall not exceed 60 dB (A) in the control room and in offices that are not always in use; in offices in permanent use levels shall not exceed 45 dB(A).	
2.02.02	Power Station Noise Level The equivalent 'A' weighted sound pressure level measurement at a height of 1.5 M above floor level in elevation and at a distance of one (1) M horizontally from the nearest surface of any equipment/machine, furnished and installed under these specification, expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dB(A) except for premises where access is prohibited when equipments are in service, like operation area of runner, thrust bearing, and generator, where no noise limit shall be imposed.	
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2.03.00	The method proposed for measurement shall be in accordance with the relevant standards/norms and shall be submitted to the Employer for acceptance. Noise Attenuation The Contractor shall use all possible solutions to attenuate noise produced by his equipment, and in particular: • Installation of sound-proofed doors for access to high noise level rooms (e.g. generator), • sufficient thick casing around the noisy parts of units, • installation of covers on some auxiliaries, In all cases, whatever sound-proofing methods are used, care shall be taken to seal off all ducts and feed-throughs in walls and enclosures around significant sound sources, in order to comply with specified objectives.			
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	ANNEXURE-VIII <u>VIBRATION CRITERIA</u>			
1.0	GENERAL The Contractor shall design and install his equipment in such a way as to prevent excessive vibrations which may harm his equipment or any neighboring structures and equipment. This shall apply to all types of normal operation, including the transient states between one operating mode and another. Vibrations and shocks to equipment from external sources shall comply with IEC standard 721 (also regarding non-electrical equipment).			
2.0	Acceptance Criteria			
2.1	Turbine-Generator Unit			
2.1.1	Balancing The Contractor shall balance the unit in accordance with ISO standard 1940. In all cases of normal operation, the criterion shall be fixed at G 6.3 mm/s for the turbine runner. The criterion shall be fixed at G 2.5 mm/s for the generator. The unit's balance shall comply with the conditions stipulated in Clause 2.1.2 of the present specification.			
2.1.2.	Measurements at commissioning			
2.1.2.1	Preliminary vibration analysis At commissioning of the unit, it shall be required to carry out a preliminary vibration analysis, consisting of a spectral analysis of vibration of non-rotating parts (bearings). Each individual peak shall be identified, its level (in mm/s) shall be registered. The recordings shall be transmitted to the Employer, stipulating the test conditions and the recording and sampling parameters. The obtained values shall not be guaranteed.			
2.1.2.2.	Guaranteed vibration levels			
2.1.2.2.1	Acceptance standards At commissioning of the unit, the Contractor shall take vibration measurements in compliance with ISO standard 10 816-5 for the non-rotating parts and ISO standard 7919-5 for the rotating shafts.			
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2.1.2.2.2	Operational conditions Measurements shall be carried out with the machine running under the following stationary conditions: ◆ at no-load - uncoupled, ◆ at no-load - coupled, ◆ at 25%, 50%, 75%, 100% of rated output, ◆ at maximum power. For each power stage, three reactive power levels shall be tested: none, supplied and absorbed. For each power stage, operational temperatures (bearings, etc.) shall be in a steady state.	
2.1.2.2.3	Acceptance criteria for measurements on non-rotating parts The guaranteed values for the 75% and 100% of rated output shall be those indicated in Appendix A of the ISO standard 10816-5. The values taken into account shall be in compliance with this standard for the A/B area. The measurements for the other loads shall be submitted to the Employer and shall not be guaranteed.	
2.1.2.2.4	Acceptance criteria for measurements on rotating shafts The guaranteed values for the 75% and 100% of rated output shall be those indicated in Appendix A of the ISO standard 7919-5. The values taken into account shall be in compliance with this standard for the A area. The measurements for the other loads shall be submitted to the Employer and shall not be guaranteed.	
2.2	Other Rotating Machines (pumps, motors, gearing, fans, etc.) The vibratory level of the machines shall be in compliance with the ISO standard 10816-3 Appendix A/ relevant Indian Standard. The Contractor shall also take all necessary steps to prevent the transmission of vibrations to neighboring structures (specially diesel engines).	
2.3	Other equipment susceptible to causing vibrations (bypass, valves, etc.) The Contractor shall ensure that pressure fluctuations or vortices induced by the flow of water, oil or air do not cause vibrations harmful to equipment, do not transmit vibrations to civil works structures and do not constitute unpleasant acoustic sources. The Contractor shall take all necessary steps to attenuate vibrations, to isolate equipment transmitting vibrations and/ or to ensure that these vibrations do not have harmful effects (adequate dimensioning, resonant frequencies sufficiently distant from excitation frequencies).	
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 MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN					PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:							
		ITEM : SUB-SYSTEM:	QP NO.: REV.NO.: DATE: PAGE: OF....											
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N			M	D*	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: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS 'W'	 FOR NTPC USE	DOC. NO.:		REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER						
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL	

SUPPLIER'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	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
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; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	 FOR NTPC USE	DOC. NO.:		REV.....		
MANUFACTURER/ SUB-SUPPLIER				MAIN-SUPPLIER				
SIGNATURE						REVIEWED BY	APPROVED BY	APPROVAL SEAL



PART-B

SUB-SECTION- M3

E.O.T. CRANES

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT
(3 X 40 MW)
ELECTRO MECHANICAL WORKS
EPC CONTRACT PACKAGE
BIDDING DOC NO.: CS-5602-003-9

TECHNICAL SPECIFICATION
SECTION-VI

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1.00.00	GENERAL TECHNICAL CONDITIONS				
1.01.00	Materials				
1.01.01	General Requirements				
	All materials forming the equipment shall be of first class commercial quality, as normally used for these type of equipment, considering strength, ductility, durability, best engineering practice and the normal or severe operating service to which the equipment will be subjected, free from any defects and imperfections, of recent manufacture and unused, and where indicated, of the classifications and grades designated therein. Materials not specifically described herein shall be the most suitable for the purpose and shall comply with the latest specifications of Bureau of Indian Standards or the American Society for Testing and Materials (ASTM), or approved equivalent standards. If the Contractor desires for any reason to deviate from or use materials not covered by these specifications he shall state the exact nature of the deviation or exception and shall submit for the approval of Employer complete specifications of the materials he proposes to use alongwith the reason of such deviation. All materials, supplies and articles not manufactured by the Contractor shall be the products of recognized reputable manufacturers.				
1.02.00	Design Stresses				
1.02.01	General Criteria				
	Liberal factors of safety shall be used throughout the design and especially in the design of all parts subject to alternating stresses or to shock loading or to most severe operational loadings. The Contractor shall furnish for record of Employer complete information, including computations, regarding the maximum unit stresses used in the design. The life of equipment supplied shall be not less than thirty five (35) years.				
1.02.02	Allowable Unit Stresses				
	Under the most severe operating conditions, the unit stresses in the materials shall not exceed the values shown in Table 1-1.				
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	TABLE - 1.1				
	MATERIAL		MAXIMUM ALLOWABLE STRESS		
	SG/ Grey Cast Iron		One tenth of (1/10) of UTS with a limit of 70 MPa in compression		
	Carbon cast steel & alloy cast steel		1/2 YS		
	Carbon or alloy steel forging		2/3 YS		
	Carbon or alloy steel plates		2/3 YS		
	Under seismic load condition, the maximum stresses shall not exceed 80% of the minimum yield strength of the material used.				
	For other materials, not covered in Table 1.1, used in the construction of cranes and associated equipments, the maximum stresses in tension or compression, due to the most severe conditions occurring in normal operation, shall neither exceed one-third of the yield strength nor one-fifth of the ultimate strength of the material. Maximum stresses in shear shall not exceed 210 kg/cm ² in components made from cast iron and shall not exceed 60 percent of the allowable stresses in tension for other materials.				
	The other sections of these specifications also contain the specific values of allowable stresses for various components of the cranes. These specific values, wherever given, will prevail for the design of corresponding components.				
	1.03.00	Electrical Equipment			
1.03.01	Electric Motors				
	a) All motors shall comply with relevant National or International Standard.				
	b) Contractor shall be fully responsible for determining that the motor duty cycle, rating, performance, tests and mechanical arrangements are all entirely relevant and suitable for compliance with the above standards for the application at the station and in the extreme environmental and site conditions specified.				
	c) The preferred type of A.C. motor is squirrel cage, totally enclosed, fan-cooled, except for single-phase motor with rating under 0.5 kW where Manufacturer's standard types are acceptable, subject to approval of Employer. Motors above 1.0 kW shall be 3-phase type.				
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1.03.02	d) The stator insulation system shall be class-F but in each case, temperature rises shall be limited to Class-B on full continuous rated load. e) All A.C. motors shall be capable of direct on-line starting and of continuous operation at rated output under abnormal frequency conditions. The starting current at full voltage shall not exceed six times the full load current. Each of the motors shall be tested at Manufacturer's works to confirm compliance with this requirement. f) Ball or roller bearings shall be used. Vertical shaft motors shall have approved thrust bearings. Lubrication fittings shall be provided for the bearings. g) The terminal box shall be weatherproof and firmly fixed to the motor frame. The terminal studs shall be so sized as to be adequate for the current duty required and shall be identified. All terminal boxes shall have approved cable adapter plates, sealing chambers or conduit entries. h) The arrangement of the terminal box shall be such as to facilitate installation of cables and allow interchanging of any two phase leads without disturbing the sealing compound, if this is used at cable terminations. i) Where practicable, the motor end cover shall be removable from the driving-end and shall have a removable plug to allow the speed to be checked by means of a portable tachometer. j) All motors having a mass of 50 kg or more shall be fitted with lifting lugs.			
	Starters and Contactors a) Motor starters and contactors shall be equipped with short circuit protection and local disconnected devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/110 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts. b) Starters and contactors shall comply with applicable IS standard or IEC 292.1 or NEMA IC 1 and shall be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Employer. The enclosures shall be complete with the locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards and other necessary items as required by the duty of the starter or contactors.			
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	c) Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage during under voltage condition. d) Thermal type overload and phase failure relays shall be supplied with starters for motors of 7.5 kW or higher rating. For motors of less than 7.5 kW rating, suitable rated 3-phase thermal overloads will be acceptable. Ammeters to monitor current in one phase shall be provided for motors above 7.5 kW. e) Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts.			
1.03.03	Moulded Case Circuit Breakers (MCCB) All moulded case circuit breakers shall be 2-pole or 3-pole, as required, having thermal time delay and instantaneous trips with "On-Trip-Off" indicating / operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The breakers shall comply with the applicable IS specification or IEC 157.1 or equivalent standards.			
1.03.04	Control Relays Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of 10 A over a range of 6 to 600 V AC.			
1.03.05	Pilot Devices a) Pilot devices such as selector switches, push-button stations and thermostats shall be of heavy duty type and where mounted outdoors, shall be housed in weatherproof enclosures specially designed for the extreme condition of environment. b) All electrical contacts for control, alarm and shutdown shall have a thermal current rating of not less than 10A at 220 V DC.			
1.03.06	Instruments/ Meters a) Instruments mounted on panels, shall be of the semi flush type, back connected, matching pattern, shape, and of approved finish to present neat and fitting appearance consistent with functional requirements.			
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1.03.07	b) Mechanical quantity measuring instruments which are directly mounted on equipment shall have circular dials and shall be properly supported and guarded against accidental injury/breakage. These shall be placed in convenient location. c) The instruments shall accurately measure and indicate the quantity under all conditions of operation with minimum instrument errors. Changes in ambient temperature within the range prevailing at site shall not affect the accuracy. d) The reading scales on the dials shall be in metric units only and range shall be such that the normal operating values of the quantities are indicated in the middle 3rd of the scale. e) Contact making instruments shall have contacts suitable for 240 V AC or 220 V DC circuits. f) All instruments shall conform to relevant National or International applicable standards. They shall be subjected to tests prior to despatch. The instruments shall be shock, vibration and moisture proof. The electrical instruments shall withstand dielectric test of 2000 Vrms to ground for one (1) minute as per standards. g) The coils of electrical instruments shall be designed for continuous operation at 110% of the full load current at instrument potential. The coil rating of the measuring instruments shall be co-ordinated with those of the associated Instrument transformers (i.e. CTS, PTs, etc.) by the Contractor. The VA burden of the instruments shall be as low as possible. The meters shall be of the first grade in respect of accuracy classification.			
	Equipment Wiring a) Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilizing slip-on ferrules approved by the Employer. b) Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted. c) Markers must withstand a tropical environment and high humidity and only fungus- proof materials will be accepted. Ferrules of adhesive type are not acceptable. d) All trip circuits shall employ markers having a red background.			
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1.03.08	e) Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only. f) All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point. g) Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly trunked inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipment. h) Multi-conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers or crimp type connectors shall be used to terminate all small wiring. Grommets or insulating bushings shall be installed, where necessary, to avoid chafing of wiring. Cubicles and Panels a) The enclosures of cubicle and panels shall be of sheet steel with minimum thickness of 2.5 mm, of rigid, self-supporting construction and supplied with channel bases. b) Cubicles shall be fitted with close fitting, gasketed, hinged, lift-off doors capable of being opened through 180°. The doors shall be provided with integral lock and master key. c) Cubicles and panels shall be vermin-proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by Employer. d) The cubicles and panels shall be adequately ventilated, if required, by vents or louvers and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel. e) Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.			
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1.03.09	f) Unless stated otherwise all cubicles and panels shall be provided with a ground bus with 40 mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120 mm². g) The standard phase arrangement when facing the front of the motor control centres and switchboards shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipment involving 3-phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards including necessary high altitude correction factors and shall not require cutting away of adjacent framework. h) The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the Contractor. i) The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of Employer. The interior of all cubicles and panels shall have a matt white finish unless specified otherwise. j) Switched interior light and socket outlets shall be provided for all cubicles and panels. k) All cubicles and panels shall be provided with lamicoid name plates, identifying the purpose of the panel and all of its components.			
	Terminal Blocks a) All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and the space between the bottom blocks and the cable gland plate being a minimum of 200 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors. In enclosed cubicles, the terminal blocks shall be provided which shall be inclined towards the door for facilitating terminations. b) The smallest size to be used shall be designed for 2.5 mm² wire and not more than two conductors shall be connected under one terminal clamp. c) Terminal identification shall be provided corresponding to wire number of connected leads. d) Circuit terminals for 415V AC shall be segregated from other terminals and shall be equipped with non-inflammable, transparent covers to prevent contact with live parts. Standard warning labels with red lettering shall be mounted thereon in a conspicuous position.			
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1.03.10	Earthing e) Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming / outgoing wires. f) Each terminal block shall be suitable for terminating the conductors without affecting any damage to the conductor either due to bad sizing, workmanship, loose connections or any other reason. Terminal Block shall have preferably screw locking design. g) Terminal blocks shall be of screw type meeting the requirements of IEC-60947-7-1. The insulating material of terminal blocks shall be polyamide 6.6, V0/V2 class, and unbreakable, fire retardant meeting inflammability requirement of UL94. All metal parts shall be of copper alloy, captive and touch proof. The terminal blocks shall be touch proof, suitable for Din and G-rail mounting. a) Earthing terminals for equipment of these specifications shall form part of equipment supplies. The Contractor shall connect the earthing conductors to these terminals. b) Earthing conductors from the station earthing bus to the equipment will also be arranged by the Contractor.			
1.03.11	All the electrical works shall be carried out as per the specification of electrical equipment indicated elsewhere in the specification.			
2.00.00	DESIGN CRITERIA FOR CRANE EQUIPMENTS			
2.01.00	General Design Criteria			
2.01.01	General a) The cranes shall be designed in compliance with requirements of latest version of IS: 13834 and IS: 3177. Where contained in the latest ISS requirements are stricter than those contained herein, the ISS requirements shall govern. b) The cranes shall be supplied in accordance with the requirements of these specifications including the limiting and / or mandatory dimensions shown on the specification drawings (Part IV). All details shall be determined by the Contractor subject to customer's approval.			
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2.01.02	c) Any design feature or detail not specified herein shall be in accordance with IS: 807 and IS: 3177 or other equivalent approved standards which shall supplement these specifications. Safety Requirements In the design of the cranes, all safety regulations provided under the Factory Act, Indian Electricity Act and other applicable legislations shall be taken into consideration and provided for.	
2.01.03	Splices and Connections a) Shop Splices All shop splices and connections shall be either welded or shall be made with ribbed fitted, or high-strength steel bolts and self-locking nuts, as applicable. Main members shall be assembled in the shop prior to reaming or drilling of holes for field connections. b) Field Splices Field connections shall be made either with ribbed or fitted bolts and self-locking nuts or with high-strength steel bolts; field welding will not be allowed. Shop assembled parts dismantled for shipping shall be clearly match-marked for field assembly. Field-bolted structural connection between girders and trucks shall be made with fitted bolts. Field-bolted connection between girder sections shall be made with high-strength steel bolts. All high-strength bolt connections shall use a sufficient quantity of fitted bolts to ensure proper alignment. c) Lubricants Grease, lubricating oil, and hydraulic brake fluid required for initial filling of all the equipment plus 100% reserve shall be furnished with each crane. This amount is exclusive of any oil or grease required for flushing or otherwise preparing the equipment for operation which shall also be provided. The selected materials for gears, bearings, and other items that come in contact with the oil or grease shall be compatible with the specified lubricants. The hydraulic brake fluid may be selected by the Contractor subject to approval by the customer.	
2.02.00	Allowable Stresses	
2.02.01	General The maximum allowable stresses in materials used for various parts of the equipment are specified herein. However, the Contractor shall be responsible for	
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2.02.02	an adequate design based on factors proven in practice and shall use lower working stresses where conditions indicate. Maximum Allowable Stresses a) General Adequate factors of safety shall be used throughout the design, especially in the design of parts subject to alternating stresses, vibration, impact, or shock. Under Seismic Load Condition, the maximum stresses shall not exceed 80% of the minimum yield strength of the material used. All wire hoisting ropes shall be selected on the basis of a factor of safety not less than six (6) based on the nominal breaking strength considering the weight of the rated load, load blocks, and lifting beam (if any) and considering the overall efficiency of the hoist reeling.				
2.03.00	Loading Conditions				
2.03.01	Loads a) General The definitions of the dead, live load, etc. shall be as given in applicable design standards, except as stated herein. All loading cases shall consider the trolley and / or live load in the position which causes the greatest stress. b) Dead Load The weight of all effective parts, the bridge structure, machinery parts and fixed equipment supported by the structure. c) Live Load Live loads shall include the weight of the ropes and lower load blocks. d) Vertical Impact Load Impact factor shall be as per IS for the applicable duty class of the cranes. e) Braking and Horizontal Loads & Longitudinal Loads Loads due to the sudden application of the bridge and trolley travel brakes shall be taken as the forces produced by locking the driven wheels with the crane carrying the rated load. The coefficient of friction for braking loads shall be taken as 0.15 in which case all driven wheels shall slide on the rail.				
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2.03.02	The coefficient of friction for tractive conditions shall be taken as 0.09 in which case no wheel shall slide on the rail. The horizontal forces resulting from the acceleration or deceleration of the trolley tractive effort and bridge tractive effort shall be as follows: i) As transverse load of Ten percent (10%) of the weight of trolley with rated load in such a position as to produce maximum stress due to moment or shear in the girders, applied equally on the two trolley rails. ii) A longitudinal load of Ten percent (10%) of the total weight of the bridge less the weight of track wheels and trucks. f) Earth-quake load These shall be derived based on seismic accelerations as specified elsewhere in the specification. g) Walkway Load All walkways shall be designed for a live load of 250 kg/m² in addition to the weight of any equipment mounted thereon. All handrails shall be designed to withstand a 50kg horizontal load for every 1.0 m of top rail. Seismic Design Criteria a) General Each crane shall be designed and constructed to withstand the earthquake loading defined in this specification. Stresses in the crane and trolley structure shall be analyzed according to the conditions specified herein. All equipment of the crane, such as bearing pedestals, machinery parts, components, and controls, shall be designed and fastened so that they do not suffer damage or misalignment and to permit operation of the crane without repairs following an earthquake. b) Seismic Loading Conditions i. The design for seismic loadings considerations shall be based on IS 1893 Part – I. All the design factor as per Zone – V shall be considered in the design of the crane. ii. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act nonconcurrently. For horizontal acceleration and vertical acceleration relevant IS shall be used as per seismic data contained in Part - A of the tender specifications. The			
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2.03.03	seismic loads shall be equal to static loads corresponding to the weight of the parts multiplied by the acceleration. The following conditions shall also be considered : Horizontal seismic load reactions between rail and wheels, in the direction of traveling, shall be limited by sliding of the wheels, considering all braked wheels blocked with friction coefficient of 0.25 between rail and wheel. For upward vertical seismic loads, the weight of all parts shall be considered overcome by the earthquake and a 0.2 g net upward force shall be considered acting. Horizontal seismic load reactions that are normal to the rails shall be considered distributed on the flanges of the wheels on one side of the crane. The positive upward vertical reactions shall be considered distributed over all rail clamps. iii. A separate loading case shall be analyzed for the seismic acceleration in each of the following directions: horizontal parallel to the crane rail, horizontal normal to the crane rail (both directions), vertical downward, and vertical upward. iv. For the seismic loading conditions, the allowable stresses for normal loading cases may be increased up to 80% of the minimum yield strength of the material, except for the design of the following parts for which the allowable stresses shall not be increased: • Wheel flanges, rail clamps, and emergency guide shoes; and • All bolts, pins, welds, and other means used for connecting above parts to the main structure and those used for mounting machinery parts, controls, or other hardware. Overall Loadings for Crane Design A. General All the cranes and runway rails shall be designed for the specified combination of extreme loads acting on them during operation or standstill. Eccentricity of loading shall be taken into consideration in the design. The maximum stresses acting on the members of the cranes and runway rails shall not exceed the safe permissible stresses under any actual combination of loads. The design of the crane shall also take into account the seismic forces as stated in the technical specifications.			
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2.04.00 2.04.01 2.04.02	B. Combination of Loadings on Crane The loading considerations for design of cranes shall conform to clause 7.3 of IS: 3177.			
	Structural Design Features			
	General All structural components shall be made from steel sections with following Minimum thickness of Structure Members: a) Load Carrying members : 8 mm (b) Tubes with both ends sealed : 4.9 mm (6 SWG) (c) Tubes with unsealed ends : 8 mm (d) Chequered plate : 6 mm O/P			
	Crane Girders a) The crane girders shall be of welded structural steel-box section construction unless otherwise specified. b) All crane girders shall be of proper width to ensure adequate lateral stiffness, shall be braced at each end, and shall be attached by ample gusset plates to the end trucks. The maximum vertical deflection of the crane girders resulting from the weight of the trolley plus the rated load shall not exceed 1/900 of the span of the crane. Girders shall be cambered an amount equal to the dead load deflection plus one half of the deflection caused by the design live load and trolley. In the design of girders the camber shall be nil or positive neutralizing the deflection. c) Wherever possible, bridge crane girders shall be notched to rest on top of the end trucks and shall be connected to the end trucks with shelf angles and horizontal gusset plates of ample size to provide a stiff connection to the end truck. An adequate number of fitted bolts for reamed holes shall be provided for the end truck connection to accurately align the girders with the end truck during erection. Squaring marks shall be provided on each girder to facilitate erection and squaring of the bridge. d) Suitable supports shall be provided at one end of the crane bridge for the placement of a temporary platform between the girders during crane erection and for use during the reeving and maintenance of the cranes trolley.			
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2.04.03	Trucks a) Trucks for crane bridges shall be of the equalizing type which shall distribute the load evenly between the wheels. Trucks shall be of structural steel box section, heavily reinforced to provide a rigid structure and minimize deflection. The outside wheels on one side shall be spaced, center to center, not closer than 1/6 the span of the crane. b) Safety lugs shall be provided to prevent a drop of more than 4.5 mm, in case of a broken wheel or axle. Truck wheels and safety lugs shall be designed to function properly on runway rails mounted as shown on the drawings. Trucks shall be equipped with rail sweeps, extending below the top of the rail and projecting in front of the truck wheels, which will push forward or off the track any object placed across the rail. c) All trucks shall be designed to permit easy wheel removal. Jacking pads shall be provided on all trucks whenever the wheel reactions with no load on the hook exceed 6500 kg per wheel. d) No part of the end truck shall project below the flange of the bridge wheel.			
2.04.04	Trolley Frame Trolley frames shall be of rigid, welded structural steel construction and shall provide equal distribution of the load on all wheels without excessive deflection. All machinery assemblies shall be mounted on machined surfaces. Shims may not be used except under brakes and motors. Trolleys shall be equipped with safety lugs, rail sweeps, and jacking pads as specified for trucks above. The trolley shall be completely floored-over without openings except as required for ropes.			
2.04.05	Bumpers and Stops a) Bumpers shall be rigidly mounted on end trucks and trolleys to contact bumper stops at both ends of each runway. b) All bumpers shall be of the spring compression type except where the full load rated speed is less than 10 m / min. in which case they may be of elastomeric, hydraulic, or other shock absorbing material. Bumpers shall have sufficient energy absorbing capacity to stop the crane or trolley when traveling at 50% of the rated speed without exceeding the normal allowable stresses and to stop the crane or trolley when traveling at full rated speed without exceeding the yield strength of the materials involved. c) All bumpers shall be designed so that there is no direct shear on bolts and shall be equipped with safety cables to prevent falling of parts from the crane in case of breakage.			
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2.04.06	d) Bumpers on bridge end trucks shall be capable of stopping the crane (not including lifted load) at a rate of deceleration not to exceed 10% of the acceleration of gravity when traveling in either direction at 20% of the rated speed. e) Trolley bumpers shall be capable of stopping the trolley (not including lifted load) at a rate of deceleration not to exceed 15% of the acceleration of gravity when traveling in either direction at one-third of the rated speed. f) In addition to the trolley bumpers specified above, all trolleys (including monorail trolleys) shall be provided with positive trolley stops at the limits of their travel. These stops shall be designed and fastened to resist the forces applied when contacted. Stops engaging the tread of the wheel will not be acceptable. Walkways and Ladders a) The access to the bridge walkway for maintenance or operation shall be from an access area as shown on the drawings and shall not require stepping over any gap exceeding 0.3 m. The crane shall be equipped with walkways and ladders to allow safe passage from the access point to the following: • All bridge walkways, • The trolley, and • crane corbels b) Equipment on the crane shall be located so as to give safe access to all points that must be reached for maintenance or operation. Fixed ladders shall be in accordance with applicable standard. c) A walkway shall be provided on both sides along the entire length of the bridge. Ladders, platforms, and steps shall be provided to permit access for lubrication, inspection, and maintenance, wherever necessary. d) Walkways should preferably be located to give headroom of not less than 2.0 m. but in no case it shall be less than 1.2 m. e) All walkways and stairways shall be of rigid construction, with non-skid chequered plate treads or grating, toe-boards not less than 0.1 m high, and double-tiered structural steel handrails not less than 1.0 m high. Walkways shall be continuous and permanently secured. Walkways shall have a clear passageway at least 0.45m. wide except opposite the bridge motor where they shall be not less than 0.4m and except opposite electric cabinets where the passage shall not be less than 0.75m. Ladders shall be of steel construction with rungs welded to the ladder rails. Rails shall extend not			
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2.04.07	less than 1.1 m. above the landing at the top, for safety in getting on or off the ladder, and shall start on a landing platform. Seismic Requirements a) Rail Clamps Each crane truck shall have 2 sets of rail clamps, and the trolley shall have 2 sets of automatic rail clamps for each crane girder rail. The rail clamps shall secure the crane bridge and the trolley against upward motion caused by seismic forces. Each clamp shall have a prong under each side of the railhead. Similar rail clamps shall be provided on all monorail trolleys to withstand seismic forces. b) Emergency Guide Shoes Emergency guide shoes shall be provided to limit the lateral displacement of Crane Bridge and trolley so as to prevent derailing if wheel flanges are damaged. c) Equipment Mountings Crane components shall be securely mounted to the crane to withstand all normal and seismic loads. Fitted pins or welded locating lugs shall be used where required.	
2.05.00	Mechanical Design Features	
2.05.01	General All parts which can be worn or damaged by dust shall be totally enclosed in dustproof housings. All units and housings weighing more than 45 kg and all housing parts weighing more than 10 kg shall be provided with suitable lugs or eyebolts for handling. All bolts and capscrews shall be provided with lock washers or locknuts. All machined units shall be thoroughly cleaned to ensure that they are free of cuttings and other abrasive material.	
2.05.02	Guards a) Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components which might constitute a hazard under normal operating conditions shall be guarded. Guards shall be fastened securely. Each guard shall be capable of supporting without permanent distortion the weight of 80 kg person unless the guard is located where it is impossible for a person to step on it.	
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2.05.03	b) If hoisting ropes run near enough to other parts to make fouling or chafing possible, guards shall be installed to prevent this condition. A guard shall be provided to prevent contact between bridge conductors and hoisting ropes if they could come into contact when the load block is swung 6 degrees from the normal vertical position. Bridge Drive a) Not less than 25% of the bridge wheels on each rail shall be driven. Bridge drive could be a single or dual or quadruple motor arrangement as best suited. All bridge drive gearing shall be enclosed in gear reduction housings and mounted on the bridge girder structure. b) If a single motor drive arrangement is provided, the travel motor shall be mounted near the center of the bridge girder and connected through suitable gearing and line shafting to the driving wheels. Flexible couplings shall be provided at each output shaft of the gear reducer and also adjacent to the truck drive pinion or to the truck wheel shaft end. c) If a dual motor drive arrangement is provided, the motors shall be located near each end of the bridge and connected to separate gear reduction units. d) The driving mechanism shall be designed and constructed so that travel will be steady and free from objectionable vibration, sluing, and racking in any part of the structure at any speed and load combination up to and including the rated speed and load. e) All gear reducers and drive mechanisms shall be designed and located to enable easy bridge wheel replacement within the confines of the powerhouse or other space limitations shown on the drawings.	
2.05.04	Trolley Drive Mechanism Trolley drive could be a single or dual motor arrangement as best suited. The trolley drive motor shall be mounted on the trolley frame and connected to at least one driving wheel on each side of the trolley through gearing and shafting. Flexible couplings shall be provided at each output shaft of the gear reducer and near the trolley drive wheel.	
2.05.05	Hoists All hoists shall be mounted on a trolley frame, and each shall be driven by a suitable motor with VVVF drive and gears to obtain the required hoisting speeds. The tangent of the maximum lead angel of wire ropes relative to drums and sheaves shall not exceed 1/12 unless sufficient evidence is submitted to justify a greater angle. Hoists shall not utilize cross-reeving rope arrangements. Equalizers shall be included to assure that the tension in the ropes is equalized.	
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2.05.06	Wheels All wheels shall be double flanged, made from forged or rolled steel wheel blanks, and accurately turned or ground to the required diameters. All bridge and trolley wheels shall be doubly supported with a bearing on each side of the wheel. Cantilevered wheel arrangements are not acceptable. Drive wheels shall be matched pairs with less than 0.25 mm difference in diameters. Wheels shall be designed to carry the maximum rated load under normal conditions without excessive wear. Maximum wheel loads shall be as given in applicable standard specification unless otherwise approved. All wheel flanges shall be not less than 25 mm high, and where seismic design criteria apply, they shall extend not less than 15 mm below the top of the rails head when the wheel is lifted free of the rail so that the rail clamps contact the underside of the rail head. Wheel flanges shall have adequate-strength to resist the specified earthquake loads without exceeding the allowable stresses for normal operation.			
2.05.07	Axles The axles shall be heat-treated steel forgings, accurately turned and ground. Rotating axles shall be fitted to the wheels with a force fit. Driving wheels shall be keyed to the rotating axle in addition to the force fit.			
2.05.08	Sheaves a) Rope sheaves shall be of cast steel or welded steel construction with machined rope grooves. b) The pitch diameter for running and idler sheaves shall be not less than 24 times the outside rope diameter when 6 x 37 class rope is furnished or 30 times the rope diameter when 6 x 19 class rope is furnished. c) Sheave grooves shall be smooth and free from surface defects which could cause rope damage. The cross sectional radius at the bottom of the groove shall be such as to form a close fitting saddle for the size of rope used, and the sides of the groove shall be tapered outward to facilitate entrance of the rope into the groove. Flange corners shall be rounded, and the rims shall run true about the axis of rotation. d) The sheave pins shall be made of annealed carbon or alloy steel (except as otherwise specified). All revolving sheaves shall be equipped with standard replaceable roller bearings with dust seals. The load sheave rpm at full rated speed shall be used to size all sheave bearings. Each sheave shall be lubricated by an individual grease fitting. All revolving sheaves shall be statically balanced. e) Drums, sheaves, bottom blocks, and hoisting rope shall be designed so that when raising or lowering no crossover reeving will occur. Idler sheave arrangements shall be designed to minimize any twist in the rope.			
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2.05.09	Load Blocks Load blocks shall be provided with close-fitting guards or other suitable devices to prevent ropes from becoming wedged in small openings when the ropes are momentarily unloaded and to guide the rope back into the groove when the load is applied again. The guards shall be of cast steel or welded construction and shall be fitted close to the periphery of the sheaves.				
2.05.10	Hooks a) Hooks and lifting eyes shall be made of forged annealed alloy or carbon steel. All hooks and lifting eyes shall swivel freely on grease lubricated roller or ball bearings and all hook beams shall be able to rotate. Bearings shall be totally enclosed, dust-tight, and constructed to prevent grease leakage. Load on roller bearings shall not exceed the static bearing capacity established by the bearing manufacturer, using a load factor of 1.0. b) Hooks shall be designed such that the resultant load on the hook passes through the centerline of the shank. The maximum stress in the hook at its rated load shall not exceed 20% of the ultimate strength of the material. c) Elevations specified for hooks refer to the bottom of the valley of the hook. d) Prior to machining, all hooks shall be given an ultrasonic test and a wet magnetic particle inspection of all surfaces of the forging in accordance with applicable Indian standards specifications. e) After machining, all machine surfaces shall be given either a wet magnetic particle inspection as above or a dry magnetic particle inspection in accordance with applicable Indian standard specifications. f) All cracks, linear indications, or aligned porosity exceeding 6 mm in length are unacceptable and shall be rejected or repaired in an approved manner. All repairs shall be reinspected using both ultrasonic and wet magnetic particle inspection. g) All hooks shall be buffed and center punched with a low stress center punch on the hook tops. The hooks shall also be center punched for recording the original dimensions of the throat opening measurements and later during the crane tests.				
2.05.11	Hoist drums Hoist drums shall be made of cast steel or welded steel of sufficient strength to sustain the combined crushing and bending loads of the rope pull. Allowance shall be made for fabrication and machining tolerances to assure adequate drum shell thickness under the machined groove. Each drum shall have right-hand and left-hand machined grooves to receive the hoisting rope. Grooves shall be smooth and				
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		well rounded. Grooves shall have minimum depth of 0.35 times the rope diameter. The minimum groove pitch shall be the rope diameter plus 3 mm. The drums shall be designed so that not less than 2.5 wraps of each part of hoisting rope will remain in the grooves when the hook is at the lowest position for the lift specified and atleast ¾ reserve turn is available, without overlapping of the rope, when the block is in the uppermost position corresponding to tripping of the block operated limit switch. The pitch diameter of the drums shall be not less than 24 times the rope diameter when 6 x 37 class rope in furnished and 30 times the rope diameter when 6 x 19 class rope is furnished. Drum flange height shall be not less than 2.5 times the rope diameter and shall be arranged so as to prevent the rope from touching gears.			
2.05.12	Shafting	Shafts shall be machined to close tolerances at bearing and gearing fits. Shafting shall be of rolled or forged steel, amply supported to prevent excessive deflection.			
2.05.13	Gearing	a) Gears shall be of the worm, helical, bevel, herringbone, or spur type. Herringbone gearing shall be of the continuous type. Worms and pinions shall be made of forged carbon or alloy steel. Gears shall be designed in accordance with applicable standards. b) Gear cases shall be oil tight and sealed. Input and output shafts of gear cases shall have seals to prevent oil leakage. The top section of each gear case shall be easily removable for inspection. Openings shall be provided in the top section for inspection of the gearing at the mesh lines. Covers for these inspection Openings shall be sealed to prevent oil leakage. Gear cases shall be made of cast steel or welded steel and shall have drain plugs, breathers, and oil level gauges. Gear cases shall be mounted on machined surfaces. Shims shall not be used .All Gears shall have guards to prevent injury to anyone while the gears are in service. c) Magnetic particle and dye penetrant inspections shall be performed, as applicable on the load holding gear trains of all hoist .These test shall be performed in accordance with the applicable IS Code.			
2.05.14	Bearings	Bearings shall be of the ball or roller type, except as otherwise specified, and shall be designed to permit easy removal of the shaft. Bridge and trolley wheel bearings shall be of the roller type .Bearings shall be designed to exclude dirt, prevent leakage of oil or grease, and to eliminate the need for frequent lubrication .Shaft Bearings shall be placed as close as possible to points of loading. Bearings shall be easily replaceable. Bearing housings shall be of cast iron, cast steel, or welded steel construction. The service life of all bearings shall be not less than 10,000 hr at			
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2.05.15	the design speed and power. These service hours shall represent the life that 90% of the bearings will complete or exceed.				
	Lubrication				
	a) Provisions shall be made for proper lubrication of all parts. High speed gears and pinions shall be provided with forced oil lubrication. Low-speed drum gears shall be lubricated by soft grease or as recommended by the gear manufacturer. b) Bearings shall be provided with means of pressure lubrication. The crane shall be provided with all necessary lubrication fittings. Lubricating points shall be located for easy and safe access without the necessity of removing guards or other parts. Lubrication lines shall be securely fastened to the cranes structure and shall be located to provide the maximum protection and so that ordinary repairs can be made without removing the lines. c) The crane shall be provided with a centralized lubrication system of reputed make. This system shall be manually operated, complete with a manual pump, reservoir, supply lines, metering valves, and discharge lines to all bearings. Either one system, mounted on the crane bridge with a quick/disconnect fitting on the supply line for connection to a flexible hose leading to the trolley, or two separate lubricating systems, one for the bridge and one for the trolley, shall be provided. Metering valves with indicators shall be provided for all points of grease application and shall be mounted at readily visible and accessible locations. All piping shall be made of suitable polymer, with flexible hoses where required.				
2.05.16	Couplings				
Couplings shall be of the flanged type with recessed bolts or suitable guards. Couplings shall be designed so that their strength equals the shaft strength and shall be of the flexible, spacer, or geared type.					
2.05.17	Keyways				
Connections subject to torsion such as couplings, driving wheels, and drive gears shall be keyed to the shafts with rectangular keys. The keys shall be sized to be within safe bearing and shearing limits of the materials in contact.					
2.05.18	Wire Rope				
Each rope shall be of sufficient length to provide the specified lift, the additional wraps, and the length required for mounting the rope. The rope shall be of 6/19, 6/36 or 6/37 class with tensile designation as 1960 (Conforming to IS 2266) or equivalent or better type with independent wire rope and regular lay construction, unless otherwise approved. Rope ends shall be anchored by clamps securely attached to the drum so that the connection provides a safety factor of not less than					
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2.05.19	6 with only 2 wraps on the drum or by an approved socket arrangement. Socketing shall be done in the manner specified by the manufacturer of the socket assembly. Eye splices shall be made in an approved manner and rope thimbles shall be used in the eye. Rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope. Spacing and number of all types of clips shall be in accordance with the clip manufacturer's recommendation. Clips shall be of forged steel. Swaged or compressed fittings shall be applied as recommended by the manufacturer of the fittings. Bolts & Nuts Bolts and nuts for mechanical equipment shall be semi-finished and shall have hexagonal heads. Nuts shall be secured by effective lock-nuts or other approved locking devices.	
2.06.00	Controls	
2.06.01	General	
	a) The Power House Cranes, ~~the Butterfly Valve House crane~~ shall be designed for operation by remote radio control from respective machine hall / service bay as well as from operator's cabin (standby control) of respective cranes. Control equipment in the stand-by control station(s) of the crane(s) shall be located and arranged so that all operating handles, switches, and buttons are within convenient reach of the operator when facing the area to be served by the load hook in. The arrangement shall allow the operator a full view of the load hook in all positions. Control equipment on remote-controlled cranes shall be located and arranged so that the operating handles, switches, and buttons are convenient for the operator's use. b) All electrical equipment shall be suitably enclosed so that live parts will not be exposed to accidental contact under normal operating conditions. All master control switches, manually operated switches, circuit breakers, starters, contactors, limit switches and relays shall be clearly and permanently identified by attached nameplates. c) All hoist controls and brakes shall provide for limiting the vertical movement of the hooks, with rated load and when starting from stand-still, within increments of 1.5 mm. d) The controls and brakes shall limit the movement of the bridge and trolley, under the above operating conditions, within increments of 3 mm. and 6 mm. respectively.	
2.06.02	Speed Regulation	
	a) General: Speed regulation shall be accomplished utilizing a variable voltage & variable frequency static stepless control system for all crane motions.	
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2.06.03	b) The hoist and travel motions shall be provided with stepless speed-regulations from 5 to 100% of rated speed. Hoist control shall be achieved by adjusting the frequency of the motor electrical supply. c) The maximum acceleration produced by the control system shall be independent of the rate of change of the control lever position. d) The speed in the first lowering position shall not exceed 5% of the synchronous hoist speed when lowering any load up to rated load. e) The speed in the first hoisting position when lifting any load up to 125% of rated hoist capacity shall not exceed 5% of the synchronous hoist speed. Control System Details a) Bridge and Trolley Travel: Each travel motion shall have a separate control lever or set of pushbuttons. b) Hoists i. <u>General:</u> Separate controllers shall be provided for each hoist. Smooth acceleration shall be provided for all loads in both directions. ii. <u>Lowering:</u> The lowering speeds for all loads within the rated capacity shall be gradually increased by advancing the controller from the 'off' position toward the 'full-on' lowering position. The lowering speed shall not exceed 125% of the rated speed on any control position. iii) <u>Hoisting:</u> The hoisting speeds for all loads within the rated, capacity shall be smoothly increased by advancing the controller from the 'off' position toward the full-speed hoisting position. In no case shall any load up to 130% of rated capacity cause a hoist to lower when the controller is in any raising position c) Control Levers and Pushbuttons i. All lever-operated controls shall have self-resetting controllers provided with a notch or latch which in the "off" position prevents the handle from being inadvertently moved to the "on" position. Switch levers shall have automatic spring return to the "off" position. ii. All pushbutton controls shall be of the momentary contact type, which make contact only while the button is depressed. iii. Wherever possible, controls shall be arranged so that the movement of each controller handle shall be in the same relative direction as the resultant movements of the load. Pushbuttons shall be oriented in the	
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		same relative direction with respect to each other as the resultant movements of the load.			
		d) Limit Switches			
		i. Limit switches shall be provided for all cranes as follows:			
		• Hoist-driven limit switches for the upper and lower hook position. • A back-up overtravel limit switch for the extreme upper position of each hoist; and • Lever-operated limit switches for both end positions of all travel motions.			
		ii. Hoist-driven limit switches shall be totally enclosed and shall be of the traveling nut or rotating cam type, adjustable for circuit opening or circuit closing and adjustable for operation at any hoist position.			
		iii. Back-up over travel limit switches shall be of the block-operated type, where the trip action is caused by the lower sheave block. These limit switches shall be arranged and adjusted so that they trip only after the normal hoist-driven switch position is overtraveled. Back-up limit switches shall be of the power type which directly interrupts the power supply to the hoist motor.			
		iv. All limit switches shall be of the type which resets automatically. Limit switches shall be of quick-break type, capable of stopping the equipment quickly under all conditions of speed and loading. All limit switches shall be unidirectional and shall not interfere with the motion in the opposite direction. Contacts shall be enclosed and protected from dust, moisture, and mechanical injury and shall be easily removable for replacement.			
3.00.00	GENERAL DESCRIPTION AND TECHNICAL REQUIREMENTS OF CRANE EQUIPMENTS				
3.01.00	Function				
3.01.01	Power House Crane				
	The powerhouse cranes shall be provided both for erection and maintenance works in the machine hall and for handling all material and equipment. During construction phase, this handling equipment shall also be used to handle and install the construction material and equipment of other contractors.				
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3.01.02	The powerhouse cranes will be used principally for the installation and removal of all heavy pieces of equipment located in the powerhouse such as generator rotor assemblies, stator sections and assemblies, and turbine runner assemblies, power transformer sub-assemblies. The assembled generator rotor shall be the heaviest assembly to be handled by the crane. Precise handling of valuable machinery at slow speed is required. The auxiliary hoist will be used for higher speed service, lesser weight assemblies and sub-assemblies. Two numbers of 10 T under slung hoist, one on each girder to handle equipments/assemblies which are beyond the reach of main/auxiliary hoist ~~Pressure Shaft BF Valve House Crane~~ ~~The butterfly valve house crane shall be provided both for erection and maintenance works and for handling all material and equipment. During construction phase, this handling equipment shall also be used to handle and install the construction material and equipment of other contractors.~~ ~~The Pressure Shaft Butterfly Valve House Crane will be used for the installation and removal of all pieces of equipments located in the valve house such as valve sub-assembly / assemblies, valve disc, valve body, dismantling joint, oil pressure equipments, electric panels, and in rare exigencies for opening the closed valve through crane actuated lifting of counter weights (of valve).~~								
3.02.00	General Description and Operating Duties / Conditions								
3.02.01	Operating Conditions The cranes shall be designed for indoor service. After installation of the generating units and auxiliaries and Butterfly Valve are completed, respective cranes will be used for maintenance purposes.								
3.02.02	General Arrangement & Specification Drawings Each crane shall be an electrically-operated single-trolley, overhead traveling bridge crane. The general arrangement of these cranes is shown in the enclosed layout drawings. Each crane shall operate on a runway provided with suitable and standard crane rails supported on crane beams.								
3.02.03	Service Classification The cranes shall be rated according to IS- 13834. The broad classification is as tabulated below: Group classification of the cranes shall be as follows: <table><tr><td>• Utilisation Class</td><td>U4</td></tr><tr><td>• Spectrum Class</td><td>Q2</td></tr></table>					• Utilisation Class	U4	• Spectrum Class	Q2
• Utilisation Class	U4								
• Spectrum Class	Q2								
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CLAUSE NO.		• Equipment Class A4 • Overall Group Classification Power House Crane M5 ~~BF Valve House~~ ~~M4~~ Mechanism Classification shall be adopted as below: a) Power House crane : <table><tr><td>Mechanism</td><td>Crane travel</td><td>Trolley travel</td><td>Lifting 125T</td><td>Lifting 25T</td><td>Lifting 5T</td></tr><tr><td>Utilisation Class</td><td>T5</td><td>T5</td><td>T4</td><td>T5</td><td>T5</td></tr><tr><td>State of Loading</td><td>L2</td><td>L2</td><td>L2</td><td>L3</td><td>L3</td></tr><tr><td>Mechanism Class</td><td>M5</td><td>M5</td><td>M4</td><td>M6</td><td>M6</td></tr></table> b) ~~B. F. Valve House Crane :~~ <table><tr><td>~~Mechanism~~</td><td>~~Crane travel~~</td><td>~~Trolley travel~~</td><td>~~Lifting 50 T~~</td><td>~~Lifting 10T~~</td><td>~~Lifting 5T~~</td></tr><tr><td>~~Utilisation Class~~</td><td>~~T4~~</td><td>~~T4~~</td><td>~~T4~~</td><td>~~T4~~</td><td>~~T4~~</td></tr><tr><td>~~State of Loading~~</td><td>~~L2~~</td><td>~~L2~~</td><td>~~L2~~</td><td>~~L2~~</td><td>~~L2~~</td></tr><tr><td>~~Mechanism Class~~</td><td>~~M4~~</td><td>~~M5~~</td><td>~~M4~~</td><td>~~M4~~</td><td>~~M4~~</td></tr></table>						Mechanism	Crane travel	Trolley travel	Lifting 125T	Lifting 25T	Lifting 5T	Utilisation Class	T5	T5	T4	T5	T5	State of Loading	L2	L2	L2	L3	L3	Mechanism Class	M5	M5	M4	M6	M6	~~Mechanism~~	~~Crane travel~~	~~Trolley travel~~	~~Lifting 50 T~~	~~Lifting 10T~~	~~Lifting 5T~~	~~Utilisation Class~~	~~T4~~	~~T4~~	~~T4~~	~~T4~~	~~T4~~	~~State of Loading~~	~~L2~~	~~L2~~	~~L2~~	~~L2~~	~~L2~~	~~Mechanism Class~~	~~M4~~	~~M5~~	~~M4~~	~~M4~~	~~M4~~		
Mechanism	Crane travel	Trolley travel	Lifting 125T	Lifting 25T	Lifting 5T																																																				
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~~State of Loading~~	~~L2~~	~~L2~~	~~L2~~	~~L2~~	~~L2~~																																																				
~~Mechanism Class~~	~~M4~~	~~M5~~	~~M4~~	~~M4~~	~~M4~~																																																				
3.02.04		Operating Parameters and Speed I Power House Cranes It will be a double hooks crane (one Main Hook and one Aux. Hook) with one under slung monorail hoist. EOT crane for Power House shall be suitable for the following parameters / duties: A) Rated Capacity (in Tonnes) a) Main Hoist 125 T b) Auxiliary Hoist 25 T c) Under Slung Monorail 5T B) Crane Span 20800 mm (approx.) C) Normal speeds & micro speeds (Inching) with full loads.																																																							
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		a)	For loads upto 125 T		
		i)	Normal hoisting speed	1.00 m/min	
		ii)	Micro speed	0.1 m/min	
		b)	For loads upto 25 T		
		i)	Normal hoisting speed	5.00 m/min	
		ii)	Micro speed	0.5 m/min	
		c)	For loads upto 5 T		
		i)	Hoisting speed	4.5 m/min	
		ii)	Micro speed	0.45m/min	
		iii)	Travelling Speed	12 m/min	
		c)	Trolley Travel	10.00 m/min	
		d)	Bridge Travel (longitudinal travel)	20.0 m/min	
		D)	Max. acceleration / deceleration of bridge travel & trolley travel	0.2 m/ sec ²	
		E)	Crane Hook Vertical Travel Reaches (Refer Relevant Tender Drawing)		
		a)	Between machine hall floor level (viz service bay floor EL412.00m) to upper most position of hooks		
		i)	For Main Hoist	> 12.5m	
		ii)	For Aux. Hoist	> 13.0m	
		b)	Between machine hall floor level to the lower most position of power house		
		i)	For Main Hoist	> 16500m	
		ii)	For Aux. Hoist	> 16500m	
		d)	Total Hook Travel		
		i)	For Main Hoist	> 29000mm	
		ii)	For Aux. Hoist	> 29500mm	
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	iii) Under Slung Monorail > 27000mm (approx.) F) Horizontal Reach of Hook from Rail C/L a) Crane No.1 (refer Cl. 5.02.08) U/stream D/stream i) Main Hook (125T) < 1500mm < 2900mm ii) Auxiliary Hook (25 T) < 2900 mm < 1500mm G) Clearance of hooks from inside of end walls on a) Service Bay End < 4000mm b) Power House End < 4000mm H) Runway, travel lengths a) Gantry rail level EL425.00m b) Length of runway 65.0m(approx) c) Trolley travel length Max. feasible for specified crane span, shall ensure specified hook reaches. I) Distance from rail C/L to nearest side obstruction on Up-stream < 950mm Down-stream < 950mm J) Distance from the crane bridge end to nearest side obstruction on Up-stream > 475mm Down-stream > 475mm K) Means for Micro speed Stepless speed control by VVVF drive with min. six (6) pulse design for inching motion for main and auxiliary lifting hooks. The hook travel and crane approaches are subject to review during detailed engineering based on actual requirement for handling of equipments.			
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	II ~~B.F. Valve House Crane~~ ~~It will be double hooks (one Main Hook and one Aux. Hook) crane with one under slung monorail hoist.~~ ~~EOT crane for Butterfly Valve House shall be suitable for the following parameters / duties.~~ ~~A) Capacity (in Tonnes)~~ ~~a) Main Hook 50 T~~ ~~b) Auxiliary Hook 10 T~~ ~~c) Under Slung Monorail 5T~~ ~~B) Crane Span 8300mm~~ ~~C) Normal speeds and micro speeds (inching) with full loads.~~ ~~a) For loads upto 50 T (Main Hook)~~ ~~i) Normal speed 1.0 m/min~~ ~~ii) Micro speed 0.1 m/min~~ ~~b) For loads upto 10 T (Aux. Hook)~~ ~~i) Normal speed 8.0 m/min~~ ~~ii) Micro speed 0.8 m/min~~ ~~b) For loads upto 5 T~~ ~~i) Hoisting speed 4.5 m/min~~ ~~ii) Micro speed 0.45 m/min~~ ~~iii) Travelling Speed 12 m/min~~ ~~c) Trolley Travel 10 m/min~~ ~~d) Bridge Travel (long) 20 m/min~~ ~~D) Max. acceleration / deceleration 0.2 m/sec²~~ ~~bridge travel and trolley travel~~ ~~E) Crane Main Hook, Aux.Hook and Under slung monorail hoist~~ ~~Vertical Travel Reaches~~ ~~(Refer Relevant Tender Drawing)~~	
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		a)	Between B.F. Valve floor level to upper most position	> 22000mm	
	F)	Position of Hook from Rail C/L		<u>U/stream</u>	<u>D/stream</u>
	a)	Main Hook (50 T)	< 2000mm	< 2200mm	
	b)	Auxiliary Hook (10 T)	< 3200mm	< 1000mm	
	G)	Clearance from end wall on both sides		< 3000mm	
	H)	Runway, travel lengths			
	a)	Gantry rail level	EL871.50m		
	b)	Length of runway	12000mm		
	c)	Trolley travel length	Max. feasible for specified crane span, shall ensure specified hook reaches.		
	I)	Distance from rail C/L to nearest side obstruction on			
		Up-stream	< 750mm		
		Down-stream	< 750mm		
	J)	Distance from the crane bridge end to nearest side obstruction on			
		Up-stream	> 350mm		
		Down-stream	> 350mm		
	K)	Means for Micro speed		Stepless speed control by VVVF drive with min. six (6) pulse design for inching motion for main and auxiliary lifting hooks.	
The hook travel and crane approaches are subject to review during detailed engineering based on actual requirement for handling of equipments					
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3.02.06	Simultaneous Operation of Hoists In case of power house crane and ~~butterfly valve house crane~~, normally one hoist of the crane would be operated at a time. It shall however be possible to change the position of the components from (including runner handling and its removal from the turbine pit using main hook through the floor openings), lying down to vertical position or vice-versa using any two of the hoists of the same crane, by suitable manipulation of the hoisting and other movements as the case may be.	
3.02.07	Performance / Quality of Operations Crane shall be capable of raising, lowering, holding and transporting the rated load without any damage to or excessive deflection of any crane component. Following tolerances shall be maintained in the operation of the crane - Smooth control of vertical movement to within 1 mm for loads to be handled by the main hook of the cranes and 3 mm for loads to be handled by the auxiliary hook of the crane with hook carrying rated load at a time and hoist, brakes properly adjusted for normal operation. - Control of bridge and trolley motion to be within 10 mm. - The motor speed not to exceed 105% of the synchronous speed while lowering the rated load. - The vertical deflection of the main girders caused by the rated load plus all dead loads not to exceed 1/900 of the crane span.	
3.02.08	Hook Reaches and Crane Clearances - Limits of travel of the hoist of each crane are specified under clause "Operating Parameters and Speed" the same shall be reviewed during detailed engineering as per requirements. - A distance of 950 mm for P.H. cranes 750 mm ~~for B.F. Valve house crane~~ from the CL of the rails to the wall faces has been envisaged on either side in the arrangements. It is expected that with this distance it shall be possible to provide clearances as specified between crane extreme points and the walls on either side. The crane Contractor shall ensure this clearance. - Necessary minimum clearance required between crane top most point and the lowest overhead civil construction obstruction shall be indicated by the Contractor.	
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3.02.09	Micro Speed (Inching Motion) & Acceleration a) Normal speeds for hoisting, cross travel and long travel shall be as specified. b) Cranes shall also have provision for raising and lowering of the loads at reduced speed (inching) of 1/10 th (one tenth) of the normal speeds in both main and auxiliary hoist capacities.	
3.02.10	Arrangement of Operators Cabins In respect of the operator cages / cabins of the crane for the Power House, it shall be fitted on the upstream side on the non adjacent girders.	
3.03.00	DESIGN The cranes shall be designed in accordance with the requirements of this Specification.	
3.03.01	Structural Features and Parts of Cranes	
3.03.01.01	General The cranes shall conform to all the requirements of clause "Structural Design Features" of this specification. The complete FEM analysis of Girders, End Carriage etc., shall be carried out and submitted to Employer for approval.	
3.03.01.02	Crane Bridge a) The crane bridge, made of two (2) girders as box type construction, reinforced with stiffening ribs, supported on end trucks, shall be designed to safely carry the full rated load without undue vertical or lateral deflection or vibration. The design shall ensure that girder vibrations are quickly dampened to within 1 mm in 4 seconds. b) The bridge shall be designed taking into consideration the specified transport and handling limits in regard to size and weight of packages. Accordingly the bridge shall be sectionalised into suitable but minimum number of sections within the transport constraints and also of need of field erection & handling. c) The joints between the sections shall be spliced and shall be made by most appropriate method. Most appropriate design shall be adopted for the spliced joints between the sections. d) The bridge shall have the following provisions : i. Welded end-stop of steel to act as stoppers for trolley / crane.	
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3.03.01.03	ii. Heavy standard rails for trolley. iii. Large gusset and skew plates with interference fit bolts at girder ends to connect to the end trucks to maintain a square rigid structure secure against shock & skewing of crane on the track. iv. Suitable number of guide rollers for guiding trolley wheels on rail track. v. Supporting structure for mono-rail hoist underneath the bridge girder of power house cranes. Trucks (End carriages) a) The trucks of box type construction with openings at each end for receiving the truck wheels shall be either cast or weld fabricated or bolted or riveted structure of steel and shall have adequate strength and stiffness. b) The ends of the trucks shall be shaped to form a hood over the truck wheels extending beyond them to receive the track (rail) sweeps and bumpers. The trucks shall be arranged so that wear may be compensated in order to maintain the drive gear in proper mesh. The size of the journals shall be ample to carry the rated capacity load at specified speed without excessive heating during continuous operation. c) Wheel assembly shall be mounted on L-type bracket and shall be so arranged that replacement of any wheel can be achieved from the side without undue difficulties. The wheel base shall not be less than $1/6^{\text{th}}$ (one sixth) of span, as reckoned between the centres of outer wheels. The end trucks shall be designed to contact end stops. d) Each truck shall have : i. Suitable numbers of double flanged rail wheels with bearings running on suitable axles, wheels, fracture props, buffer etc. for easy maintenance. ii. Suitable track sweeps at each end of trucks, effective in both directions of travel. iii. Guide rollers extending below the top of rail on both sides to prevent the trucks from leaving the rails. iv. Lugs to prevent a drop of not more than 2.5mm in case of axle getting broken. v. Resilient bumpers or spring buffers on contact faces of end stops.			
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3.03.01.04	vi. End stops at each end of runway rails, designed in such a way that they make contact with the face of the end truck and not the wheel. vii. Suitable pads on each truck for all wheels for jacking of the crane for changing truck wheels and bearings, to be so designed as not to interfere with the replacement of the truck wheels. viii. Lifting jib arrangement alongwith a lifting jack. Jack need not be of built-in type. ix. Hand holes with removable covers, in each closed compartment of end trucks to facilitate painting of the interior with a spray gun without major disassembly. e) Arrangement for jacking the cross traverse wheels shall be similar to the one described above for L.T. wheels. The Contractor shall furnish the technical details of jacks to be supplied. Wheels, Axles and Wheel Bearings A) Wheels a) The bridge shall be carried on at least 16 (sixteen) wheels, 8 (eight) on each side, for power house cranes and 8 (eight) wheels, ~~4 (four) on each side for B.F. Valve house crane~~ suitably mounted on trucks and designed so as to distribute the load equally on truck beams & wheels. The wheels shall meet the following requirements : i) Double flanged type with treads machined and ground to size. ii) Turned, bored and ground to true and uniform diameters concentrically. iii) Made of cast steel or forged steel and heat treated. Cast iron wheels are not acceptable. iv) Equalized in pairs or individually as necessary. v) Flanges tapered and radiused to prevent derailment. vi) Tread width to have proper clearance, and to be of sufficient size to withstand maximum static and moving / rolling loads. The BHN of hardness of wheels shall be atleast 50 points more than the BHN of rails. vii) Bridge wheels shall be identified for interchangeability. Similarly trolley wheels shall be identified for interchangeability.	
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3.03.01.05	b) The design of the wheel truck assembly shall be such as would allow the wheels to adjust themselves to irregularities of the runaway within allowable limits B) Wheel Axles The wheel axles shall be in accordance with following: a) Made of forged carbon or alloy steel. b) Accurately turned, ground and polished at the positions fitting into wheels. c) Suitable interference fit with the wheels. d) Driving wheel axles to be keyed, in addition to interference fit. C) Wheel Axle Bearings The wheel bearings shall be interchangeable, easily removable type & shall comprise the following: a) Bearing housings / journals fitted into truck bodies. b) Anti friction roller bearings with high pressure grease lubrication.				
	Trolley The trolley shall be made as a welded frame of structural steel and shall be designed and fabricated in accordance with the following: a) Provision of adequate bracing to withstand vertical, lateral and torsional strains. b) Properly machined to receive the drum, wheels, axles and motors for hoisting and cross travel. c) Provision of heavy duty roller bearings, for trolley wheels & winding drum, with bearing caps and fittings for pressure lubrication. d) Double end resilient or spring buffers at bottom of trolley frame on each side to engage stops at each end of the bridge. e) A provision to fit / receive a device to lift the heaviest parts of the trolley viz. the drum and motors for maintenance without any external place for anchoring the hooks or need for any other device.				
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3.03.01.06		Operator Cabin, Walkways and Ladders, Safety Guards			
		a) Operator Cabins			
		The cabin of structural steel frame shall be designed and constructed in accordance with the following requirements			
		i. Enclosed type for indoor service having adequate working space for operation and maintenance with sufficient ventilating type windows which also allow the operator to have clear view of all operations. Suitable inspection cages to accomodate two persons to facilitate inspection of down shop lead.			
		ii. Adequately braced to the crane so as not to sway, swing, or shake.			
		iii. Floor of steel plates securely connected to the frame and covered with matting.			
		iv. Located on the upstream side of the bridge Power House and ~~B. F. Valve House crane~~ and suspended from their outside girders.			
		v. Adequate carbon dioxide gas cylinders of 4.5 Kg..			
		vi. One non oscillating ventilating fan.			
		vii. A cut-off switch near the cabin for disconnecting the incoming power supply before entering or leaving the cabin, for operator safety.			
		viii. One brass gong suspended outside the Cabin and operated from inside.			
		ix. A foot operated electric warning horn of double bell type suitable for 240 V AC. of noise level 95 dBA at 3.5 m			
		b) Walkways and Ladders			
		Ladders, platform, walkways, hand holds, etc., necessary to give safe access to and movement in the cage, bridge drive and trolley drive mechanisms and all other components of the crane needing inspection, maintenance and repair shall be provided. The walkways and ladders shall be in accordance with the following requirements:			
		i. Walkways to be of steel chequered plating for full bridge length, at same elevation as the bridge, attached to outside of each girders; width, clearance from drive units and head room to be minimum 700 , 500 and 2000 mm respectively.			
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	ii. Steel ladders and stairs to have non-slip treads, not less than 600 mm wide between sides, preferably sloped forward, and provided with back safety guards in case height of ladders exceeds 3000 mm. iii. Hand rails for access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways, platform, stairs, ladders, etc.with an intermediate rail. iv. Two plates on each side edge of all walkways of about 100 mm height. c) Safety Guards Appropriate and effective safety guards, encasements, and covers shall be provided for various rotating components, and for live electrical conductors of the crane as below: i. For gears, chain drives: Encasements. ii. For revolving shafts & couplings: Guards for full lengths. iii. For sheaves of hook block and rope : Guards to prevent trapping of hand, and to prevent rope from dismounting from sheave grooves even if rope slackening develops. iv. For openings in foot walk floorings and other inspection platforms: Covers of lockable type.			
3.03.01.07	Safety Lugs Suitable safety lugs shall be provided to contain the movement of the crane during an earthquake. Clamps to keep the crane in locked condition while not in operation shall also be provided.			
3.03.01.08	Name Plates The crane shall have permanent main name plates affixed to each side of the crane, so as to be clearly legible from the floor, showing the name of the manufacturer and the rated capacity. In addition, each hoist shall have its rated capacity clearly marked on its block. These nameplates shall be in English.			
3.03.02	Mechanical Features and Parts of Cranes			
3.03.02.01	General a) The main Power House Crane shall conform to all requirements of Clause “Mechanical Design Features”.			
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3.03.02.02	b) The travel motion shall be equipped with automatic spring set, electrically-released, shoe type brakes. These brakes shall be applied automatically when the control lever of the master contract is in the "off" position and shall be capable of holding the crane stationary. Bridge Travel Mechanism a) For power house crane the mechanism shall comprise of four (4) electric motors and totally enclosed speed reduction helical gear units, two (2) for each end of the bridge, to drive the four (4) bridge wheels and shall ensure equal speed. ~~For other cranes, the mechanism shall comprise of two electric motors. Alternatively for B.F. Valve house, the bridge wheels on both sides can be driven with control drive system and controlling shaft.~~ b) The gear motors shall be keyed directly to the extended wheel shafts. c) The bridge motion shall be free from vibrations and rocking under all conditions of operations and the crane structure shall not have any tendency to get out of line. d) The coupling for the shafts of the motors, gear units and wheels shall be of safety flange type accurately faced and turned and shrunk into place with taper flush keys.	
3.03.02.03	Trolley Travel Mechanism This mechanism shall comprise of two (2) electric motors for Power House cranes and totally enclosed speed reduction gear units, one (1) for each end of the trolley to drive two (2) trolley wheels, designed to ensure equal speed and steady motion, free from vibrations and rocking. ~~For B.F. Valve House, motors can be two (2) or less and control drive system as mentioned in bridge travel mechanism can also be adopted.~~	
3.03.02.04	Hoisting Mechanism for Raising and Lowering of Load The hoisting mechanism provided and mounted on the crane trolley shall comprise of motors, speed reduction gear units for normal speed, drums, brakes, lifting tackles and hooks, hoisting rope and slings as below: a) Hoist Drive for Normal Speed The hoist shall be driven by a motor through speed reduction gear units for normal speed of the hoist and shall be complete with brakes and retarding devices.	
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	b) Winding Drum The winding drum shall have machined grooves to receive the full hoisting rope without overlapping. The drum shall be of such size that there will be not more than one layer of rope on the drum when the rope is in fully wound position and its length shall be such that each lead of rope has a minimum of two full turns on the drum when the hook is in its lowest position and one spare groove for each rope lead off the drum when the hook is at its highest position. The drums shall be designed to withstand the maximum compressive stresses and local bending stresses in the drum at the grooves when the rope is wound on. c) Lifting Tackles & Hooks - The lifting tackles shall consist of a safety type lower pulley block, hook, necessary sheaves and flexible steel wire rope. The lower block shall be a heavy steel housing to support the sheaves and hook. - Sheaves shall be made of cast steel and shall be machine grooved to a depth of not less than one and a half (1.5) times the diameter of the rope. The groove shall be finished smooth and shall be free from surface defects likely to injure the rope. The sheaves shall be provided with guards to retain the rope in grooves and other requirements of sheaves shall be as per approved relevant standards. - The swiveling hook shall be of forged steel and mounted on ball thrust bearings and protective skirt shall be provided to enclose the bearings. - The main hook shall be of the Ramshorn type conforming to approved relevant standards (IS:5749) and the auxiliary hook shall be of shank type conforming to IS : 3815. d) Hoisting Ropes & Slings - The hoisting rope shall be of the type as specified above in these specifications. The factor of safety for the hoisting ropes shall be not less than six (6). The rope system shall be equalised and arrangements entailing reverse bends shall be avoided as far as possible. - The offer shall include requisite wire rope slings of suitable lengths having a safety factor of not less than six (6) lifting specified load with the angle formed at the hook not less than 90 degrees. A minimum of five pairs shall be provided for different loads up to the rated	
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3.03.02.05	capacity of main hoist for each of the four numbers of cranes under scope of supply. The slings shall be suitable for use with hoist. iii. Each sling shall have a ring at one end and a ring or a hard eye at the other, with matching shackle for the hard eye. Sling rings are to be suitably proportioned to fit on the crane hook. iv. A wall chart shall be provided showing the maximum safe lift of the slings individually and in pairs at various angles. Each sling and shackle shall have a permanent fixed label on which is stamped the maximum safe lift at 90 degree spread. A storage rack for safe keeping of the slings shall also be supplied.			
	Brakes for Various Drives / Motors A) The brakes for various motion drives shall be as per the IS : 3177. The following type of brakes shall be provided for the various crane drives: a) Bridge Travel i) Main Braking by means of frequency speed control of motors down to zero (0) (Regenerative braking). ii) Automatic DC electro-magnetic brake for each motor drive. iii) Automatic Electro-Hydraulic thruster brakes for each motor drive. b) Trolley Travel i) Main braking by means of frequency speed control of motors down to zero (0) (Regenerative braking). ii) Automatic DC electro-magnetic brake for each motor drive. iii) Automatic Electro-Hydraulic thruster brakes. c) Hoisting Motion For Main Hoist: i) Main braking by means of frequency speed control of motors down to zero (0) (regenerative braking). ii) Automatic DC electro-magnetic brake for each motor drive			
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		iii) Automatic electro hydraulic thruster brake For Auxiliary Hoist for Power House and ~~B.F. Valve house crane:~~ i) Main braking by means of frequency speed control of motors down to zero (0) (regenerative braking). ii) Automatic DC electro-magnetic brake for each motor drive. iii) Automatic electro hydraulic thruster brake or double brake discs . B) The electromagnetic brakes shall be of DC type complete with rectifier equipment to convert the available AC 230 V, 50 Hz supply. The electro-hydraulic thruster brakes shall be of AC type. C) The operating solenoids of the DC Electro-magnetic brakes shall release the brakes on energisation and shall automatically apply all the brakes immediately in the event of stoppage, interruption or failure of electrical power supply. The brakes shall also apply immediately on operating the emergency stop push button or switch irrespective of controller position. D) The DC Electro-magnetic brakes shall be of spring set shoe type equally effective in both directions of rotation. The springs for the Electro-magnetic brakes shall be of compression type and shall have adequate factor of safety. E) The brake system shall have the following provisions: a) Locking device in the brake lever. b) Means for adjustment to compensate for wear of the shoes / discs. c) Emergency stop push buttons. F) The wearing surfaces of all brake drums shall be machined and shall be cylindrically smooth and free from defects. The brake lining shall be effectively and permanently secured to the brake shoes during the effective life of the lining and shall be protected from water, grease, oil and other adverse effects. The brake pedals in case of foot operated brakes shall have non-slip surfaces and it shall be possible to apply the foot brakes with a force not exceeding 25 kgs.			
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3.03.02.06	G) All the brakes shall have adequate capacity. The brakes for hoisting when applied shall arrest the motion and sustain the load up to the test load at any position of the lift. Provision shall be made to control with safety the lowering of any load up to the test load. H) Brakes in other motions shall be capable of bringing the relevant motions of the fully loaded crane safely to rest in the shortest possible time with least possible shock and shall arrest the motion under all other service conditions. I) The various brakes shall be designed to exert, the torque equal to 1.5 times the full load torque of motors. J) The brake torques may be increased if considered necessary by the Contractor in order to ensure proper and safe application of the brakes. All Electro-magnetic brake coils shall have continuous rating. K) Each brake of the travel motions shall be equipped with a manual disconnect lever which will allow the brakes to be released without electrical power. Gears The gears and the gear trains for reduction of speeds of the motors for various motions of the cranes shall be designed, manufactured / fabricated and shall have following provisions: a) Only spur and helical gears shall be used for speed reduction gearing. The tooth profiles are to be carefully designed and machined. b) The gears having speeds higher than 500 rpm shall be of helical teeth type with active contact area hardened to a depth of 0.2 to 0.3 mm. c) Shall be made of cast steel or forged steel and designed as per IS : 4460 for the specified crane duty. d) Shall be totally enclosed in oil tight gear cases of welded fabricated steel. e) Shall have Inspection covers on the top of the gear case for quick and easy inspection of gears and for adding oil in the gear case. f) Adequate breathing and drainage facilities on all gear cases. g) An oil level indicator. h) Proper guards for uncased gears. i) Markings of pitch line on all gears for facilitating erection.			
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3.03.02.07	Shaft All shafts shall be designed and made in accordance with the following: - Material - High tensile rolled steel or forged steel. - Shaft diameter to take into account the provision of key slot & splines. Slot bottom shall have proper radius. - Where needed designed with suitable shoulders / step-up diameter for carrying and fitting of gears, pinions and similar parts. - Provision of fillets of ample radius at all diametral changes in sections. - Designed to limit shaft deflection to within $1/3000^{\text{th}}$ of the span between bearings.	
3.03.02.08	Bearings All bearings shall be designed and provided in accordance with the following: - Provide antifriction / roller, ball or bush (sleeve) journal type as applicable for components as per sound practice. - Bearings shall be located close to the points of loading and shall be easily replaceable type. - The bearing preferably shall be of self lubricated type. - Bearings at shaft ends shall be sealed appropriately so as to be drip proof in case of oil lubrication. - In case of grease lubrication type, open ends of bearings to be appropriately sealed with grease retainers.	
3.03.02.09	Lubrication Arrangement of Bearings Lubrication arrangement of bearings, journals, ball & roller bearings in case bearings are not self lubricated type shall comprise the following: - Pressure lubrication system comprising gun for lubrication of all easily accessible grease type bearings with grease nipples. - Centralized hand operated lubrication system comprising pump and grease pipelines of copper or brass for bearings not easily accessible e.g. end carriage wheels. For reliability, distribution lines shall be double lines, ensuring continuous lubrication, in case one line gets choked.	
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	c) Provision to prevent development of excess lubrication pressure at the bearings. d) Gear trains shall be lubricated by oil bath. Sleeve bearings shall be oil lubricated type. e) Initial lubrication of crane before handing over shall be Contractor's responsibility which shall be done in the presence of Employer. f) Portable hand operated lubrication equipment viz. grease gun etc. shall be included in the supply. g) Specification and details of lubricants shall be furnished by Contractor. The brands of oil / grease used above shall be stated.			
3.03.02.10	Drip Pans and Covers a) All bearings and gear cases shall be made oil tight. Suitable drip pans shall be provided to collect oil and grease which may drip from bearings, gear cases and other components of the crane. In case drip proof arrangement is not possible, means for cleaning the drip pans shall be available. b) Dust covers shall be provided where necessary to protect sliding and rotating parts and to prevent dust from mixing with the lubrication.			
3.03.02.11	Bumpers Resilient / spring bumpers shall be attached to the bridge trucks and the trolley. The bridge shall have four bumpers one at each corner, arranged to meet the crane stops squarely. The trolley shall have two bumpers on each side placed to meet the track stops squarely at the end of the stops. The bumpers shall be capable to absorb safely the kinetic energy and shall be capable of bringing the crane and the trolley to a gradual stop when travelling at rated speed in either direction, when the power supply is suddenly cut-off and thus, eliminate excessive stresses and damage to any part of the crane.			
3.03.03	Electrical Features and Parts of Cranes			
3.03.03.01	General a) The electrical drives, switchgear and controls for various motions for the cranes shall comprise of electric motors of requisite capacities for specified duties and speeds, switches, breakers, resistors, electromagnet brakes, isolating switches, controllers, earthing, cabling / wiring, in accordance with the latest version of IS : 3177.			
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	b) The power supply for the electrical equipment shall be 415 V, 3 phase, 4 wire, 50 Hz AC. The supply for crane control shall be 110V AC and for lighting shall be 240 V, 1 phase, 50 Hz AC and shall be obtained through individual 415/110V AC & 415 / 240 V transformers, wherever necessary. These transformers shall be part of crane supply. All electrical equipment shall be suitably designed and constructed for operation under tropical conditions. c) Permissible temperature rise of the electric motors and individual components of associated switchgear equipment shall be as prescribed in the Indian standards and shall be based on ambient temperature of 40°C. d) The electrical control, operating mechanisms and devices shall be located and arranged in neat and convenient manner which shall be subjected to the approval of the Employer. Crane control levers, motors, switches and other operating mechanism shall be marked plainly and permanently. e) The technical particulars of various electrical equipment and devices shall be as specified here in. The Contractor shall furnish the make, type and other relevant details of the electrical equipment devices, being offered by them. Description Equipment for controlling this drive shall be a multi drive system, with inverters in one cabinet. Each cabinet consists of one common rectifier with a common DC-bus, with inverters connected. This system will, in case braking energy is being supplied from one motor, supply the energy to the next motor connected to the DC-bus. If the braking energy exceeds the energy used by the other inverters, a braking chopper will open, and supply the energy to a braking resistor. It is a vector controlled frequency converter, which means it can drive a motor through 0 rev. at full torque. To achieve this a Pulse encoder (Tacho) is used at the motor to control the flux and phase shift, in order to obtain the exact position of the rotor. All frequency converters shall be connected to application process controller (APC), where all controls on the frequency converters shall be done. The APC shall programme the application to fit the required specifications. The APC shall be also provided with communication controllers to other systems, or frequency converters. The control shall be closed loop vector control system.	
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3.03.03.02	Functional Description Each movement of the crane motors is controlled by joysticks in the crane control cabin. Motors are controlled by the APC in the frequency converter cubicle. The APC gets the direction / speed signals from the joystick. The APC calculates the speed and torque, in order to secure correct speed. When stopping the operation of hoisting or lowering, the APC performs commands to the frequency converter, for lowering the speed to zero, and keeping it at zero speed before giving order to turn on the brake. When starting the operation of lowering or hoisting, the APC controls the frequency converter with a certain torque before releasing the brake, in order to avoid any drop. If the braking energy exceeds the energy of all the frequency converters, the braking chopper will open and use the braking resistor. When being in "position Mode", the joystick signal is being disabled and only joystick movement signal is being used. When the crane operator moves the joystick forward, the crane will move only over a predefined distance, and stop. To move an additional step he will have to move the joystick once more etc.			
	Detailed Specifications of Individual Equipment a) Motor for Various Motions i) Motor Standards As per IS: 325 and IS: 3177 ii) Capacity Of ample capacity to suit respective duties. Full load torque of motors shall be higher than the maximum load torque. iii) Type and Enclosures All motors will be of squirrel cage type to suit 415 V, AC, 3 phase, 50 Hz, four wire power supply, totally enclosed. The motors shall be suitable for direct on line starting any hoisting / lowering rated load, even in event of frequency control system being out of order. Protection. iv) Variation of Voltage & Frequency IP- 54 with fan cooling arrangement for Power House crane, ~~for B.F. valve house crane.~~ Voltage: $\pm 10\%$, Frequency: $+3\%$, -5% Any combination values of voltage and frequency variations within the above limits.			
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		v) Pull out torque vi) Insulation vii) Time rating viii) Temperature rating ix) Rated synchronous speed x) Over speed xi) Space heaters xii) Motor bearings xiii) Tests xiv) Temperature rise xv) Climate xvi) Terminal xvii) General requirements	Not less than Two point seven five (2.75) times the full load torque of motors at rated voltage and frequency. Class - F One (1) hour for all motors Temperature rise not to exceed the limits in Table-1 of IS : 325. Max. Temperatures rise at full load measured by resistance method shall not exceed 70°C over the maximum ambient temp. of 40°C. To suit duty for various motions Two point five (2.5) times rated capacity withstand speed or 2000 rpm whichever is less To be provided in case motor capacity is ≥ 20 KW (To suit 240 V, AC supply) Roller type. Sealed to prevent grease leakage and entry of dust. Shall be of ample strength to withstand heavy shocks and vibration to which subjected under all conditions of operation. Type & routine tests as per IS : 325. Copies of test reports to be furnished by the Contractor By resistance method measurement Shall be located indoor in tropical climate. Protection against fungus, vermin, and corrosion shall be provided Shall be arranged such that terminals are easily accessible for inspection and maintenance. Natural ventilation shall not be restricted Sturdy and strong to withstand operational shocks and vibrations	
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3.03.03.03	b) Limit Switches					
	c) Limit switches for hoisting motion shall be spindle type, while for bridge and trolley motions, these shall be of lever / roller and proximity type with maintained contacts. The number of limit switches shall be as under:					
		Motion /Travel	Travel	Raising	Lowering	Emergency 'up' limit
	Main Hoist	-		1	1	1
	Auxiliary Hoist	-		1	1	1
	Bridge (two-way self-resetting type)	2	-	-	-	-
	Trolley (two-way self-resetting type)	2	-	-	-	-
	Type, contact rating and resetting of limit switches shall respectively be totally enclosed type, 5 A at 240 V AC, by reversing the controller.					
	Load Cell System					
	a) The main and auxiliary hoist on the Powerhouse crane as also the ~~B.F. Valve House Crane~~ shall be equipped with a load cell system capable of measuring the load on their hooks. The load cell system shall measure loads from 0 to 130% of the hoists rated capacity with a precision of ± 5% or better, between the effective and the indicated loads, for all loads between 0 and 130% of the rated load of the hoists.					
b) The load cell shall be of corrosion-resistant steel construction and shall be designed with a factor of safety of not less than four (4) at 130% of the rated hoists capacity, relative to the ultimate strength of the material.						
c) The load cell system shall operate from the crane's AC power supply and shall display the load on the hooks in tons through a 3-digit display or meter readout located at the stand-by station.						
d) The load cell system shall incorporate a capacity limiting feature which will prevent the crane from handling a load which exceeds a set point by stopping all crane motions. This point shall be adjustable for any load between 90% and 120% of the hoists rated capacity. Whenever this feature stops the crane, a flashing red light, visible from the floor beneath the crane, shall be energized, to indicate that the crane is overloaded. An override						
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		switch shall be provided in the radio control transmitter to allow for overload tests. The response of this capacity limiting feature shall be suitably delayed to compensate for the momentary, dynamic loading when the hoist's motors are started.											
3.04.00		Electrical Controls and Protection for Operation of Cranes											
3.04.01		General											
		a) Each crane of Power House, ~~Butterfly Valve House~~ shall normally be controlled from the floor by radio control. The cranes shall also be controllable from a stand-by control station located in the operator's cage. This stand-by station shall be equipped with a complete set of lever type controls for temporary crane operation and shall provide reasonable visibility for the operator to permit safe temporary operation. The crane shall be provided with a control scheme selector switch located at the stand-by control station. This switch shall select between the radio control and the standby control scheme. Modes of operation shall be controllable by the radio control scheme. b) The radio control system shall provide all crane motions with separate control levers. c) All crane motions (hoist, trolley, and bridge) shall be regulated by adjusting either the voltage and / or frequency of the motor electrical supply with a variable frequency drive device. d) Each crane shall be provided with control panel / desk located in the operator's cabin. The controls shall provide for Individual independent control of cranes for all motions and various speeds up to normal speeds.											
3.04.02		Control Switches, Levers and Speed Controls											
		a) For individual independent control (start, stop and motor speed selection) of each crane, lever type switches shall be provided. b) The controls shall provide for torque and speed control of the various motors in following number of steps in both direction of motions : c) For Power House cranes: <table><thead><tr><th>Description</th><th>Hoisting</th><th>Long Travel</th><th>Cross Travel</th></tr></thead><tbody><tr><td>Hoist Motor (Main and Auxiliary Hoist)</td><td>6 Steps</td><td>-</td><td>-</td></tr></tbody></table>				Description	Hoisting	Long Travel	Cross Travel	Hoist Motor (Main and Auxiliary Hoist)	6 Steps	-	-
Description	Hoisting	Long Travel	Cross Travel										
Hoist Motor (Main and Auxiliary Hoist)	6 Steps	-	-										
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3.04.03	Bridge Travel - 4 Steps -																							
	Cross Travel - - 4 Steps																							

	The trolley travel controllers shall be provided with drift points in both directions of travel.																							
	ii) For B.F. Valve House crane																							

	<table><tr><td>Description</td><td>Hoisting</td><td>Long Travel</td><td>Cross Travel</td></tr><tr><td colspan="4">-----</td></tr><tr><td>Hoist Motor (Main) and Auxiliary Hoist</td><td>6 steps</td><td>-</td><td>-</td></tr><tr><td>Bridge Travel</td><td>-</td><td>4 steps</td><td>-</td></tr><tr><td>Cross Travel</td><td>-</td><td>-</td><td>4 steps</td></tr></table>				Description	Hoisting	Long Travel	Cross Travel	-----				Hoist Motor (Main) and Auxiliary Hoist	6 steps	-	-	Bridge Travel	-	4 steps	-	Cross Travel	-	-	4 steps
	Description	Hoisting	Long Travel	Cross Travel																				

	Hoist Motor (Main) and Auxiliary Hoist	6 steps	-	-																				
Bridge Travel	-	4 steps	-																					
Cross Travel	-	-	4 steps																					
Remote Radio Control																								
a) General																								
i. The operation of Power House cranes from machine hall and service bay floor shall be made by remote radio control system. However, provision for control of these cranes, operated individually from the floors immediately below the cranes available during the progressive construction of the power house (including the lowermost floor) when subsequent floors have not been casted, shall also be possible by the above remote radio control system.																								
ii. ~~Provision for control / operation of the B.F. Valve House crane from the B.F. Valve house floor shall be made by remote radio control system.~~																								
iii. The equipment furnished shall provide for the complete radio control of all crane functions specified in following paragraphs.																								
iv. Each radio controlled crane shall be equipped with a 100-W amber indicator lamp located beneath the center of one of the bridge girders. This light shall be energized whenever the crane is in the radio control mode and the crane's master contactor has been energized.																								
v. Reliability, dependability, and ease of maintenance shall be prime considerations in the design and construction of all components and parts of the equipment, to ensure positive operation of the system under all conditions of dust, moisture, temperature, vibration, and electrical interference. Reduced maintenance requirements and long service shall be achieved through simplicity and use of conservatively																								
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	rated, heavy-duty industrial type parts. The design of the equipment circuitry and application of components shall represent the state of the art. vi. Wherever practicable, replaceable modules with reliable plug-in connections shall be used. vii. The system shall be designed so that no field tuning adjustments will be required when replacing a faulty module and shall permit a field change of the operating frequency by replacement of plug-in type components with minimum adjustment. viii. The radio control equipment shall be the type accepted by and shall conform to all applicable Government rules and regulations. The frequency of operation shall be in the requisite frequency band. However, the remote radio control of the two cranes of the power house shall operate at different operating frequencies within the requisite frequency band. The Contractor shall perform a frequency search and shall obtain license on behalf of the Employer. xi. Radio crane control equipment shall be of reputed make. b) Operation i. The following function shall be radio controlled: • Forward and reverse speed control of the bridge travel motion; • Right and left speed control of each trolley (crane and monorail hoist) travel motion; • Up and down speed control of each hoist motions; • On and off control of the lights on the underside of the crane bridge; • On and off control for the crane's alarm gong. • On and off control of the crane's master contactor : ii. The speed control of each motion shall provide for the direct radio stepless control specified for that motion. iii. Stepless radio control shall be accomplished with a speed set point telemetering system utilizing pulse rate, pulse width, or other similar systems. The speed of a motion shall be a direct function of the control lever's position and shall preferably utilize a logarithmic scale	
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	for greater control of the slower speeds. A "jogging" system of controlling a motorized potentiometer or any other system, in which the control lever's position corresponds to acceleration rather than a speed is unacceptable. iv. Control information shall be transmitted using digitally coded information. The radio control system shall allow simultaneous transmission of all crane functions. A means of checking and detecting error in the digital data stream shall be provided to prevent a misoperation of the crane. Radio interference signal shall not cause operation of any of the crane functions. v. The power supply to the radio receiver shall be obtained from a branch circuit in the power distribution panel. vi. When a "control hand-over" feature is specified for a crane, there shall be 2 radio control units, each equipped to control all crane functions and tuned to operate on different radio frequencies. Interlocking circuitry in the receiver shall permit only 1 of the 2 control units to be effective at a time. There shall be no crane motion when one of the units takes control, and all crane drives must be stopped when a unit releases control. c) Safety i. The complete control systems shall be designed to provide maximum safety for personnel, crane equipment, adjacent structures, plant equipment, and material being conveyed. The equipment shall comply with all laid down safety requirements applicable to this class of equipment. ii. Control signal combinations shall be designed for safe operation so that uncommanded operation of any crane cannot result from stray or transient control signals or from extraneous natural or man-made sources of radio frequency interference. iii. The system shall be designed "fail safe". Failure of electronic components or normal aging beyond specific limits shall result in stopping all crane motions. Crane motions shall also stop when any crane receiver is out of the range of its transmitter. iv. A "dead man" feature, consisting of self-centering control levers and safety cut-off switches, shall be built into the control transmitters to cause all crane motions to stop if the operator releases pressure on the corresponding control lever or if he accidentally trips, or fall or drop the transmitter.			
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	e)	Receivers			
	i.	Receivers shall be designed to respond only to signals from the transmitter control unit designed and adjusted for operating that specific receiver.			
	ii.	Receivers shall be shock-proof to resist vibration.			
	iii.	Receiving antennas shall be of rugged construction and shall be mounted under the crane bridge.			
	iv.	The receivers shall be completely solid state. All semi-conductors shall be silicon to the extent practicable.			
	v.	Failure of any electronic component shall result in "fail safe" operation bringing all crane motions to a halt. Uncommanded motions shall not be possible. Digital coding shall be designed to prevent inadvertent control actions.			
	f)	Intermediate Relays			
	i.	Intermediate relays shall be heavy-duty type with 10-A continuously rated contacts and shall be capable of withstanding inductive transient voltages resulting from crane control contactor operation. Surge suppression shall also be provided to protect receiver components from inductive transient voltages.			
	ii.	Intermediate relay panels shall be separately fused and provided with disconnect devices.			
	g)	Alarm Gong Operation			
		The crane shall have a radio control function to sound the alarm gong whenever the operator elects.			
	h)	Operating Distances			
		The crane shall be operable by radio control system from a minimum horizontal distance equal to the length of the crane's runway. It shall be operable at this distance from the available floor immediately below the crane.			
3.04.04	Operation of Brakes				
	Whenever power supply to the various drive motors for various motions are cut-off, the brakes shall be automatically and instantly applied. The brakes shall also be applied immediately in case of any over speed of the hoist motor in the lowering direction.				
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3.04.05	Electrical Interlocks a) The main circuit breaker (CB) for power supply to the crane shall have interlock providing CB to be able to be closed only when all the control lever switches for the various motors are in "Off" positions. The interlock shall be so arranged that if the contactors for various motors / drives have failed to open even through the control lever switches have been brought to the "Off" positions, the CB will not close. b) The master controller shall be provided with a thumb operated auxiliary switch so as to ensure the safety of personnel and equipment in case of loss of attention or chance death of the operator during operation of any crane. The control circuit of the master controller shall be so arranged that all the controls during starting and subsequent operations shall be de-energised unless the thumb operated switch is kept in pressed position. During the operation also if the operator fails to keep it pressed, the power supply to the controls shall be disconnected. c) An isolator fitted on the crane bridge which cannot be operated from the floor, shall be provided to prevent inadvertent operation of the crane from the floor from Radio Remote Control system while maintenance work is being carried out on the crane. d) Power supply to the cranes shall be provided at two ends at for power house cranes, for ~~B.F. valve house crane~~. T.P. isolators with indicating lamps shall be provided at these locations so that it can be operated from ground and power supply can be cut off immediately in case of any emergency condition.	
3.04.06	Miscellaneous Features The controls shall have following provisions: a) 3 pole 415 V AC, ACB with rupture current not less than 20 KA. b) A master push button for complete emergency stop in the cabin at a convenient location. c) A key operated electrical switch for the control circuit to prevent unauthorised operation and for the safety of maintenance and operating personnel. d) Indicating lamp to show that the control circuit is healthy. e) Indicating lamp for the main circuit breaker position (OFF or ON). f) Radio Remote Control system with proper indication. g) All control panels shall be of minimum 14 SWG, CRCA sheet steel.	
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3.04.07	Automatic Electrical Protection The electrical equipment and circuitry shall be provided with automatic protection, as detailed below against various faults and mal-operation of the equipment. a) Protective relays for protection against instantaneous over-current, over-load, single phasing and under voltage for all motors. The OC relay shall be adjustable between two (2) to three (3) times the full load motor current. b) Protective relays of motors to trip the main power supply circuit breaker in case of their operation due to fault. c) MCCB's for control and protection of all motor circuits. d) Air circuit breaker located in operator cabin, of 3 pole, 415 V, A.C, totally enclosed type for power supply tapping from the main collectors, with interrupting capacity not less than 20 KA, equipped with short circuit, overload and under-voltage trip devices and one shunt trip coil and prevention against single phasing, three (3), timer relays and other necessary devices / items. e) Protection against over speed of the hoist motors which shall cut-off the power supply and apply the brakes in case any hoist motor speed increases to 105% of the rated synchronous speed. f) Operation of any protective relays of motors shall trip the motor supply circuits by opening the primary contactors of the motors.			
3.04.08	Control gear Accessories a) Motors i. Controls for various motors shall be full magnetic reversing type with definite time limit or frequency controlled acceleration devices. ii. The motor - speed changes shall be provided by variable voltage & variable frequency for Power House, ~~B.F. valve house cranes.~~ iii. Master switches for operation shall be vertical type lever handle design pointing in the actual direction of the performed motion when operated. These shall be suitably labeled indicating directions of motion for which they are meant. b) Circuit Breaker / Controllers. Each main supply circuit breaker or contactor shall have an interrupting capacity of not less than 45kA symmetrical at 415 volts. All switches, contactors, primary relays and primary circuits on the controller shall have a thermal capacity corresponding to 45kA for one second without injury and shall have a rating of atleast 660 volts and capacity ratings in accordance			
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	with the British Standards or those of the National Electrical Manufacturer's Association (NEMA) standards. Allowable temperature rises shall be as prescribed in the Indian Standards or other equivalent standard and based on an ambient temperature of 40 deg. C. c) All switchgear control and protective equipment viz breakers, contactors, controller control switch, HRC fuses, relays, meters etc. shall be housed suitably in a cabinet placed in a manner convenient for operation and maintenance in the cabins / travelling girders of the cranes for wiring suitable terminal blocks complete and ready for making external connection shall be provided. The cabinet shall be tropicalized. 3.04.09 Alarm Gong An electrically operated alarm gong or buzzer which will sound while the crane is in motion shall be furnished with each crane. The alarm gong shall also be operable from a conveniently located switch when the crane is not in motion. 3.05.00 Power Supply Tapping & Other Electrical Arrangement 3.05.01 Collectors The collectors shall be designed to reduce sparking between collectors and conductors to the minimum. The minimum clearance between live parts and ground parts shall be 80 mm. The collector shall be suitably covered to avoid accidental contacts. 3.05.02 Trolley Conductors The trolley conductors shall be of PVC/TRS flexible trailing cable type of copper core and of suitable size. It shall be mounted on retracing support. 3.05.03 Down Shop Leads (Main Runway Conductors) a) A safe, robust and compact approved shrouded type down shop leads (DSL) power supply system with suitable collector using latest technology shall be provided for the along the entire length of Power House and ~~B.F. Valve House~~. The locations of these conductors are shown on respective specification drawings. It shall consists of substantial rolled copper conductors or angle iron of adequate capacity with end brackets and insulators, straining bolts, intermediate brackets and insulators etc. to suit various caverns / underground buildings. One end of each conductor shall be fitted with a terminal log to enable power and earth wires to be connected. Safety guards shall be provided to avoid the possibility of any accidental touch with these conductors. The supply to D.S.L. shall be controlled by two (2) nos. L.T. breakers installed at each end at a convenient place so as to receive the supply from L.T. Switchgear.	
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	b) Down shop lead conductor system shall have ratings and characteristics as follows: - Normal operating voltage, V 415 - Maximum design voltage, V 600 - Number of poles 3 + 1 N Theses conductors shall have a continuous current rating as necessary to supply the maximum demand during crane operation, as determined by the greater of the following two (2) operating conditions: - Load current for the simultaneous operation of main hoist motors and all bridge travel motors and - Load current for the simultaneous operation of main hoist motors and all trolley travel motors. c) The Down shop lead system, when assembled in place, shall permit independent longitudinal movement of the housings and conductors to allow for unequal thermal expansion and contraction. All conductors wherever required shall be housed in a common enclosure made of sheet steel not less than 16 gauge thick. Conductors shall be capable of carrying the rated current per pole continuously without overheating. Pickup trolleys shall have wheels equipped with sealed ball bearings and contacts of sufficient size to maintain full current carrying capacity without overheating. Contacts shall maintain constant contact pressure and alignment with the conductors. d) The Contractor shall furnish all necessary supports, wall brackets, mounting bolts and accessories, anchor bolts, concrete inserts, and conduit and cable connections for the power supply to the feed box. The Contractor shall verify and satisfy himself about the adequacy of levelling, grouting etc.	
3.05.04	Power Conductors for the Crane Trolley Trolley power conductors shall be of the festooned (looped) insulated wire type. Each motor on the trolley shall have separate conductors for the power and control circuits, and in no case shall a power conductor be used as a common conductor for more than one circuit. The power conductors shall be insulated, jacketed, 90°C conductor temperature, extra flexible cables. All conductors, insulators, and brackets shall be supplied with each crane.	
3.05.05	Circuit Arrangement a) The leads from the down shop collector shall be connected to a master manual magnetic contactor which shall be controlled by "on" and "off" pushbuttons and / or radio-controlled relays as specified for each crane. A	
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3.05.06	control transformer shall be provided to activate the contactor and the radio receiver. The master contactor shall be connected to two (2) circuit breakers, each of appropriate carrying and interrupting capacity. One circuit breaker shall be connected to a 415 V/ 220 V, 3-phase, dry-type transformer of the rating required to supply power for all lights, controls, heaters, and convenience outlets on the crane. The second circuit breaker shall supply the main feed for the bridge, trolley, and hoist motors. b) A 220 V, distribution panel equipped with branch circuit breakers as required, shall be provided to distribute power to the lights, heaters, and receptacles. c) Interlocking circuits shall permit closure of the contactor only when all motion controllers are in the "off" position. Other interlocking features, as specified for the individual cranes, shall also be furnished. Wiring All electrical wiring shall conform to latest version of IS : 1554 (part I) "PVC insulated (heavy duty) electric cables, for working voltage upto and including 1100 volts". All conductors for primary power, lighting and control circuits shall be insulated for not less than 1100 volts and shall have standard moisture resisting double braid coverings. All conductors between the secondaries of the motor contactors and resistors shall have sufficient current carrying capacity in accordance with the standard specifications and shall be insulated with 1100 volts class asbestos, high temperature type tropical insulation with moisture resisting impregnation. The primary conductors to the motor shall have standard, continuous current carrying capacity of not less than 100% of the rated full load primary current of the motors. All control and lighting conductors shall be of copper of suitable sizes. All the wiring shall be subject to approval of the Employer. All wiring shall be laid in hot dip galvanised metal conduits. Alternately armoured cables can be used. Conductor having nominal equivalent copper area of cross section less than 2.5 mm shall not be used for wiring.			
3.05.07	Illumination and Convenience Outlets The permanent AC illumination system on the crane shall consist of four 1000 watts high bay beamed flood lighting units for the Power House ~~and two 1000 watts high bay beamed flood lighting units each for BF Valve House~~ to illuminate uniformly the area under each crane. Two 100 watts lighting units and two convenience outlets shall be provided in operator's cabin. A convenient outlet at each end of the bridge shall also be provided. The system shall be supplied from 415 V. AC crane power system through 415 V circuit breaker. For lighting and convenience outlets, 4 branch circuits shall be taken; one connected to two 100 watts lights in the operator's cage, another two branch circuits each connected to two 1000 watts high bay lights and fourth branch circuit connected to four convenience outlets. The wiring shall be done in accordance with latest Indian Electricity Rules. The 415V circuit breaker shall be provided with an overload tripping element for each pole.			
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3.05.08		The flood lighting units shall be suitable for control by both on-off push-buttons and radio control. A portable hand lamp with plug and 25 m long wiring shall also be supplied for each of the crane by the Contractor for use during maintenance. Earthing a) The crane structure, motor frames and metal cases of all electrical equipment including metal conduits or cable armoring or guards shall be efficiently bonded to facilitate earthing as per Indian Electricity Rules 1956 and latest edition of IS : 3043. b) The Contractor shall provide an earthing system to which all equipment under his scope of supply shall be interconnected. This system will in turn be connected to the power house earth mat.			
3.06.00		Runway Rails, and other Miscellaneous Items			
3.06.01		Runway Rails for Power House, ~~BF Valve House~~ a) One (1) set each of runway rails suitable for each sets of cranes complete with sole plates, anchor bolts, clamps etc. for the bridge travel shall be designed and supplied by the Contractor. The rails shall extend for the : i. Power House length covering the generating units and service bay. ii. ~~Butterfly Valve House length.~~ b) The runway rails for Power House and ~~B.F. Valve House cranes~~ shall preferably be CR-100, CR 80 type respectively, as per IS : 3443. . The faces of the rail lengths shall be inclined at an angle of forty five (45⁰) degrees to the length to provide oblique gaps between rail lengths. c) The rails for bridge travel shall be laid on and fixed to the crane beam by means of anchor bolts etc. The Contractor shall supply all the materials including embedded parts for fixing the bridge rails on the crane beam. The supervision of erection of embedded parts for crane rails shall be responsibility of the contractor.			
3.06.02		End Stops Suitable end stops shall be provided at the end of the runway-rails for each set of the cranes.			
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3.07.00	Miscellaneous Requirements	
3.07.01	Hook Reach Limits The required hook reach limits are indicated in this specification and also in specification drawings (Part-E) etc. However, this is subject to review during detailed engineering.	
3.07.02	Specification Drawings The supplier shall note that the specification drawings as appended with the tender documents are merely illustrative and are not to be construed as defining or limiting the design of cranes.	
4.00.00	SHOP ASSEMBLY AND TESTS	
4.01.00	General a) The Quality Assurance Plan and requirement of tests in general have been discussed in Part-B Section VI of the specification. All applicable tests as laid down in IS : 807 and IS : 3177 shall be carried out. b) All motors, accessories and auxiliary equipment forming part of the crane shall be tested in accordance with the requirement of the latest relevant IS / IEEE standards. Each mechanical and electrical sub-assembly shall be tested for proper functioning and continuity of the electrical circuit. c) On all auxiliary equipments, routine and type tests shall be carried out in the shop as per standard and test certificates shall be submitted to the Employer for approval before despatch.	
4.02.00	Material Tests The material tests shall include chemical analysis, mechanical test and non-destructive tests. a) Chemical analysis: For all main components and components exposed to high stresses and / or conditions where the composition is of importance, chemical analysis of the material will be carried out in accordance with normal practice to verify that the components conform to the required specifications. b) Mechanical Tests : Mechanical tests will be carried out on all main components according to the normal practice and relevant standards to ascertain that material properties conform to the requirements and specification. Such tests include the determination of the yield strength, UTS, elongation / contraction and impact	
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	strength in aged / non-aged condition as required. Bend test of plates and sheets will also be performed as required. c) Non-Destructive Test i) Non-destructive test include ultrasonic test, x-ray tests, magnetic particle tests and dye-penetrant tests. ii) The test of visual examination will be carried out on all principal castings and forgings which are subject to, or affected by, high service stresses. Defects, if any, will be removed by suitable means and soundness of metal will be checked by means of magnetic particle or dye penetrant inspection. iii) Plates which are subjected to high service stress impact, fatigue, or vibration stress will undergo visual inspection and ultrasonic testing prior to use for manufacture and welding. iv) All welds shall be 100 % radiographically tested. Alternatively, these shall be subjected to ultrasonic examination. Defects in welds disclosed by ultrasonic or radiographic testing or dye penetrant or magnetic particle testing will be completely removed by chiseling and after re-welding, the new weld will again be subjected to radiographic examination for soundness. v) The tests shall be carried out as per applicable National / International codes and standards.			
4.03.00	Radiographic Test on Welded Joints Welded joints of the bridge girders shall be one hundred (100%) percent tested during the course of fabrication (radiographic / ultrasonic sound test / magnetic particle test) and test certificates shall be submitted to Employer for their approval.			
4.04.00	Test on Steel Plates Steel plates used for manufacture shall be certified by the steel plate producers, highlighting the following information a) Charge No. b) Chemical analysis of the melt c) Plate thickness and size d) Following tests along rolling direction i. Yield strength, tensile strength and elongation rupture			
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4.05.00	ii. Three ISO, V-notch toughness test at 0°C in the thickness direction The findings should conform to minimum requirements of the specification for the material approved for the relevant structure. Ultrasonic tests will be made on all plates subject to lateral stress. Shop Assembly Test a) The cranes shall be subjected to tests as elaborated in , Part-QA, Section VI of the specification. b) The cranes shall be load tested as per IS 3177 including overload test. c) All control elements, including brakes and limit switches, shall be connected and operable for the shop test. The controls shall be tested, and all relay operations shall be checked.				
5.00.00	FIELD ASSEMBLY, ERECTION, TESTING AND COMMISSIONING				
5.01.00	General				
	a) All equipment will be assembled and installed in accordance with the applicable Drawings; written instructions of the Contractor and applicable codes, standards, and specification. Test will include, but not be limited to, those specified herein. b) Details of complete procedure and sequence of operation shall be indicated. The mobile crane, if needed, shall be arranged by the Contractor. All the tools, tackles, instruments, devices and any consumables needed for the erection, testing and commissioning of the EOT cranes shall be arranged by the Contractor. c) All welding done at site shall be subject to 100 % radiographic examination.				
5.02.00	Preliminary Checks The crane equipment shall be examined for proper field assembly and damage during shipment. In particular, it will be checked for rain or moisture damage to motors and panels, inadequate painting, accumulations of dirt and rubbish, and oil leaks.				
5.03.00	Site Tests The Contractor shall furnish a complete list in sequential order of all essential site tests to be performed on cranes during the course of assembly, erection, pre-commissioning and commissioning. The Contractor shall furnish a comprehensive and exhaustive list of all such tests, covering test values & permissible tolerances				
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5.04.00	for approval during design stage which shall cover but not be limited to tests stated in the following clauses: No-Load Static Tests - All gearing, bearings, couplings, and rotating parts will be checked for proper oil level or lubrication, and hydraulic brakes will be checked for brake fluid. - The controller for each motion will be checked to ensure that hook and travel motions agree with marked controller directions. - All lights will be checked for satisfactory operation and to determine if lamp fixtures on each bridge walkway are operable and convenient for re-lamping. - All hooks will be numbered and all throat openings will be measured and recorded. These values will be compared to the dimensions recorded by the Contractor - Overall inspection & verification of crane dimensions, clearances, hook reaches and other important items. - Verification of insulation resistance for electrical equipment and wiring circuits. - Operational tests on each controller, switch, contactor, relay and other control devices including limit switches. - Operational tests on all protective devices. - Tests for checking correctness of all circuits, interlocks and sequences of operation. - Any other tests as laid down in IS : 807 & IS : 3177.			
5.05.00	No-Load Operation Tests Each hoist will be run in both the hoisting and lowering direction for the full length of the hook lift until the limit switches stop travel. Both upper and lower limit switches will be checked for proper setting (for resulting hook elevation and amount of rope remaining on drum after switch stops travel) and operation. The additional overtravel limit switches will also be checked by temporarily by-passing the action of the normal upper limit switch. Each hoist will be checked to determine whether the hooks operate within the specified maximum speed ranges. At least two (2) complete raising and lowering operations will be made for each hoist at maximum speed. Proper alignment, quiet operation, and any major tendency toward overheating of motors, bearings, and gear drives will be checked. Hoist brakes will be checked to determine whether they are functioning properly.			
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5.06.00	ii. All hook approaches, both the side approaches to the rails and the end approaches to the end walls, will be checked for conformance to approved shop drawings and the requirements of these Specifications. The limit switches shall allow the specified hook approaches or better approaches. iii. The trolley will be run in each direction of travel for at least four (4) complete cycles of trolley travel to disclose any tendency towards noisy operation and misalignment at bearings, gearing, or motor. The trolley will be checked to determine whether the trolley travels at the required speed. The motion of the trolley upon setting the controller to the "off" position will be checked to determine whether the travel brake correctly stops the trolley. iv. The bridge drive will be run in both directions of travel for the full available length of runway. The test will consist of a check for quiet operation as well as a check of both the electric and hydraulic brakes. The bridge will be run at full speed in both directions to determine whether the drive operates within the specified maximum speed range. The electric brake and drift points will be checked for smooth and effective operation. Rated Load Tests a) Hoist i. With each hoist loaded with its rated load, the tests outlined under this specification shall be repeated except that the additional block-operated over travel limit switch operation need not be rechecked. The operation of the electric load brake will be carefully checked. All components will be checked for overheating. Operating speed on the maximum speed point will be checked and recorded. The maximum lowering speed will be checked to ensure that it is not more than 125% of the no-load hoisting speed. The control system will be checked for proper operation. The first speed point will be checked to ensure that it does not exceed 5% of the no-load hook speed in the lowering direction and 25% in either direction. The entire hoist will be checked for overheating after completing the hoisting and lowering cycle with the test load. ii. The loaded hoist will be checked to determine whether the hoist control and the solenoid brake satisfactorily control the handling of the load. The hoist must demonstrate its ability to raise, lower, and hold the rated load in any position. b) Trolley Travel The tests outlined above will be repeated for the trolley with the hoists loaded with their rated load.			
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5.07.00	c) Bridge Travel The tests outlined above will be repeated with the main hoists loaded with their rated load. Overload Tests a) Hoist With each hoist loaded with 125% of rated load, the hoist will be checked to determine whether it can raise, lower, or hold the overload in all speed positions without a drift. Each hoist will be checked to determine that the load will not lower on any hoisting position. The throat openings of all hooks will be re-measured and recorded after the overload test and compared to the initial measurements to check for deformation. b) Bridge The bridge structure will be checked for excessive deflection while loaded with 125% of their rated capacity with the trolley at the center of the crane span. c) Travel No trolley or bridge travel will be required during the overload tests. d) Deflection of the bridge girders with 100% and 125% of full load keeping the trolley at the centre of the crane span shall be measured and should be within the limits prescribed in the standards and as guaranteed in this specification.	
5.08.00	Test Load Frames a) The Contractor shall design, submit Shop drawings, manufacture, and deliver suitable cradle or a test load frame (or frames) and all required slings to be used for the rated load and overload tests on each of the cranes to be furnished. The test loads will be made up of steel test weights or any other suitable material. Standard sizes of semi-finished steel ingots or slabs can be used as test weights. b) The powerhouse crane will be completely tested as described above, including the rated load test and the overload test. Each crane will be tested separately. Test load frames shall be provided for all the load tests required such as the testing of the tangs of sister hooks and center pin holes in sister hooks. Each crane will have its hooks tangs tested first, as described for the rated load tests.	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9		TECHNICAL SPECIFICATION SECTION-VI PART-B SUB-SECTION - M3 PAGE 67 OF 68

CLAUSE NO.	E.O.T. CRANES (M3)	एनटीपीसी NTPC हाइड्रो hydro		
5.09.00	c) The test load frames shall be designed to support a sufficient quantity of steel or concrete test weights for the required load tests. The material of the test load shall be decided by the employer subject to the availability at site. The design of the frames shall make allowances for varying heights as well as for other possible deviations in the overall dimensions of the concrete/ steel test weights. The test load frames as the case may be (steel or concrete test weights) shall be designed at the same stress levels as the crane structure. d) All pins or other devices for attaching the frames to the hooks and slings and other required accessories for all required tests shall be provided. e) Test load frames shall be shop assembled to assure proper fit during field erection. f) All structural components of the test load frames shall be cleaned and painted as per painting specification elaborated in Part C, Section IV of the specification. The Test Load for the load test at Site shall be provided by Employer within the vicinity of project site (including barrage area). Transportation, handling etc. of test loads from their location to the power house and back to their original location shall be done by the contractor.			
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SECTION-III

DOCUMENTS TO BE SUBMITTED ALONG WITH BID

	RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANES FOR POWER HOUSE (125/25 T)	SPECIFICATION NO.: PE-TS-414-501-A001	
		SECTION: III	
		SUB SECTION:IIIA	
		REV: 00	DATE: 14-01-2022
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DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

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

- a) Signed and Stamped copy of Compliance cum Confirmation Certificate
- b) Unpriced copy of price format as enclosed with tender indicating quoted/ not applicable against each row/ column.
- c) Unpriced copy of Cost of Withdrawal (Deviation schedule) sheet in format attached with GCC. Any Deviation/s with reference to specific clauses of the technical specification to be mentioned in "Cost of withdrawal" format only. Any deviation which is mentioned elsewhere in the offer, shall not be taken into cognizance. Bidder to indicate no deviation in this sheet, in case of no deviation to tender specification.
- d) Signed and Stamped copy of Pre bid clarifications (if any).

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

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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 and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer, if not sought/required for bid evaluation shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements, the same shall be resolved by the bidder 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, the 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 are deemed to be included in the base price.
- g) All sub-vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee/Warranty for plant/equipment shall be as per relevant clause of GCC / SCC / other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break-up, approved drawing or approved Bill of quantities within

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	RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) DOUBLE GIRDER EOT CRANES FOR POWER HOUSE (125/25 T)	SPECIFICATION No: PE-TS-414-501-A001
		SECTION : III
		SUB SECTION IIIB
		REV. NO. 00
		SHEET: 2 OF 2

the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account.

j) Schedule of drawings/documents/quality plans submission, comment incorporation & approval shall be as stipulated elsewhere in the specification. 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 tampered with this compliance-cum-confirmation certificate and if at any stage any tampering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection/installation manual for each of the equipment supplied under this contract as per the schedule of submission of documents and well before the scheduled erection of the equipment / component concerned.

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

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



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PROJECT (3 X 40 MW)
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PRE-BID CLARIFICATION SCHEDULE

[illegible]

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