

COCHIN PORT TRUST

MECHANICAL ENGINEERING DEPARTMENT

**DESIGN, MANUFACTURE, SUPPLY, ERECTION, TESTING AND
COMMISSIONING OF 1 NO. 15 TON RAIL MOUNTED ELL CRANE FOR
INDIAN COAST GUARD, INCLUDING AMC FOR A PERIOD OF 5 YEARS
AFTER TWO YEARS' GUARANTEE PERIOD**

SECTION – 4

SCOPE OF WORK AND TECHNICAL SPECIFICATIONS

4.0 GENERAL

The proposed work comprises of design, manufacture, inspection and testing at works at all stages as required, supply, delivery at site, erection, testing at site, commissioning and handing over 1 no. rail mounted, Electric Level Luffing crane in fully working condition to the entire satisfaction of CoPT /ICG, including furnishing of all labour, material & services, essential tools, spares and documentation in accordance with the specifications as furnished in the subsequent sections. The equipment shall be complete with all necessary parts, auxiliary items and safety devices whether specified herein or not which should form part of crane as deemed fit by OEM for operating the crane for intended purpose.

The crane is intended for handling of Break bulk Cargo/ Heavy Engines/ Machinery / equipments for maintenance of Vessels and related operations/ spare parts from / to the vessels calling at Indian Coast Guard berth at Fort Kochi.

4.1 SCOPE OF WORK:

Item 1:

Sl.	ITEM	UNIT	QTY
1	Design, manufacture, supply, inspection, transport to site, storage at site, erection, testing, commissioning and maintenance for 15 Tons capacity rail mounted ELL crane suitable for working with LT external electric supply including supply of suitable LT Copper trailing cable of length 160 meter, with 2 years comprehensive guarantee.	Number	ONE
2.	Automatic crane trailing cable trench covering system suitable for the above crane as per the details in the tender.	Meter	200

Item 2:

Sl.	ITEM	Rate	Amount
1	Annual Maintenance contract for a period of for 5 years after completion of 2 years guarantee period.	-----	-----
a	1 st year	LS	
b	2 nd year	LS	
c	3 rd year	LS	
d	4 th year	LS	
e	5 th year	LS	

- 4.1.1 The tenderer shall be responsible for design, manufacture, supply, inspection, transport to site, storage at site, erection, testing, commissioning and maintenance for 2 year guarantee period of **ONE No. 15 Tons rail mounted ELL crane** suitable for working with LT external electric supply including supply of suitable size good quality UV resistant LT Copper trailing cable of length 160 metres.
- 4.1.2 **The ELL crane shall work at Indian Coast Guard(ICG) berth in Fort Kochi, Kerala, complete with all mechanical and electrical installations/components along with hook for handling variety of items such as machine parts, break bulk, steel items etc from/to the ships / vessels.**
- 4.1.3 Supply, installation, testing and commissioning of automatic crane trailing cable trench covering system suitable for the above crane. Approximate length of the trench is 200 meters. However, the supplier of crane should ascertain the actual length as per the travelling distance of the crane.
- 4.1.4 The scope of supply shall include:
- (a) The design as per standards applicable and mentioned herewith, manufacture as per quality norms & complying with industrial standard procedures, as per rules & clauses of TPIA, transportation of units, delivery and off load at ICG site, transportation of units/ blocks/ components from storage area to erection site, on-site assembly and erection, testing, setting to work, commissioning, statutory approvals including insurance coverage from material dispatch till commissioning of the crane and all necessary peripherals inclusive of all necessary temporary works required. Safety of items delivered against damages, theft, etc. and its preservation till commissioning are covered under the scope of the supplier. Work considered is fully Turn-key in nature. The crane is to be designed for handling ship sections, machinery parts & allied components weighing up to 15 Ton during the repair of ships etc. The crane supplier shall undertake fabrication of the items at supplier's works or elsewhere (in view of constraints of space for the same within the ICG project site premises).

- (b) Crane rails (CR100) shall be supplied and laid by the Civil Construction Works Contractor as part of a separate contract already issued by CoPT/ ICG and hence not covered within the purview of this contract.
- (c) Buffer stops and end stops, storm anchors including sockets, all embedment which are to be casted in concrete etc shall be supplied by crane supplier. Necessary details in this regard shall be intimated by the crane supplier in advance. The civil work of cable reeling duct, long travel end stoppers, Crane storm anchor and positions, Crane jack-up point will be done by the Civil Construction Works Contractor.
- (d) The input power supply to the crane is 415V (+10%), 50Hz (+5%), 3 Phase and earth.
- (e) The supply of an initial stock of operating spare parts as listed in this specification shall be provided within the price quoted.
- (f) Recommendations for spare parts necessary to maintain the cranes in service for 5 years of operation shall be enclosed while submitting the bid as specified.
- (g) Comprehensive operating, maintenance and spare parts manuals for the cranes shall be supplied. All such manuals shall be in English.
- (h) All necessary operating and maintenance training at site for Employer's nominated personnel shall be provided.

4.1.5. Third Party Inspection Authority (TPIA) will be appointed by Cochin Port Trust by inviting separate tender. The same will be finalized by Cochin Port Trust within 15 days from the date of award of contract.

4.2 Guarantee

The contractor shall give guarantee of the satisfactory operation of the crane for a period of 24 months from date of taking over the equipment by ICG /Cochin Port Trust. During the guarantee period the contractor shall perform the periodic maintenance as per maintenance schedule of the equipment. More over any break down /defects noticed shall be attended to immediately and the crane shall be made operational within the reasonable period as mentioned in this document. The contractor shall arrange all tools, tackles, precision instruments and labour for carrying out the work. Should such damage or failure occur within that period, the supplier shall replace or repair the defective parts at his cost. If any of the spare from insurance spares provided with the cranes is used by the contractor during the guarantee period, the same shall be replenished within reasonable period. Detailed conditions are given under the section for Guarantee and Comprehensive Annual Maintenance contract in the tender documents.

The following minimum skilled and supervisory staff will be posted for the above purpose.

- 1) Electrical & Electronics Engineer : 01 no. in day shift only
- 2) Skilled Staff : 02 nos. in each shift

4.3 MINIMUM QUALIFICATION CRITERION

- 4.3.1 The supplier of the crane shall be in the field of similar Crane designing and manufacturing for at least 7 years. They shall have their own manufacturing facility with manufacturing related certification as given in the tender and should have supplied at least 1 no. of similar cranes in the last 7 years.
- 4.3.2 The bidder shall offer the technical support and personnel for the maintenance of the crane including Own experts in the logical controls systems including programming and troubleshooting etc.
- 4.3.3 **After sales service:** The bidder should have **sales and service office in South India** for rendering after sales service of the Crane quoted or should establish the sales and service centre in South India if it becomes the successful bidder. An undertaking in this regard may be submitted.
- 4.3.4 The supplier shall be in a position/ capable of sending the technical experts including logical systems /drive experts to the site within 48 HRS of receiving maintenance call from the users of crane.

4.4 STANDARD AND DESIGN PARAMETER:

The Shore Crane shall be designed for light service, non-continuous operation used for repair works of ships at berths, loading /unloading of machine parts for repairs works. Loads may vary from none to occasional full capacity. The crane shall be designed and built for marine application.

- 4.4.1 The crane shall be designed, built and tested to comply with the latest Indian Standards(IS), IS:4594, IS:3177, IS:807.

Sl No.	Nature of Work	Class of Utilization	Load Spectrum class	Appliance / Mechanism class
1.	Steel Structure	U4	Q2	A4
2.	Hoisting -Mechanism	T4	L2	M4
3.	Slew mechanism	T4	L2	M4
4.	Long travel mechanism	T4	L2	M4
5.	Luffing mechanism	T4	L2	M4

- 4.4.2. The classification/rating of the crane is not limited to the above, but shall confirm to the latest standards/specifications and operational requirements as specified in the tender, the crane has to be designed considering all safety standards and satisfying the operational requirements as detailed in the tender documents.
- 4.4.3. It is the sole responsibility and duty of crane supplier that they shall consider, comply and implement all applicable statutory rules and guidelines scrupulously to the relevant class of certification as well as to all relevant agencies or departments of Government of India in line with crane design, manufacture, transportation, erection, testing and commissioning.

4.4.4. Moreover the supplier shall take note on each applicable rule and procedure prevailing in Indian Coast Guard /Cochin Port Trust an ISO certified organization, in full while discharging duties or executing works as per the purchase /work order issued from CoPT.

4.4.5. **Design Requirements:**

Quantity	1 No.
Lifting capacity	15T capacity on hook with 15 T from 9 M to 18 M and 10 T from 18 M to 28 M Radius.
Materials to be handled	Machine parts, Electrical and mechanical Equipments, break bulk cargo etc.

Operator's eye level above berth	Shall be comfortable for smooth operation and full vision inside deck.	
Wheel load maximum	Max. static wheel load : 20.00T	
Inclination crane installation	+/- 1 degree.	
Source of External Power supply (Incoming)	415 V; 3phase; 50 Hz AC	
Short circuit level at substation	25 KA.	
Permissible Voltage and Frequency variations For LT 415 V	Voltage +10% & - 10%	Frequency +5% & -3%
Ambient Temperature	40° C inside and 45 ⁰ C outside	
Rail span	5.5 M	
Portal Height	Min. 4.5 M (For easy passage of vehicle)	
Wind load Design wind velocity	180Km/hr =50M/sec The crane shall be designed & manufactured so as to operate in any position without any fixing under steady wind pressure of 25kg/m ² over the full height of the crane.	
Drives (Stepless control)	Type	Speeds
Hoisting & Lowering	AC- Sq. Cage Motor with VVVF drive controls.	15M/Min.- at Full load 30M/Min. - at Empty hook/ low load up to 3T.
Slew motion	AC- Sq. Cage Motor with VVVF drive controls.	0.8 RPM
Boom luffing	Screw / Wire rope system	100 Sec.
Gantry travel	AC- Sq. Cage Motor with VVVF drive controls.	30M / Min

Hook Assembly Outreach(radius) Maximum Minimum	Provision for attaching as per crane capacity. 28 M 8 to 11 M
Rail size Tolerance *Rail top level with respect to chart datum level.	CR 100 As per clause of Indian standard To be finalized by Civil Dept.
Height of lift Above berth Below berth Total	25 m 13 m 38 m
Height of Crane	The maximum overall height of the crane shall be limited to 50Metres.

*The above specifications are the minimum requirements.

4.5 ELECTRICAL SUPPLY SYSTEM

415 V, 50 Hz. LT three phase power supply will be arranged and made available by CoPT at suitable location in the underground pit at the centre of the berth wharf/jetty for the crane proposed. The suitable design for the pit including the components shall be provided by the successful bidder, with the power cable guiding systems/ arrangements, safety items, sensing systems in the ground and also in the crane.

The total length of the berth will be 220 Mtrs. 415 V, 3 phase power supply-feeding points shall be provided at the centre of the berth. The power trailing cable shall have a length of at least **160 Mtrs inclusive of 3 dead turns in the CRD**. CRD supplied shall be of proven make and shall withstand the climatic conditions. The CRD shall be fitted according to feeding point.

4.6 STATUTORY REQUIREMENT:

The crane shall be designed and constructed to meet the requirements of the following :

- a) **IS 4594 Duty Class III, IS-807 or latest.**
- b) The Dock Workers (Safety, Health and Welfare) Regulations 1990.
- c) The Indian Electricity Act 2003 & Indian Electricity Rules 1956. CEA safety regulation 2010 and its amendment as prevailing /Latest.
- d) The Indian Factories Act 1948 or its latest.

4.7 GENERAL DESCRIPTION:

- 4.7.1 The crane shall be provided with a suitable jib system, for ensuring an almost horizontal path of the load during luffing.
- 4.7.2 Minimum gantry clearance of 4.5 Meter height from berth level across the crane rail span for easy travel vehicle movement under the crane.
- 4.7.3 The machinery frame with the jib system shall rotate on a slew bearing.

- 4.7.4 The hoist drive winches, the slew drive units and associated electrical system shall be located on the machinery frame and protected by a spacious house. The operator's cabin can also be located by the side of the boom.
- 4.7.5 The electrical panels with control system are to be located inside an air conditioned E-house along with other drives, adjacent to machine room. The electrical panel for LT motion shall be located inside LT Portal area. It should be ensured that the overall crane height should not exceed 50M from the rail.
- 4.7.6 The crane shall be capable of picking of the materials from the ships, holding and discharging into load carriers /jetty and also be used for transferring material from the jetty to the ship and ship to jetty.
- 4.7.7 The crane shall be capable of handling break bulk cargo like steel structural, Ship parts, Engineering equipments, sophisticated Electrical and Electronic items etc.
- 4.7.8 The crane shall be designed for the stability as per IS:807 or latest.
- 4.7.9 The fabrication of structural parts shall be carried by MIG/Fluxed cored arc welding wherever in house fabrication work is carried out. The welding at site especially open environment shall be carried out with standard quality fluxed coated welding rods.
- 4.7.10 All auxiliary junction boxes, control boxes used in the crane shall be of SS material for preventing corrosion.

4.8 MECHANICAL ARRANGEMENTS:

- 4.8.1 All parts shall be conveniently arranged and neatly grouped for ease of access. Special attention shall be paid to ensure ease of removal of all machinery components.
- 4.8.2 The motors of the power motions shall be connected to the gearboxes by flexible couplings and brake disc/drum. All gear elements are to be made high-grade wear-resistant heat treatable steels. The gear wheels with helical teeth shall run on antifriction bearings in rugged dust and oil-tight boxes, with oil bath lubrication. The gearboxes shall warrant a high degree of dependability at good efficiency and low noise level.
- 4.8.3 All rope sheaves shall be of cast steel and not fabricated and run on friction bearings with re-lubricating feature.
- 4.8.4 The crane shall be provided with independent drive units for all operations, each being operated by its own motors.
- 4.8.5 The machinery house shall be suitably designed to carry hoist, slew drives, including electrical panels, brakes and switchgear arrangements.
- 4.8.6 Adequate space shall be arranged for the maintenance of the equipment installed and exhaust fans shall be provided in the machinery house. Air duct for sufficient air circulation shall be provided if necessary.
- 4.8.7 The machinery house shall be of steel construction, covered on the outside with profiled steel sheets and provided with windows and access shall be through a floor hatch.
 - (a) A Hoist Block shall be provided in the machinery house for repair work. The capacity of the HB shall be such as to lift the heaviest machinery item in the machinery house from the ground level.

- (b) The sidewall and roof of the house shall be constructed in sections, which can be easily removed for easy dismantling of any of the equipment. The machinery house shall have waterproof roof. The flooring shall be of anti-skid arrangement type.
- 4.8.8 The structural members in the design shall be checked for fatigue test, as per Indian Standards (IS).
- 4.8.9 Safety railing guard shall be provided around the moving parts.
- 4.8.10 All electrical will be located in separate 'E-house'. E-house will be provided with AC. etc.
- 4.8.11 Sufficient number of Air Blowers / Exhaust Fans shall be provided in the Machinery house and at Engine room with air duct for sufficient air circulation to keep the temperature comfortable.

4.9 PART A: PARTICULAR SITE CONDITIONS AND REQUIREMENTS

4.9.1 Site Location and Layout

- 4.9.1.1 The Level Luffing Single Jib Crane is to be delivered, installed and operated at the Project site of Indian Coast Guard (ICG) jetty located at Fort Kochi, Cochin, Kerala in India. The crane is intended to be installed for operation at the Jetty of 220M length, which is presently being constructed at the Mattancherry Channel. The crane erection work shall be executed in coordination with civil works of the ICG project. Crane suppliers who wish to tender for the supply of the crane shall visit the ICG project premises to fully familiarize themselves with the intended location, the prevailing site conditions and any possible constraints in advance of submitting their offer. Submitting the offer without proper assessment of the site conditions will not relieve the crane supplier from meeting all the contractual obligations.
- 4.9.1.2 Cochin lies on the South West Coast of India in the state of Kerala. The project site is located at the Eastern side of the Mattancherry channel, Fort Kochi, in the territory of Cochin Port Trust.

4.9.2 Environmental and Climatic Considerations

- 4.9.2.1 The temperature in the case of design purpose shall be considered as 45°C and 98% in the case of humidity. The atmosphere is highly saline in nature.
- 4.9.2.2 Climate: Marine /Tropical: All elements and components of supply shall be suited to perform reliably and to specification within the environmental and climatic conditions that prevail in the ICG project premises as summarized below.

4.9.2.3 Humidity

Average daily relative humidity Max = 95%

Average daily relative humidity Min = 75%

4.9.2.4 Wind

The basic wind speed as applicable to 10 m height above mean ground level is 39m/s for the Cochin area as per the fig-1 in the IS 875-Part 3-1987 (Clause 5.2). From this, the resultant design wind speed considering all the risk, topographic, type of structure and terrain factors can be determined. The maximum design wind speed shall be 43.4 m/s for a 3 second gust for the total height of the crane. The design wind speed to be used during operation of crane shall be 20m/s for not less than 3 second gust.

4.10 PART B: TECHNICAL REQUIREMENTS

Technical requirements for the 15T Level Luffing Single Jib crane required are broadly given below:

- 4.10.1 The Contractor is requested to submit detailed specifications of the crane offered in line with technical requirements also, which should include the type, make, capacity, rating, material specifications etc. of major components.
- 4.10.2 The Crane and its accessories shall be inspected either by the purchaser or his authorized representative/ Third Party Inspection Agency (TPIA) during various stages/ steps to confirm whether structural strength capacities, load test, dimensions, accuracy, operating requirement, working of safety devices such as limit switches and functioning of control system assigned with positive logics, brakes etc. meet with the approved specifications, drawings and crane design code as applicable.
- 4.10.3 CoPT reserves the right to inspect and /or to depute any external inspection agency to inspect at supplier's works and also at his sub-contractors works. Necessary facilities shall be provided by the supplier for the above. Moreover the supplier shall extend all sorts of support to explain and demonstrate the functions in a reasonable level. Travelling, boarding and lodging costs of officials would be borne by CoPT/ICG/TPA.
- 4.10.4 It is the responsibility of the contractor to inform one month in advance before shipment in order to carry the witnessing of factory acceptance test by the employer. All required facilities, test equipments/units shall be arranged by crane manufacturer at their cost. The design, manufacture, supply, erection, testing and commissioning shall be covered under inspection by a TPIA, viz. IRS/LRS/BV/ABS/DNV/TUV etc shall be appointed by CoPT.
- 4.10.5 CoPT reserves the right and power to choose and finalize the TPIA and the supplier have no rights to question or disobey the same. Cost for TPIA for the third party inspection shall be borne by CoPT/ ICG.
- 4.10.6 The supplier has to comply with various requirements of TPIA meeting QAP, inspection, testing of crane subassemblies as per International Standards.

4.11 Exclusions and Facility to be provided by CoPT/ ICG

- 4.11.1 Test loads for load testing will be in the scope of crane supplier.
- 4.11.2 Civil works in connection with the fixing of embedment of crane parts in berths etc. supplied by Crane supplier, if supplied after civil works.
- 4.11.3 **Appointment of TPIA & their inspection charges.**

4.12 Schedule

Supplier may take notice that the crane is required for ICG and is to be commissioned along with the ICG project completion. It is the responsibility and risk of the supplier to imbibe and coordinate with CoPT/ ICG and main civil construction contractor executing

ICG project works. The supplier shall understand the requirement of completion and shall duly intimate CoPT/ICG regarding the progress of proceedings on a reasonable timeframe. The supplier shall choose reliable sub-suppliers meticulously to match the schedule as given in the tender. Supplier shall ensure compliances of all applicable procedures, rules, regulations for ensuring the safety and protection of men and materials in all respects and ensure seamless safe working procedure at ICG site. Formal Purchase Order (PO) will be released within 15 days of LOA The split up of the schedule is stipulated below.

Sl.no	Activity	Time lines
1	Submission of Quality Assurance Plan, Civil related drawings pertaining to End stopper Storm anchors, Jacking base, Power feeding arrangement etc to CoPT to enable progress of civil work by the civil construction contractor.	Within 1 month after issue of LoA
2	Submission of the design detail Documentation & General Arrangement drawing of the crane to TPIA / CoPT for approval	Within 2 months after issue of LoA
3	Approval of the design details documentation & General Arrangement drawing by TPIA/ CoPT.	Within 4 months after issue of LoA
4	Cable trench embedded items on the berth shall be supplied and fixed for facilitating Civil work	Within 4months from the date of LoA
5	Supply of embedment items like storm anchor, jacking base, end buffers, embedment to be casted in connection with the power feeding arrangement etc. which are to be installed along with civil works.	Within 4 months after issue of LoA
6	Receipt of crane components, materials etc as per mutually agreed material delivery schedule.	Within 9/10 months after issue of LoA
7	Completion of Erection, Testing, Commissioning, Approvals and handing over of the crane to ICG.	As per the time of completion in the tender / LoA

Notes:

- a) It is assumed that subsequent to the approval of design, documentation & General Arrangement drawing by TPIA, crane supplier shall progressively submit the remaining drawings and receive approval detailing with the fabrication sequence of crane components in order to comply with the total project schedule **of 12 months**.
- b) The installation of the crane on the site is dependent on the completion of civil construction activities and associated mechanical & electrical works. Since the construction work is presently progressing, crane supplier shall be initially provided with minimum 50 M track length to start the erection activities.

- c) The present schedule is aligned with the construction period. However, in case of emergency, ICG reserves the right to shift the installation activities by a period of 04 months without any additional cost implication.
The construction period mentioned in the tender is for the construction of Jetty by the Civil contractor. Hence 4 months period mentioned in the tender is a maximum period that may be required for ICG/ Port to hand over the site to crane supplier and for which no liability will be fixed on the crane supplier, in the event of such delay in handing over of Jetty by ICG/ CoPT happens.
- d) The crane shall be handed over to ICG after erection, satisfactory trials, testing and commissioning at ICG site. The entire responsibility regarding handling of material, manpower, compliance of statutory and safety regulations, rules or act for the above actions rest with the supplier of the crane. Supplier of crane may take notice that ICG is in no way responsible for any actions, failures, non-compliances of statutory and safety rules/ regulations/ act as applicable and especially inside ICG area during the transportation of materials inside yard or during erection process of cranes or during trails/ tests/ statutory tests or evaluations or any regulations or rules as stipulated by Government of India time to time during the period of contract and supplier of the crane solely be responsible for all such actions and has to be dealt with at their risk and cost.

4.13 Drawing Approval Procedure

- 4.13.1 One(1) paper and one(1) electronic copy (in a PC compatible AutoCAD/ MS Windows format/ PDF) of all design drawings, specifications, calculations, technical literature, erection, testing, commissioning and setting to work program are to be supplied to TPIA and CoPT for approval purpose. TPIA will respond within four (4) weeks of receipt of such information advising of each item approved or those being returned for amendment. Supplier shall furnish the revised drawing/ documents incorporating TPIA/ CoPT and comments for approval within two weeks from the date of issue of TPIA/ CoPT Comments. However, comments/ approval of the drawings by the TPIA/CoPT will not relieve the Contractor of his responsibility for the correctness, adequacy of design and completeness of his work as per the Contract. The approval procedure for amended items will be the same as for the original submission. Final approval will be given by TPIA and the same will be countersigned by CoPT.
- 4.13.2 The Contractor shall submit, on request from ICG/TPIA, additional calculations required to substantiate aspects of the design. With respect to items of proprietary supply, the manufacturers own selection chart or certificate of approval may be submitted as appropriate.
- 4.13.3 The Contractor shall maintain a complete record of all and any changes made to the crane design or construction.
- 4.13.4 The Contractor shall maintain a complete record of all and any changes made to the crane design or construction and supply to the Employer at delivery five sets of “as built” prints together with five sets drawings, each on a CD-R disc in a PC compatible AutoCAD/MS Windows format.

4.14 Minimum Drawing Requirements

- 4.14.1 The drawings and documentation supplied shall, as a minimum, include the following:

- a) Calculations pertaining to wheel load, stability and power requirements for all the drive units, and design parameters of all the components of crane.
- b) General arrangement of each equipments / arrangements.
- c) Specifications / catalogues / datasheets of all standard brought-out items, along with copies of purchase orders / Contracts, without rates placed on the sub-contractor / vendor.
- d) All drawings other than shop fabrication / manufacturing drawings. These will include but not be limited to assembly, sub assembly, key components etc.
- e) Wirings drawings, Electrical schematic drawings, cable routes, equipment interconnection diagrams.
- f) General arrangements of drawings indicating ratings / location / fixing of LT switchgear, MV panel, VVVF control, PLC panel control desk, transformer , Operators panels etc.
- g) General arrangements of drawings of L.T.Panel and Control Cable Junction Box and Cable Turning Device.
- h) I/O Chart and Control Schematics.
- i) General arrangements of lighting and lightning protection and earthing system.
- j) Hydraulic drawings, Engine details, Engine Command Panel details/ drawings.
- k) Spare parts details with address of suppliers.
- l) Calculation in support of selection of the following items:
 - (i) Switch gears.
 - (ii) Size of the power cable.
 - (iii) Number of cores of control cables and sizes.

All the above details shall be given in both hardcopy and soft copy.

4.14.2 The contractor shall submit progressively for CME/ Dy. CME (Ele)'s approval six copies each of the following documents at least two months prior to the starting of the manufacture of these items. The scope of these drawings etc., shall include, but not be limited to the following:

1. Quality Assurance Plan (QAP). Necessary comments as directed by CoPT, TPIA to be included in the final document.
2. Crane storm anchor loads and positions, Storm anchoring arrangement and required civil works.
3. Crane temporary jack up point loads and positions.
4. Details of End Stoppers.
5. Details of embedment to be casted into concrete in connection with the power feeding arrangement.
6. Detailed delivery schedule indicating all the important activities.
7. Detailed Bill of Material with makes of items covered under contract.
8. Details of shop tests, inspection and procedure for such inspection and tests.
9. Manufacturer's test certificate for structural steel (used for the construction of load bearing members) certified by Classification society (IACS member) at the cost and responsibility of bidder.
10. General arrangement drawings showing all principal dimensions and clearances.
11. Design calculation sheets showing the structural strength calculations and maximum wheel loads etc.
12. Equipment drawings giving dimensions, and clearance for maintenance and withdrawal.

13. Cable selection (sizing) calculation, voltage grade, type of cable selected.
14. Arrangement drawings of all electrical items.
15. Calculation details of motor HP, brakes cable sizes etc.
16. Earthing schedule and drawing including sizing.
17. Make and type of all major components including source-indigenous/ imported.
18. Machinery assembly drawings with itemized parts lists and component ratings as appropriate.
19. Structural arrangement drawings with materials and quantities.
20. Layout drawings of machinery control room(s).
21. Control cabin layout and arrangement showing operators seat, windows, limiting sight lines, location of operating controls and all other significant features.
22. HMI screen design with mimic diagrams.
23. Schematic diagrams of rope reeling systems for all rope motions.
24. Test certificates for Cable, rope, load cell, Gear box, Motor, brakes, and other machineries.
25. Installation and commissioning details with schedule of site assembly & erection.
26. Structural erection drawings.
27. Machinery/mechanical erection drawings.
28. Instruction and maintenance manuals (05 sets) along with spare parts catalogues and literature and one soft copy.

4.14.3 In addition the Contractor shall supply full documentation for the installed electrical power and control systems as below:

- (a) List of all equipment and devices complete with ratings as appropriate.
- (b) Line diagrams of power distribution system.
- (c) Simple schematic diagrams depicting each control circuit.
- (d) PLC logic diagrams.
- (e) Power supply termination details and dimensional requirements for the power connection pit and termination box.
- (f) Block diagram showing all conduits, trunking and cable trays with their associated sizes together with all cable sizes identifying insulation and conductor types.
- (g) Scale wiring layout diagram indicating the location of each item of equipment, any junction boxes and the routing of each conduit, trunk and cable tray.
- (h) Connection diagrams for all electrical equipment showing all terminal strips in their correct orientation with each wire and conduit identified.
- (i) Connection detail of the power supply cable within the end connection pit to the yard power.

4.14.4 The contractor shall supply bound into a suitable folder or manual, five sets of operating and maintenance instructions for use by the Employer. In addition, a copy of such instructions shall be supplied suitable for display in a prominent position in the driver's cabin.

4.14.5 **DOCUMENTS WITH EACH CONSIGNMENT:**

- (a) Test certificate (in triplicate with original).
- (b) Authentic Test and Inspection report with results along with approvals of TPIA
- (c) Packing list (with reference to each item of Bill of Material).

(d) Any other certificates required as per tender.

The supplier shall be entirely responsible for any errors, calculation mistakes, and / or omissions from the drawings etc. and the sufficiency and efficiency of the crane in all respects, notwithstanding any approval, which the purchaser /TPIA may have given to the drawings prepared by the supplier. If such situation occurs, the supplier shall ensure the remedial actions at their cost and ICG would not be responsible for the same. In spite of all the above, the entire responsibility for satisfactory functioning of the crane rests with the supplier.

4.15 Health and Safety

- 4.15.1 Permanent safe access must be provided for all operating and routine maintenance functions on the crane. Safe access means stairways, ladders, safety hoops, platforms, guard rails and all doors, hatches and other openings having safe means of securing in both the open and shut positions all to a standard appropriate to best Indian practice.
- 4.15.2 Stairways, ladders, platforms shall be made from steel and tread areas are to be provided with a non-slip finish or be constructed from galvanized expanded metal sections/ gratings of approved design. All guard rails and toe boards shall similarly be of steel construction (GI).
- 4.15.3 Alternative exit routes of walkways, platforms, stairways and ladders, shall be available to enable the driver and any maintenance personnel escape from the crane cab and machinery house areas in an emergency.
- 4.15.4 The maximum permitted noise levels that may be generated by crane operation shall be as per the design code followed.
- 4.15.5 The crane structure and lifting hook shall be prominently marked with their respective safe working load.
- 4.15.6 The Contractor must fully comply with all relevant Indian health and safety legislation in force at the date of tender submission.
- 4.15.7 The crane shall have a programmable anti-collision device to avoid collision with two more Level Luffing Single Jib cranes to be procured and installed on same track in future.
- 4.15.8 All required warning signs shall be displayed in English and Hindi as far as possible.

4.16. Crane Design Classification and Construction Standards

- 4.16.1. Design, manufacturing, testing of all the elements of crane structure, machinery together with all equipment & components shall comply with requirements of recognized international standards and codes of latest version as indicated under Bureau of Indian Standards (BIS)
- 4.16.2. A complete schedule of standards and codes that are intended to employ shall be submitted with Techno-commercial Bid for consideration and approval. Changes to approved standards following acceptance of the bid will not be permitted. Approved standards to be employed shall be provided in English language, before commencement of design and procurement activities.
- 4.16.3. The International System of measurement units (SI) shall apply throughout.
- 4.16.4. The crane design shall satisfy all applicable statutory requirements and any other regulations applicable locally, i.e. Factories Act, Central Electricity Authority Rules and Regulations, Indian Electricity Act and other statutory regulations pertaining to design,

manufacture, installation, operation and maintenance of such machinery for service at Cochin, India.

- 4.16.5. In case of practices not specifically mentioned in the standards, the normal practice of the industry or the contractor shall be applied with prior permission from the purchaser.
- 4.16.6. Electrical equipment, materials shall conform to the current standards of IS(Indian Standard) amended from time to time & where Indian Standards are not available, the equipment shall conform to IEC. All electrical and control system components shall be suitable for operation under humidity and temperature mentioned elsewhere and in a salt laden atmosphere. As the electrical installation of the crane is to be approved by Central Electricity Authority(CEA), all documents seeking approval can be submitted only through Grade "A" licensed electrical contractor. The license shall be issued by any of the State Electrical Licensing Board in India valid for the entire period of project including installation, testing, commissioning and handing over of the crane to CoPT/ICG. As per rules, electrical works are to be carried out under his guidance. Any prior approvals from CEA required shall also be obtained.

Note: Wherever Indian Standards and regulations are specifically mentioned in the following technical specification, the same shall be followed as the approvals from statutory authorities of the crane are to be obtained from India.

4.17. Operator Training

- 4.17.1. Full training at the site in the safe operation and maintenance of the crane and all equipment shall be provided to the CoPT/ ICG nominated personnels by a suitably qualified person, or persons, employed by the supplier and approved by CoPT/ ICG. If interpreters are required to assist the exchange of information and instructions from the trainer to the operators, these are to be provided by the Contractor at his own cost. The necessary training programs shall be developed jointly with COPT/ ICG to ensure that the specific operational and maintenance requirements of the yard and workforce are adequately addressed.

Training at site will commence during the site assembly stage for the maintenance personnel and continue through testing and commissioning and into the setting to work phase for the crane operators.

- 4.17.2. Maintenance training, for up to 5 (five) maintenance staffs not less than one week shall include, inter alia:
- a) Routine examination and maintenance.
 - b) Fault diagnosis.
 - c) Removal, dismantling and replacement of parts and components.
 - d) Basic electrical checks, safety routines and component replacement.
 - e) Approach to hydraulic systems overhaul.
 - f) Procedures /instructions for corrections or modifications in PLC /VVFD.
 - g) Details regarding the logical integration implemented.
 - h) Swapping of components on emergency.
 - i) Bypassing of PLC elements safely.
 - j) Training on crane management system if any.
 - k) Uploading and downloading procedures in relevant concepts.

- l) Rectification on fiber optic cables-procedures.
- m) Training for reading electrical and hydraulic system drawings.
- n) Maintenance planning records and procedures.
- o) Instruction and familiarization regarding the overall operation and maintenance of the crane including Health & safety provisions incorporated (including the operation of items such as load weighing and limit switches etc).
- p) Uploading and downloading of programs to PLC and HMI

4.17.3. Operational training for up to six crane operators for not less than one week shall include, inter alia:

- a) Safety procedures.
- b) Practice at the control and synchronization of the main crane motions such as long travel, luffing, slewing and hoisting.
- c) Start up and shut down procedures including use of the storm anchors and any supplementary securing equipment.
- d) Application of the daily check list.
- e) Instruction and familiarization regarding the overall operation and maintenance of the crane including Health & Safety provisions incorporated (including the operation of items such as load weighing and limit switches etc).
- f) Instruction in use of the slewing / long travel anti-collision device over-ride feature.
- g) Explaining the power and control circuit.

4.18. Operational and Maintenance Manuals

- 4.18.1. Separate illustrated manuals shall be provided by the supplier covering the operation, maintenance and parts identification for the cranes and associated equipment and components. Proprietary equipment supplier's manuals may be provided where they comply with the requirements of this specification. Where possible the manuals shall be presented in A4 format and be protected from damage by employing durable covers and plastic encapsulated pages.
- 4.18.2. The operator's manuals shall contain advice and instructions on all aspects of the safe operation and use of the crane including actions to be taken in the event of emergency or breakdown. A start up and hand over check list for the drivers shall also be included.
- 4.18.3. Manuals of PLC, HMI, VVVFDS, encoders etc. shall be given along with relevant instructions or programs. Detailed interconnection diagrams shall be provided. Programming manuals of each unit shall be provided. System software, application software, programs, laptop with system software and application software loaded and passwords if any , interfacing units including cables to Laptop from PLC and HMI shall be provided. "Drawing As fitted and commissioned" shall be provided without any error or mistake and is a compulsory requirement as per this tender. Fault diagnosis procedures and supporting codes shall be provided.
- 4.18.4. The maintenance manual set shall include illustrated instructions on what tasks need to be undertaken on a regular basis and how to perform all routine and scheduled maintenance. Additionally a separate document, or set of documents, with exploded isometrics where possible identifying all components and their associated spare part numbers for all items

and components of the crane, both of the Contractor's manufacture and of all sub-contractors and suppliers manufacture, shall be provided.

- 4.18.5. Copies of all manuals and illustrations etc. shall also be provided on CD-R discs compatible with a PC system running on Microsoft Windows. In total five (05) sets of paper based and two sets of CD-R disc based copies of all manuals shall be provided. . All as built drawings (electrical, mechanical, control system) shall be handed over to COPT/ ICG upon successful commissioning of the crane.
- 4.18.6. The covers of each paper copy of the operating manuals and the boxes for the CD-R discs and USB sticks of the operating manual shall carry the following clear title: **“OPERATING INSTRUCTIONS FOR 15 T SINGLE JIB LEVEL LUFFING CRANE”**
- 4.18.7. The comparable sets of manuals, CD-R discs and USB sticks for the maintenance instructions shall be marked using the same format.

4.19. Crane Rails and Crane Wheels

- 4.19.1. The rails shall be CR100 to suit double flanged forged steel wheels.
- 4.19.2. There is no height difference between the rails. The crane rail tolerances are maintained according to Indian Standards (IS). The crane is to be so designed that it can safely move on the crane track of rail type CR100 to suit double flanged forged/cast steel wheel. The Crane Supplier is responsible for ensuring the suitability of the wheel size and wheel loads of the crane as per CR100 rails.
- 4.19.3. Supply and laying of crane rails and rail fixtures are not in scope of supply of the Crane Contractor and will be done by the civil works contractor, already entrusted by COPT/ ICG.
- 4.19.4. All track wheels shall have straight tread and shall be double flanged type and made of forged steel. Wheels should have protrusion on both sides. All the wheels shall be machined accurately to obtain the correct diameter. The wheel tread shall have hardness not less than 250 BHN or as per design codes selected, whichever is higher. The crane wheel specification shall be generally based on selection as per Indian Standards (IS) or design codes adopted.

4.20. Crane Wheel Loads

The maximum wheel load under any loading condition (operational, storm) shall not exceed the following combination as shown below:

The maximum permissible horizontal loads are 5% of vertical load in transverse direction and 10% of vertical load in longitudinal direction.

4.21. Materials and Workmanship

- 4.21.1. All major items of equipment and major materials used in the manufacture of the crane shall have been specified and procured specifically for this contract. No pre-used or substandard materials or equipment shall be employed.
- 4.21.2. The country of origin and manufacture for all major materials, equipment and systems shall be identified by the Contractor for approval by COPT/ ICG / TPIA.
- 4.21.3. Date of manufacture of all Electrical equipment & materials shall be after date of issue of LOI/ purchase order.

4.21.4. The Contractor shall provide complete details of the Quality Assurance system followed by them during manufacturing / fabrication and the relevant certifications. The QA systems and certifications must cover all aspects of in house design and manufacture as well as covering the monitoring of quality from external suppliers of sub-assemblies and components. The QA plan shall be approved by the Employer/TPIA.

4.22. Power Supply

4.22.1. Power to the crane is to be supplied from the outgoing 415 V 50Hz feeder in the MES substation.

Supply	3 phase and Earth
Frequency	50 Hz +5% & -3%
Voltage	415 +/- 10%

4.22.1. All electronic and electrical equipment shall be adequately protected from the effects of multiple transient voltages. The crane electrical systems shall be provided with an agreed level of radio frequency immunity and all installed electrical equipment and machinery shall be suppressed against radio frequency generation. The Crane Contractor shall liaise with the Construction Works Contractor regarding confirmation of sizes of cables which are to be laid from Main Electrical Substation to crane switch located in the cable pit. The supply, laying and termination of cable from MES-2 substation up to the crane switch located inside cable pit will be carried out by the civil contractor. Adequate protection shall be provided on the entire crane structure against any accidental electric shock to the personnel and materials.

4.22.2. The crane drive system shall also be equipped to handle the reverse energy generated in the crane to feedback on to the electrical network and also ensure that the harmonics are not transferred into the source.

4.23. Operating Conditions

4.23.1. The crane is to be stable in still air conditions with 160% of the safe working load upon the hook.

4.23.2. The crane shall be stable under all operational and out of service conditions. The maximum permissible linear rail loading specified shall not be exceeded for any possible load, outreach and operating or out of service combinations including, inter alia, dead loads, live loads, inertia forces and wind and storm loadings. The highest loading for any condition shall always remain within the permitted rail load.

4.23.3. The maximum overload test by manufacturer shall be performed for 125% of SWL static and 100% dynamic.

4.24. Out Of Service Securing and Storm Anchors

- 4.24.1. Hydraulically operated Rail Clamps shall be provided on each legs of the crane to clamp the crane to the rails. The rail clamps shall be remotely operated from the driver's cabin, to secure the crane when not in service. The clamps shall be capable of safely holding the crane against movement by wind with 50% of the wheel brakes inoperative. Electric interlocks shall be provided such that the travelling machinery cannot be energized until the clamps have been released. It should be noted that the top of the rails are flush with the surface of the concrete and that the sides/undersides of the rail will be surrounded with concrete and will therefore not be available for clamping. The clamps should have sufficient tangential holding force to safely hold the crane in locking position during non-operating wind conditions. The rail clamps are to be quick acting mechanically operated hydraulically released type. The clamp jaws should grip the rail from top. The jaws should have replaceable hardened steel teeth. When released, the clamps should not drag on the rails.
- 4.24.2. The crane shall also be equipped with two (2) mechanical locking devices, by stowage pins of reputed and proven make, on each leg of the crane locating into special reinforced anchor location (to be supplied in advance of the cranes for incorporation into the civil works) or similar to secure against movement during storm conditions. Pin/arrangement are to be designed to hold the crane from moving under stowed conditions with the gantry brakes inoperative. The device(s) shall be fitted to the crane portal structure on each side of the crane, not to the long travel bogies. Ideally the pin/arrangement and anchor locations shall provide the resistance to overturning rather than having to resort to separate tie down provisions where the design rules adopted allow for the existence of net overturning moments. Electric interlocks shall be provided such that the travelling machinery cannot be energized until the storm anchors automatic clamps have been released. There shall be indicators in the cabin for operator about anchors and rail clamps in HMI.
- 4.24.3. Considering 220 M length for Jetty, it is required to anchor the crane at three locations. Hence the supply of embedment shall meet this requirement.
- 4.24.4. If it is required that the crane jib shall be parked in a certain configuration to avoid allowable wheel loads being exceeded, necessary devices shall be provided to ensure that the crane cannot be parked until the jib is in the required alignment.

4.25 Structure

- 4.25.1 The main structural elements of the crane are considered to comprise, inter alia, the portal, crane column, slewing frame, machinery house, 'A'-frame, Jib and counterbalance arrangement, operator's cabin etc. The crane portal is to have a minimum clear height of 4.5 M to permit material storage and vehicle access to the Jetty.
- 4.25.2 All structural elements shall be made from low carbon weldable steel in accordance with IS 2062/ EN 10025, 1993 standards or as dictated otherwise by the crane design code adopted. The minimum allowable thickness for structurally significant elements is 8mm or 1mm in excess of the calculated design thickness where this is more than 8mm.
- 4.25.3 The structural members of the crane shall be of rolled steel plates and sections and shall be constructed using electric arc welding.
- 4.25.4 The ballast designed as a counter balance shall be sufficient for all working and test condition. It shall be of cement concrete, cast iron or cast steel and not of loose material

like scrap etc. The supplier shall state the required weight of ballast together with necessary drawings showing the arrangement and disposition of ballast. The counter balance weight for ballast would be under the scope of supplier.

- 4.25.5 All enclosed volumes within the structure that are not 100% sealed shall be fitted with weatherproof covers or similar to facilitate inspection. Fully enclosed volumes shall be treated with a wax type corrosion inhibitor immediately prior to final closure.
- 4.25.6 Construction joints, such as splice plates in the portal and jib, employing clench bolts or similar high strength friction fastenings shall be assembled with clean metal to metal surfaces. Such joints shall then to be fully coated after completion. Other structural bolted joints shall be made by painting the contacting surfaces and assembling whilst the paint is still wet.
- 4.25.7 Platforms, walkways and stairs shall be designed to accommodate a live load of 3.5kN/M^2 and a concentrated load of 100 kg at any point. All such components shall be hot dip galvanized to BSEN/ISO 1461 or equivalent standard.
- 4.25.8 Where electric cables, hydraulic lines or similar vulnerable items are run through the crane structure access panels shall be provided for inspection and maintenance purposes. All exterior surface runs shall be adequately protected from accidental damage.
- 4.25.9 Steel mill cast or batch properties certificates relating to all major structural steel shall be provided to TPIA /COPT by the Supplier. The unique steel batch identities shall be traceable throughout all stages of manufacture up to and including site erection. All such certification information shall be retained within the Contractors QA and internal documentation storage system. This information shall be available for inspection by the Employer on request at any time throughout the operating life of the crane.
- 4.25.10 Computations for stresses shall take into account all dead and live loads, including allowance for impact, wind loads, acceleration and overloads.
- 4.25.11 All shop fabrication shall be done by welding and only assembling and erection shall be done at site.
- 4.25.12 Revolving structure: The revolving frame shall be constructed of structural shapes and rolled steel plates with bolted and welded connections. The jib shall be constructed of high-tension steel pipes with welded connections, and shall be jointed to the revolving frame at the level of the operator's cabin. These structures shall be designed to resist lateral and vertical stresses. Jib of box structure shape fabricated from steel plates instead of pipe structure based on payload and radius shall be acceptable.
- 4.25.13 Portal frame and tower: Portal frame shall be box type construction and shall be so designed as to avoid accumulation of water and oil inside and outside the box. The weight of the crane and loads shall be distributed on braced legs, each leg being connected by pin joints to welded bogies. The tower shall be constructed of high tension steel pipes or rolled steel plates with welded connections. Care shall be taken in the design of portal frame and tower to provide ample strength to resist not only the vertical stresses but also lateral stresses set up by the wind and acceleration. The crane portal is to have a minimum clear height of 4.5 M to permit vehicle access.

4.26 Welding

- 4.26.1 All welding shall be undertaken using the carbon arc or metal arc process. All welding consumable shall be stored and used in strict accordance with the manufacturer's recommendations and the electrodes selected shall provide weld metal properties as close

as possible those of the parent materials. The Contractor shall hold copies of the manufacturer's tests on representative samples of electrodes.

- 4.26.2 Welding shall be as per the Welding Procedure Specification approved by Third Party Inspection Agency. Makes of weld consumables to be used in fabrication shall be mentioned in the technical bid. AWS classification electrode approved by TPIA (appointed by COPT/ ICG) shall be used.
- 4.26.3 Structural welding shall only be undertaken at the Supplier's works or within the premises of appointed sub-contractors.
- 4.26.4 All weld spatters shall be removed and welding scars from stray arcs and temporary attachments etc. shall be made good. All free edges of steel work shall be ground or similarly dressed to provide a corner radius of not less than 2mm to prevent premature failure of the coating system applied.
- 4.26.5 Only adequately qualified welders able to demonstrate their competence through recognized examination or work record shall be employed on the fabrication of the crane.
- 4.26.6 All welds shall be subject to 100% visual inspection for defects such as undercutting, surface porosity, acceptable weld bead, fillet shape and size. All structural full penetration butt welds shall be subject to 100% NDT inspection by dye penetration or ultrasonic whilst other structural welds shall be subject to 25% NDT inspection on a random selection basis or as per Designer's QAP and approved by COPT/ ICG /TPIA. Non-destructive testing of welds includes radiographic testing also. Any significant weld defects identified shall be rectified by the most appropriate means.
- 4.26.7 Witnessing of Testing will be carried out by TPIA appointed by COPT/ICG. Copies of test certificates shall be provided to TPIA / COPT/ICG within 7 days of testing.

4.27 **Mechanical Connections**

- 4.27.1 All high tensile bolts and fastenings shall be supplied with identifying marks and, where employed for structural joints all such fastenings shall be supplied with a recognized corrosion resistant surface finish. All fastenings shall be supplied in metric sizes. Where high strength threaded fastenings are employed a schedule of fastening torques is to be supplied.
- 4.27.2 All structural fastenings shall be 12mm diameter or larger and no connection transmitting a design load shall employ less than two fastenings.
- 4.27.3 Any fixing bolts required to be cast into the concrete shall be supplied by the crane supplier and installed by the Construction Works Contractor.

4.28 **Paint Coating System**

- 4.28.1 The paint coating system shall be mostly applied within the manufacturer's works in a controlled environment with only damage repair, construction joint painting being permitted on site prior to the application of the top coat. Each paint coat shall be of a different colour to the preceding one to help ensure proper coverage is achieved. All coatings are to be applied in conformance with the paint manufacturer's published requirements. Such requirements are considered to form an integral part of this specification.
- 4.28.2 The paint system shall comply with ISO 12944. Steel materials of all structural parts shall be sand blasted or shot blasted to SA 2.5 finish to remove rust, mill scale and grease prior to fabrication and painted as follows:

- i. After sand blasting or shot blasting – One (1) coat of epoxy or equivalent paint (primer) of 40 microns thick (minimum)
 - ii. After partial assembly and inspection at the supplier's works – Two (2) coats of modified epoxy paint each coat of 70 microns thick (minimum).
 - iii. After erection at site – One coat (1) of modified epoxy paint of 60 microns thick (minimum). If the crane is brought at site in fully assembled condition, cuts/ scratch areas shall be properly treated and painted to make good.
- 4.28.3 Total dry film thickness of 240 microns (nominal) shall be maintained. Each coat shall be clearly different in colour and shall completely cover the surface over which it is painted.
- 4.28.4 Wherever possible paint shall be applied by airless spray. Where this process is impracticable roller or brush application may be employed although the number of applied coats may need to be adjusted to achieve the desired DFT at each nominal coat stage.
- 4.28.5 The supplier shall provide suitable colour swatches to enable the precise paint colours shall be identified in advance and approved by the Employer. Coated surfaces will only be inspected when the paint is fully dry. Inspection criteria will include achieved DFT, consistency of application and the physical appearance of the paint coat. The Employer may reject unsatisfactory paint work which shall then be rectified at the Contractor expense, to the Employer's satisfaction.
- 4.28.6 Any repairs necessary to the coating system should be undertaken at the earliest possible opportunity to reinstate the relevant stage and DFT. The coating system in way of the bare steel construction joints shall be stepped back, coat by coat, to allow the overall coating system integrity shall be achieved on site. The same acceptance criteria as used for the workshops will apply.
- 4.28.7 The external finish top coat shall be Admiralty Grey or as designated by COPT/ ICG. Orange and white stripes or as instructed by aviation rules shall be used for crane jib and swing lever. The interior of the machinery house and other man accessed areas shall be gloss white. The supplier shall provide suitable colour swatches to enable the precise paint colours shall be identified in advance and approved by the Employer.
- 4.28.8 Interiors of the gear casings shall be painted with one coat of oil resisting paint.
- 4.29 **Other Protective Requirement.**
- 4.29.1 All machined surfaces of machinery or components for assembly and spares shall be protected against corrosion during transit and storage generally in accordance with BS 1133 or similar recognized standard.
- 4.29.2 All spare parts forming part of the contract supply shall also be protected from corrosion by packaging or similar means to prevent deterioration during transit and storage. All spare parts shall be adequately identified by name and/or part number as appropriate.
- 4.30 **Machinery**
- 4.30.1 The machinery design and selection shall be in accordance with those standards mentioned in the Tender document and embrace logical equipment layouts that will deliver safe and reliable operation and ready access to all elements for inspection and maintenance including ready removal and replacement.
- 4.30.2 All critical items of machinery demanding precise alignment one with another shall be located by means of dowels or fitted bolts.

4.31 Gearboxes

- 4.31.1 All gearboxes shall be procured from the recommended makers list. The gearboxes shall be sized to withstand all normal service loads likely to be imposed and to have a predicted life equal to that of the crane. Gear boxes shall be provided with Catalogue rating and Selection chart of the manufacturer and basis of selection. The criteria and supporting calculations used in selecting the individual gearboxes shall be submitted.
- 4.31.2 All the gearbox casings shall be readily opened for inspection and maintenance of the internals and shall be completely oil tight during operation. Lubrication shall be by oil bath and splash rather than pump circulation. Shaft sealing shall be by spring pressurized lip seal.
- 4.31.3 Easily visible external oil level shall be provided on each gearbox.
- 4.31.4 All gearboxes shall be equipped with oil drainage valve with blank. Any drainage valve(s) shall be protected from accidental damage.
- 4.31.5 The gear boxes shall be of oil tight welded, forged, cast iron or cast steel construction. Enclosures shall be split horizontally or vertically to match with the maker standard. In case of gearboxes for travelling, vertical split enclosure or monoblock enclosure shall be applicable to match with the maker standard. The gear box mating faces shall be sealed with sealing compound. Each reduction gear shall be equipped with an oil level gauge.
- 4.31.6 Machine gears shall be chosen spur gears of 20° pressure angle, helical gears, double helical gears, bevel gears and worm gears surface-hardened and ground. The gears shall be enclosed in a gearbox and shall be closed oil, bath type. Gear reducers shall be provided with anti-friction bearings. Final stage pinion and internal gear of slewing turntable shall be of open gear type and lubricated by open-gear-grease. The open gears shall be greased manually by brush.

4.32 Bearings

- 4.32.1 Anti-friction bearings shall be provided for the primary stage of hoisting, luffing, slewing and travelling gear reducers, the driven shaft of luffing motor, sheaves of the jib top and hook. Other bearings may be of sleeves type removable bronze linings.
- 4.32.2 All rotating bearings shall be of the low friction type of a reputable make and have a service life compatible with that of the equipment on which installed. All exposed bearings (not in gearboxes etc) shall incorporate two seals per side to separately exclude foreign materials and retain the lubricant.
- 4.32.3 Pre lubricated sealed for life bearings shall not be used on any of the major crane components. Grease nipples shall be provided wherever necessary.

4.33 Rope Drums

- 4.33.1 All drums shall be fabricated from weldable carbon steel and be machined after fabrication and stress relieving. The drum shall carry helical grooves to suit the diameter of wire rope and as specified in the design standard employed. The pitch diameter of the drums for hoisting shall not be less than 25 times the outside diameter of the ropes to be used conforming to relevant standards.
- 4.33.2 There shall be a minimum of 3 (three) dead turns remaining on the drums when the hooks are at their lowest point. The last wrap of the rope shall be fixed firmly and safely to the

drum. The laying of the wires during hoisting shall be by means of guide rollers controlled by a scroll mechanism. The loss of a wire from its normal lay position during slack rope conditions shall be prevented by a control roller extending the full width of the drum.

- 4.33.3 No more than one layers of rope shall be permitted on the drums. At least one spare full wrap of the drums shall be available when the hooks are in the fully raised position.
- 4.33.4 A full width and depth drip tray shall be provided beneath each rope drum to catch and contain any rope lubricant spill.
- 4.33.5 All drums shall be mounted in roller bearings and fitted with fail-safe electro hydraulic or electro mechanical thrusters operating on a full wrap lined band brake/disc brake. The brakes shall be able to securely hold the design maximum test overload load of the individual winches. Provision shall be made to safely control the progressive release of such brakes to effect the lowering of any load.
- 4.33.6 The external brake drums shall form an integral part of the rope drums.

4.34 **Wire Ropes**

- 4.34.1 Wire ropes shall be of the pre-formed non-galvanised non-rotating type, 35 + steel core (Seale Warrington type) of approved construction. The ropes should conform to ISO 2408 and ISO 4308 standards and be supplied in the lubricated condition. FOS shall be 5.6.
- 4.34.2 Wire ropes that are operated in pairs from left and right grooved drums shall be constructed to opposite hands. The rope ends shall be secured on each of the drums by means of bolted clamps, possibly located on the outside of one of the drum end plates/ on the drum in accordance with applicable standards. Each rope shall be made in one piece.

4.35 **Rope Sheaves**

- 4.35.1 The minimum pitch diameter of the sheaves and the groove radius and form shall be in accordance with the requirements of the crane design standard being employed. All sheaves within a particular hoist system shall be standardized with material of cast steel and fully interchangeable one with another. All individual sheaves shall be statically balanced. Bearing diameters for the sheaves shall be equal to or greater than specified within the design standard employed. Sheave bearings shall be mounted on sleeves as in IPSS -1-08-002-09. (It is same as specification for sheaves assembly for EOT crane based on IS 4137:1985)
- 4.35.2 The blocks and trolley sheaves assemblies shall permit easy and ready removal and replacement of individual sheaves, bearings and associated shafts with adequate and safe working space available in all cases. The individual sheaves shall be designed to allow ease of handling.
- 4.35.3 The sheaves shall be fitted with suitable covers and collectors to contain, as far as reasonable, contamination of the surrounding structure and area beneath the crane from excess rope lubricant. The covers are to be fitted with inspection doors and be designed so as to offer minimum obstruction to the maintenance of the sheaves.

4.36 Blocks& Hooks

- 4.36.1 The hoist hook shall be of the ram's horn type conforming to BS 3017 / DIN15401 or 15402, mounted on roller bearings and fitted with gravity type safety catches generally to BS 2903. The hook shall be of annealed forged steel. A protective skirt shall be provided to enclose the bearings. Necessary locking arrangement shall be provided in the hook to prevent slings slipping off the hook.

PART C: MAIN CRANE MOTIONS

4.37 General

- 4.37.1 The cranes shall be provided with independent machinery units for Hoisting, Luffing, Slewing and Long Travelling, each operated by their independent motor(s) with PLC and VVVF drives. The cranes shall be capable of performing all operations as per detailed in the tender specification. The motion shall be continuous, smooth with fine speed control.

4.38 Long Travel

- 4.38.1 The crane travel shall be rail mounted, the drive shall be electrically driven with AC-Squirrel Cage Motor with VVVF drive control and motors of proven system with most reliable technology. The motors of long travel shall be controlled jointly and synchronized. The synchronous speed shall be obtained by input reference from master controller in the operation desk in the operator's cabin. The structure shall be supported on suitably mounted bogies with balancers, for even distribution of load. The wheels shall be of good quality and proven make with sufficient load bearing capacity and durable to the climatic condition.
- 4.38.2 The long travel drives shall be located within the portal beams, to avoid damage during working.
- 4.38.3 The bogie frame shall be designed in such a manner that all the gears and wheels are adequately protected against weather and ingress of abrasive matter.
- 4.38.4 Driving and non driving drives shall be designed to have a smooth travel without any strain to the structures. The motors shall be of TENV type. The long travel machinery shall consist of a number of identical bogie mounted drive units installed at the corners of the portal leg structures. Typically the drive units will be powered by intermittently rated totally enclosed AC squirrel cage induction motor driving at least one crane wheel through a geared reduction drive via a flexible coupling or by torque arm type shaft mounted gear motor with built-in brake. The total installed power shall be capable of moving the crane at 75% of rated speed into the maximum in-service wind.
- 4.38.5 Local control panel with standard design shall be provided near the gantry leg for shifting the crane with all the necessary controls including switching on the crane and controls systems.
- 4.38.6 Travel alarm and Gantry parking brake (hydraulic) shall be provided to arrest the movement of the crane from the parking position. Furthermore, the four trucks will be provided with: 2 electro-hydraulic operated clamps acting on the rails, and able to keep the Crane stopped in any position with operating wind max pressure; 2 mechanical

anchoring pins for storm wind. It is allowed to use manual drive for 2 electro-hydraulic operated anchoring pins for storm wind. 4 safety hydraulic bumper against possible shocks at the runway ends, 4 set of sweepers on rails and people removing devices. This is to ensure parking of crane without movement as rail clamp.

- 4.38.7 When developing their designs for this element of the crane Contractor shall read this section in conjunction with details of crane rail and its loading.
- 4.38.8 Reputed make Geared motor with Integral electromagnetic disc brake arrangement for maintenance free and compact design shall be used.
- 4.38.9 Each drive/motors unit shall also be equipped with an electro-magnetically released brake located at the gearbox input capable of holding the crane in the stopped condition and providing emergency braking capabilities sufficient to stop the crane with the maximum in-service following wind and shall be rated 50% higher. DCEM disc brake shall be used.
- 4.38.10 All brakes and motors shall be installed within weather proof covers provided.
- 4.38.11 A minimum of 50% of the rail wheels shall be driven and braked. Any open gearing shall be either contained within the bogie frames or enclosed within robust guards. Generous ground clearances shall apply in both cases. The drive and braking arrangement selected must allow movement of the crane by external means (in exceptional circumstances) without inducing any consequential damage. Clear spaces for movement both inside and outside of gantry legs shall be ensured while designing the system.
- 4.38.12 All crane wheels shall be of the double flange type. The wheels and gears shall run in low-friction bearings. Pinned connections on the crane bogie frames and any load equalizing structures can be mounted in plain, nonferrous bushes. The loading on each group of wheels shall, as far as can be realized, be made equal.
- 4.38.13 Jacking hard points to the concrete surfacing of the crane track will be provided by the civil construction contractor to permit the safe jacking of the crane to allow bogie maintenance. Necessary materials in this regard shall be supplied by crane supplier. The crane supplier shall provide details of the jacking system being provided within one month from issue of PO including.
 - a. The area of the base plate of the jack.
 - b. The maximum anticipated vertical load on each jack (including for all potential wind loads).
 - c. The "in plan" position of the jacking pedestals on the crane bogie and of the jack baseplate when jacking is undertaken.
- 4.38.14. Buffer blocks shall be provided at both ends of long travel tracks.
- 4.38.15. Audio & Visual (LED) alarms shall be fitted at eye height on the four ground corners of the crane shall be initiated whenever the long travel drive is selected. The crane movement itself shall be delayed by some seconds from the alarms to allow personnel and machinery to move out of danger. The audio & visual alarms shall operate continuously while the crane is in motion.

- 4.38.16. The following interlocks and limit devices shall be fitted:
- a. The limits of track travel in both directions shall be regulated by means of two sets of limit switches. After the stop limit switch, additional emergency limit switch shall also be incorporated in both directions to trip the main control if the stop limit switch fails. This shall come into action in the case of failure of stop limit switches. Limit switches shall be provided in such a way that drive motors are switched off before the buffers are pressed. Apart from the items mentioned any other safety requirements for the crane as per design code and crane classification shall be ensured by the supplier without any additional cost.
 - b. Crane long travel motion shall be inhibited if the storm anchor pins are deployed, if the bogies maintenance jacking points and rail clamps are being used.
 - c. Trip bars, trip plates or optical sensors are to be provided covering from near rail level to a height of 2 metre, positioned at each corner of the crane to cover the full width of the bogies in the direction of travel. They shall interrupt the long travel drive and apply the brakes if contacted or triggered by personnel or objects. For this purpose ultrasonic radar and microwave sensors and systems can also be used (without any extra cost).
 - d. Accepted using ultrasonic, radar and microwave sensors and systems for these purposes.
- 4.38.17. Four (04) sets of shock absorbing buffers shall be provided at the extreme ends of the bogies or rocker beams. Details of civil drawings of end stoppers for gantry trucks shall be furnished by crane supplier to facilitate the civil work from the side of construction contractor. Buffers shall be heavy duty hydraulic/rubber/oleo type as applicable. All materials in this regard shall be supplied by the crane supplier.
- 4.38.18. Rail sweepers shall be fitted to the leading edges of each outer bogie to clear the rails of minor debris.

4.39 Luffing Motion

- 4.39.1 The luffing motion of the jib may be operated either by luff screw or a multi sheaved rope system, and shall be powered by an intermittently rated AC squirrel cage induction motor.
- 4.39.2 In case of luff screw system, the luffing connecting rod shall be driven by the luffing motor through a friction or elastic couplings, reducing gear and screw.
- 4.39.3 The luffing motion control system shall be provided with a variable voltage variable frequency controlled drives over the full motor speed/torque range.
- 4.39.4 In case of rope luffing crane, the jib must be capable of being lowered to the ground for rope changing and maintenance.
- 4.39.5 As a minimum, the luffing system employed shall be duplicated for safety, such that in the event of one element of the system failing the remaining element(s) will be able to securely retain the maximum possible load/outreach combination.

- 4.39.6 Two sets of failsafe brake assemblies shall be installed on the drive each provided with a positive mechanical link between the applied load and the brake components.
- 4.39.7 Normal braking shall be regenerative, regulated by the control system, VVVF drives to provide smooth operation and mechanical brakes shall be applied further. An over-speed sensing system shall be provided which will automatically shut down the motion and apply the brakes if activated. The luffing machineries shall be equipped with VVVF speed control system with closed loop speed control with encoder. The rated speed shall be obtained by input reference from master controller in the operation desk in the operator's cabin.
- 4.39.8 The limits of luff travel in both directions shall be regulated by means of two sets of limit switches. This is for initially reducing the luff travel speed to preferably 10% of maximum and further switching off the drive and the brakes applied. As a safeguard against possible failure of the normal limit switches extra ultimate travel switch shall be installed and wired directly such that power supply gets tripped. After actuation of either of end limit switches, the luffing control system shall only allow movement of the jib in the opposite direction.
- 4.39.9 Mechanical stoppers shall be provided at both ends in the case of a luffing screw mechanism in addition to limit switches and structural buffers. Ton-radius monitoring for hook, alarm and tripping shall be provided. Apart from the safety items mentioned, any other safety requirements for the crane as per design code and crane classification shall be ensured by the supplier without any additional cost.
- 4.39.10 Emergency braking should be sufficient to quickly stop the luff motion with minimum shock in the event of over-travel interlock actuation, reaching the ton-metre limit of the crane, mains power failure or the application of and Emergency Stop button.
- 4.39.11 The luff position of the crane is to be continuously monitored and factored with the hook load information from the hoist to provide actual ton-metre loading information. If the design value is reached at any radius the control system shall inhibit any further luff out and only allow the jib to be luffed in.
- 4.39.12 Tail portion of luffing connecting rod shall be protected. Luffing motor and brake shall be protected by steel cover case as applicable. Luffing screw rod and screw nut shall be suitably lubricated and front portion of screw shall be covered with oil tight telescopic steel cover. Luffing motor shall be inter-locked with forced lubricating system, to prevent from failure of lubrication as applicable.
- 4.39.13 Working radius indicator:
Luff radius indicator shall be provided and shall be of digital display type with sensor fitted in suitable place for easy maintenance. This shall be interconnected with loading of the crane for hook. Suitable warning and shut down facility shall be provided to prevent overloading and exceeding limits of radius of the crane. Luff-indicating system shall be from internationally reputed make with reliable and rugged construction.
- 4.39.14 Mechanical/ electronic working radius indicator shall also be provided at a proper place on the revolving structure so that it is visible both from the cabin and the ground. The supplier can provide more than one mechanical/electronic working radius indicator also to meet the requirement of visibility from cabin and ground.

- 4.39.15 In case of multi sheaved rope system, level luffing machinery shall be provided with the following main machinery components;
- a. One (1) AC motor, protection class IP 55.
 - b. Two (2) spring operated disc brakes with electro-hydraulic thruster
 - c. One (1) gear reducer with hollow shaft mounted on the shaft of rope drum.
 - d. One (1) rope drum with grooves for two wire ropes.
 - e. For drum a round bar with limit switch to stop the machinery in the event that the ropes spring out from the drum grooves.
 - f. Two (2) ropes.
 - g. Bumpers at the A-frame to positively limit the inner boom position.
 - h. Max. and min. outreach limit switches including slow down and additional over limit switches
- 4.39.16 The jib must be capable of being lowered for rope changing and maintenance.

4.40 Slewing Motion

- 4.40.1 The slew drive shall be AC- Squirrel Cage Motor with VVVF drive control unit with planetary gear boxes arranged on the revolving machinery frame with their output shafts projecting downward with a pinion on it engaging with the slewing gear. The crane slewing system shall consist of multiple, intermittently rated AC squirrel cage induction motors operating through reduction gear sets to rotate the superstructure assembly through 360 degrees relative to the portal base. AC motor with VVVF Drive control shall be connected to the gear reducers. The gear reducers are of planetary type, with enclosed oil tight construction and shafts running on anti friction bearings. The slewing equipment shall be arranged on the revolving frame.
- 4.40.2 The disc/ drum brake with 120% of full load motor torque, in service for slewing motion. Automatic Mechanical locking is to be provided to restrict the slewing of boom during parking and in storm condition and shall be controlled from the operator cabin.
- 4.40.3 Slew motor mounted on planetary gearbox directly without coupling. Drive motors to be fitted with twin external brake. Alternatively, Slew motor shall be mounted to planetary gearbox directly and no couplings are required. One brake shall be in between planetary gear box and motor. Other shall be behind motor. Hence motor cannot be coupled directly to planetary gearbox.
- 4.40.4 The top revolving portion of the crane is to be supported on a large diameter slew ring bearing. The bearing is to be capable of dealing with all axial loads and overturning moments.
- 4.40.5 The drive motors, or first stage gearboxes input shafts, shall each be fitted with twin external shoe spring/electromagnetic brakes. Normal braking shall be regenerative, regulated by the control system, VVVF drives to provide smooth operation.
- 4.40.6 The slewing motion control system shall provide with VVVF control over the full torque/speed range. The motor speed is to be coordinated with the jib luff position to ensure excessive load travel speeds and centrifugal forces are avoided.

- 4.40.7 The motors of slewing shall be controlled jointly and independently. The slewing machineries shall be equipped with VVVF speed control system with closed loop speed control with encoder. The rated speed shall be obtained by input reference from master controller in the operation desk in the operator's cabin.
- 4.40.8 Apart from the safety items mentioned any other safety requirements for the crane as per design code and crane classification shall be ensured by the supplier without any additional cost. The slew bearing shall be designed to operate not less than the designed life. The slew center of the crane shall be located at the center. A remote operated mechanical locking pin shall be provided to arrest movement during parking and shall be electrically interlocked with slew motors.
- 4.40.9 The entire revolving structure shall be mounted on an anti-friction heavy duty slew bearing with suitable double/ triple row ball & roller, slewing ring with the integral gear on the top of the vertical mast as per the load requirement based on design.
- 4.41 **Hoist Motion**
- 4.41.1 The hoisting/ lowering arrangement shall be AC- Squirrel Cage Motor with VVVF drive controls.
- 4.41.2 The motor drive shall comprise a fabricated rope drum driven by a motor with an electro hydraulic thruster drum type/electromagnetic disc type brake through a totally enclosed helical gear reducer. The motor shall be connected by means of a flexible coupling to the gear reducer.
- 4.41.3 Two numbers of Electro-Hydraulic thruster brakes drum type / electro-magnetic disc type shall be designed 1.6 times the hoist load and shall be capable of braking the dynamic test load without damaging snatch effect and without unacceptable / excessive overheating and it shall be floor mounted between the motor and gearbox.
- 4.41.4 The brake system shall be equipped with manual release mechanism for emergency release and automatic lining wear compensation, with a limit switch to sense the lining wear.
- 4.41.5 While hoisting/lowering the Elimination of slack rope and optimum utilization of motor, capacity with simple and efficient control.
- 4.41.6 A proven electronic load cell over-load protection device with radius indicator display shall be included in the system, which shall give an alarm when safe load is reached and also cut off the power to the motor, in the event the load lifter exceeds the safe working load by 2%.
- 4.41.7 Reliable and proven designed load cell shall be adopted and shall indicate the loads in the fault display unit/HMI.
- 4.41.8 Detailed specification and outline of load cell with amplifier to be furnished by the supplier.
- 4.41.9 Over speed switch shall be provided in the hoist system to stop the movement during over speed.

- 4.41.10 Main hoist slack rope protection shall be provided with indication in operator cabin, which shall disable further movement when sensed.
- 4.41.11 The hoisting equipment shall be arranged in the machinery room.
- 4.41.12 The main hoist machinery shall consist of a winch driven by an AC squirrel cage induction motor through an enclosed reduction gearbox driving the rope drum. Normal braking shall be regenerative and regulated by the electrical control system, VVVF drives to produce smooth step less electrical braking.
- 4.41.13 A rope tension or drum torque measuring devices shall be provided on all winches to provide continuous load indication readout to the operator's cab. The hoists shall automatically apply load matching counter torque to the drums immediately prior to brake release, whether for further hoisting or lowering, to prevent load snatch. Lowering shall be automatically stopped if a slack rope condition is encountered.
- 4.41.14 Normal lowering operations shall be by means of regenerative braking so as to provide continuously variable speed control. In addition the hoists shall be equipped with two nos spring operated disc/drum brakes with electro-hydraulic thrustors with hand release arrangement able to bring a lowering load, up to and including the test load, to a complete and smooth halt in the event of mains supply power failure or the application of an Emergency Stop button and safely hold the load at any position of the lift during normal operations.
- 4.41.15 The winches shall each be fitted with an over-speed monitoring and prevention system able to apply the brakes to control the load if necessary. Additionally, the operator's cabin shall be provided with readouts depicting either the rope or the hook speed for each winch. Suitable over speed sensor on rope drum to stop when hook speed exceeds 10-15% of the rated speed to be provided.
- 4.41.16 The brake systems shall be designed for at least 3 times the hoist load, or shall be designed as per TPIA approval. There shall be a positive mechanical link between the winch component that generates the braking effect and the supported load.
- 4.41.17 An over-speed switch shall be fitted to the drum that, in an over-speed condition, will shut down the motion drive and apply the brakes.
- 4.41.18 Operation of the hoist motion shall be regulated by the following limits and interlocks:
 - a. The upper and lower limits of the hoist motion shall have normal slow down and stop limit switches. The switches shall be wired into the control circuit. To safeguard against failure of the normal limits, an over hoist and lower limit shall be provided at a short distance beyond the normal stop limit and be wired into the main hoist contactor for tripping.
 - b. There shall be fitted a limit switch to stop the machinery if the rope has come out of the rope grooves on the rope drum;
 - c. There shall be fitted a limit switch to stop the machinery if, with the hook on the ground, there is less than 2 turns of rope remaining on the drum.

- d. Apart from the safety items mentioned any other safety requirements for the crane as per design code and crane classification shall be ensured by the supplier without any additional cost.
- 4.41.19. The operation of the crane shall be so designed that a continuous variable speed with variable voltage variable frequency control over the full torque / speed range with micro positioning of the loads are possible. A drum speed indicator calibrated in m/min shall be fitted in the view of the driver. The control system is to include a full range of safety functions that, when activated, will cause the machinery to be switched off and the mechanical brake to be applied.
- 4.41.20. The control system shall sense the load and control speed of the motors. The hoisting machineries shall be equipped with VVVF control system with closed loop speed control with encoder. The rated speed shall be obtained by input reference from master controllers of the operation desk in the operator's cabin. At heavy loadings the full speed shall be determined by the AC squirrel cage motor torque-speed curve. Independent operation is required for main and auxiliary hoists. Speed changing shall be interlocked with the load limiter and achieved by inverter control unit. When the load is more than half the rated load, hoisting speed shall be controlled at low speed.

PART D: ELECTRICAL EQUIPMENT

4.42 General

- 4.42.1 The electrical installations shall be carried out in accordance with Central Electricity Authority Regulations, Indian Electricity Act and IS Codes amended up to date. The electrical equipment (motors, PLC, VVVF drives, HMIs, Encoders, controls, switches, safety devices, panels, etc.) shall be designed for safe and satisfactory operation under conditions of temperature and moisture as indicated in the main particulars.
- 4.42.2 All electrical equipment shall be located for ready accessibility for maintenance, repair and removal. All electrical equipment shall be protected, by means of installing them in closed casings when needed, so as to exclude accidental contact.

4.43 Power Supply

- 4.43.1 An isolation device (MCCB or ACB) with junction boxes (SS Material) having IP protection Class IP 56 shall be provided at berth pit for taking the supply for the crane from the main incoming supply , same shall be included along with the supply of crane.
- 4.43.2 All electronic and electrical equipment shall be adequately protected from the effects of multiple transient voltages, either in the power supply itself or from lightning strikes etc. Screen and armoured cable, lightning arrestor, surge protectors, isolation of signal and power cables, separate power and signal earthing system, etc. to be used. The Contractor shall provide full details of the protection system(s) to be installed during detailed design stage.
- 4.43.3 Lightning arrestors shall be provided at the upper extremities of the crane and the crane structure shall be electrically bonded to the rail. Use of the long travel bogies and wheels as the conduction path is not permitted. Contractor shall provide full details of the system.

4.43.4 All power distribution cables employed on the crane shall be of adequate size as per calculations and grade with approved insulation and sheathing.

4.44 CABLES AND WIRES:

4.44.1 All cables used shall be copper and minimum size of power cable shall be 2.5 sq mm. All fixed cables, power and control cables, operating at > 110V shall be armoured type. All fixed control cables operating at < 110V shall be armoured/shielded type. Signaling cables shall be screened type or as recommended by OEM of field signaling Device. Multicore cables shall be used in all cases.

4.44.2 Fire retardant low smoke low halogen cables shall be used in the case of power cables. In the case of 415V fixed power and decision of COPT/ ICG would be final in this regard. In fixed installation, the cables shall be fastened on galvanized cable ladders and trays. Cable ducts are also permitted for laying cables. Cable selection (sizing) calculation, voltage grade, type of cable selected along with standards considered shall be submitted for approval during detailed design stage.

4.44.3 The clamping of cables in cable trays and ladders shall be done with suitably sized PVC or rubber insulated stainless steel bands and clamps. In cable ducts, cables shall be suitably supported/clamped. GI pipes or other mechanical protective methods shall be provided where there is a risk of mechanical damage to the cable. All cable terminations shall be made through suitable watertight glands. PVC glands shall be avoided to the maximum possible extent.

4.44.4 Design provisions shall be made to minimize the probability of condensation occurring at any point in the electrical installation whether in conduits, junction boxes, control cabinets etc. Weather protected, cold resistant and UV protected insulation shall be ensured wherever applicable. In the case of electronic circuits, suitable voltage graded cables shall be used. In the case of connections between central units and I/O units, shielded twisted pairs, coaxial cable or optical fiber cables shall be used. Care shall be taken to avoid interference resulting due to power cables with communication cables. Where the control system wiring or similar vulnerable means of transmitting electrical or electronic signals are run through the crane structure, access panels shall be provided for the inspection and maintenance purposes.

4.44.5 Standard Copper shall be used for conductors in all wiring and cables shall be sized in accordance to requirement of IEC. Signal cables shall be individually screened. All signal cables shall have the same characteristics and impedance and separated from power cables. Single strand wire shall not be used. All lay out of wiring in the control cubicles shall be designed to prevent spreading of fire. Where ever necessary UV grade cables shall be used for external wiring exposed to sunlight .

4.44.6 Terminations of all cables shall be made with solder less crimped lugs. All connector and terminals blocks shall be installed in single stack manner, such that easy access shall be made to the cables terminations. All connections shall be made with due consideration for the safety of maintenance staff. Not more than two cables shall be terminated at any terminal point. All terminals shall be properly insulated with PVC sleeves. Use of PVC tapes on the terminals shall not be allowed.

- 4.44.7 Every cable shall be secured and supported in such a manner that the cable and its termination shall not be exposed to undue mechanical strain.
- 4.44.8 All cables shall be run in conduits, trunking, ducting and supported by clips at appropriate spacing. Cables shall be laid in orderly manner and according to the requirement of the NCE/IEE regulations. All cables shall be protected from the sharp edges of the structure and junction boxes wherever ducting, trunking are not possible, not deep galvanized cable tray of suitable size shall be provided.
- 4.44.9 All conduits (rigid or flexible) and trunking shall be watertight and continuous, providing protection to the entire length of the cables and positioned, such that they are protected from accidental damages.
- 4.44.10 Every cable shall be properly marked on both sides. They shall be done permanently by hot stamping the identifications on to PVC sleeves. The marking of the cables as per manufacturer's standard proven design is also acceptable. The numbering of the cables shall be systematic such that maintenance staff can easily identify the location, function or electrical system of a cable through the number.
- 4.44.11 20% of spare controls cables shall be provided, properly marked and terminated at spare connector or terminal blocks through out the crane.

4.45 CRD trailing cables

- 4.45.1 The cable shall be flexible for use on connecting movable parts in the crane CRD system for outdoor use. It shall be suitable for any energy supply on the cable reels associated to high mechanical stresses, frequent bending/torsional operation, copper braiding , and fast movement with strong acceleration.
- 4.45.2 Standards
 - 1) VDE 0250 part 814 or equivalent latest specification
 - 2) DIN VDE 0298 part 4.
 - a) Conductor : Tinned copper conductor, flexible cl. 5L IEC 60228
 - b) Insulation : HEPR compound better than 3GI3
 - c) Inner sheath : Polychloroprene rubber based compound.
 - d) Anti-twisting
 - e) Protection : synthetic yarns etc.
 - f) Outer sheathed : Black/ coloured polychloroprene rubber compound, UV resistance, thermal, oil, Flame retardant, Halogen free and chemical resistant better than 5GM2. (as per VDE/IEC Standard). VDE 0472, IEC 60332.
 - g) Electrical : Rated Voltage: $U_o/U= .6/1Kv$.
 - h) $U_m = 1.2Kv$
 - i) Mechanical : Tensile load up to 20 N/mm².

4.46 Earthing

- 4.46.1 Earthing of the crane shall be done with copper only in view of saline conditions prevailing at site. Grid Earthing using suitably rated earth strips shall be provided for the entire structure of the crane as per design standards and codes followed. Earthing of electrics shall be done using suitably rated copper strip/bare copper/copper cable. Double earthing shall be provided for all electrics including panels, motors, safety devices, brakes, junction boxes, limit switches etc. All metallic glands used shall be earthed. Details of earthing with sizes shall be submitted for approval during detailed design stage. Copper strips used for earthing shall have purity >99%
- 4.46.2 Earthing system shall be strictly in accordance with BIS 3043-1987 or latest and INDIAN electricity rules/acts. All earthing shall be subjected to free from fitting, laminating rust, scale and other mechanical & electrical defects.

The minimum size of copper strip/ wire earth conductors shall be as follows:

Items	Size / Rating
LT switchgear, MCC, Machine room floor.	40mm x 6mm (flat)
LT AC motor 150KW & above.	25mm x 4mm (flat)
LT AC motor from 110KW & above.	25mm x 4mm (flat)
LT AC motor from 15kw to 90KW.	25mm x 4mm (flat)
LT AC motor from 3.57KW to 11KW and control panel.	25mm x 4mm (flat)
Columns and structures.	40mm x 6mm (flat)
Other areas.	6 sq mm. wire standard
LT AC motor 0.75KW to 2.2 KW and isolator upto18A.	16swg wire
Lighting Fixtures, lighting circuits.	8 SWG wire

- 4.46.3 Lightning protection system for allied structure shall be in accordance with BIS 2308-1989.
- 4.46.4 Small wiring in control cabinets and consoles shall be made up into replaceable harnesses.
- 4.46.5 All electrical cables and all wiring shall be clearly marked to coincide with the wiring diagrams to be supplied for all systems by the Contractor.

4.47 Fire fighting equipments

- 4.47.1 A bracket mounted 4.5 kg CO2 portable fire extinguisher shall be provided within easy reach inside each entrance and electrical room. A 3 kg portable CO2 fire extinguisher shall be mounted in the operator's cabin within easy reach of the operator.

4.48 Slipping Columns

- 4.48.1 Vertically arranged current collector column with spring loaded double brush is to be provided. The current collector column is to be dust and vermin proof with toughened glass windows for inspection. The same shall be subjected to third party inspection. Slip rings shall be made of copper. Required nos of slip rings plus five spare rings shall be provided.

4.49 Electric Motors

- 4.49.1 All motors shall be AC squirrel cage, 415V, 50Hz, copper wound induction motors suitable for speed control by variable voltage variable frequency drive.
- 4.49.2 The electric motors fitted to all the crane motion drives shall comply with relevant Indian standards/IEC. All motion motors shall be suitable for operating with VVVF drives and frequency shall be 50Hz. All motors for motion shall be IP55, Class F, S3 duty. CDF of motor shall be 60% for all motions. If different duty and CDF is required as per design codes, standards and classification, the same shall be used. All motors shall be of the totally enclosed type. Cooling shall be provided by separate external fan or by integral fan depending on rating and duty. Irrespective of IP grading, all motors located outside shall have protective covers. Winding temperature detector & over temperature protection and anti-condensation heater shall be provided for main motors. Main motor means that the motors used for main motion such as all hoisting, luffing, slewing and travelling. Over current and earth fault protection shall be ensured for all motors.
- 4.49.3 The hoist motors shall be capable of withstanding an over speed of 15%.
- 4.49.4 All motors shall have their windings suitably impregnated to withstand tropical duties and to insulation Class F suitable for variable frequency variable voltage drives.

4.50 Limit Switches and External Interlocks

- 4.50.1 All limit switches shall be of robust construction and totally weather proof. The crane shall be provided with the limit switches (heavy duty/ crane duty) and interlocking needed for safe operation and maintenance of the crane. Proper logical safety interlocks shall be provided as per the rule requirements, design codes, safety standards and classification of the crane and as specified elsewhere for level luffing single jib cranes. Such interlocks shall ensure 100 % failsafe mechanisms and safe and smooth operations of the crane and its machineries.
- 4.50.2 All motions of the crane shall be protected from over travel by means of limit switches as specified elsewhere. All the field elements associated with the control shall be of minimum IP 56 grading. Additional canopy shall also be provided for field devices installed outdoor.

4.51 Cable Reel system

- 4.51.1 The proposed power feeding arrangement to the crane is using cable reeling drum. The reeling drum at the crane shall be selected taking into account the cable diameter, weight and cable length required to cover the travelling distance of the crane. The type of system shall be Reeling Drum Driven by Squirrel Cage Motors with Torque Regulators. The crane supplier shall deliver the cable drum at the crane respecting the distance between rail centre line and cable trench centre line including sufficient cable on the drum for the required travelling distance plus entering the cable pit, loops around the drum and connection to the supply cable within the cable pit. In addition, the drum shall be of such length that at least 3 full turns of cable shall be available on the drum when the end buffer of crane touches the end stopper. The cable pit is located approximately at center and the distance from end stoppers to cable pit shall be ascertained by the crane supplier. The reeling cable drum, cables and all accessories including slip rings, interlocking switches, etc shall be supplied and installed by crane supplier. Control panel as required shall be provided. The limit switches of long travel shall operate in parallel cable reel to provide protection. The cable shall be sized to compensate for voltage drop along its length and shall be capable of handling full load current when all motions are working at full load. The capacity calculation of cable shall be submitted for approval and any comments offered in this regard shall be addressed without any price implication. The crane supplier shall provide a switch with IP65 protection inside cable pit for terminating the required runs of incoming cables from substation.
- 4.51.2 The reel and associated gearbox shall be fitted with all protective devices interlocked to shut down the long travel drive in the event of problems.
- 4.51.3 The reel shall be constructed from galvanised steel and be sited on the crane such that it fits within the overall envelope of the crane. Reeling in and out shall be synchronised to suit the crane long travel movement and the cable shall be guided onto the reel from the cable trench by means of paired rollers.
- 4.51.4 Termination boxes and associated cable glands on the cable reeling system shall be watertight, complying with protection code IP 65 as a minimum. Power take off from the cable to the crane shall be through a totally enclosed slip-ring collector. The enclosure shall be provided with an anti-condensation heater and weatherproofed to protection code IP 65. A dedicated separate earthing slip-ring shall be provided for the cable reel itself. Appropriate slip-rings for the communications etc. together with as number of spare rings for future needs shall also be provided. Spare rings shall be at least 10% or 2 (whichever is more) more than the minimum number of rings required to feed the cable. Each ring shall have minimum two copper graphite spring loaded brush and all the rocker arms shall be mounted on the common assembly to avoid misalignment. The current carrying capacity of the rings shall be minimum 3 times the full load current up to 100 amps and 2 times for higher rating. The insulation of the ring shall be from high impact polycarbonate or epoxy and shall be able to withstand 3 times the full load voltage. The slip ring shall be made of brass conforming to IS 6912:1985 or copper. Adequate precautions shall be taken for insulation in view of high moisture content and salinity in the atmosphere.

- 4.51.5 The cable drum and funnel, which are located inside the pit have to be designed by the crane supplier who is responsible for the supply and installation of these two units (cable drum and funnel). The cable protection over cable trench along jetty area shall be supplied and installed by the crane supplier. Also, all other works including supply of items related to cable reeling drum are under the scope of the crane supplier. Remote operation for the same shall be provided at Portal leg of the crane for winding/unwinding the cable in the drum.
- 4.51.6 The cable reel drive system shall be capable of paying out cable whilst in the un-powered condition, in response to wind movement of the crane, without over tensioning the cable.
- 4.51.7 Adequate access by staircase and platforms shall be provided to the whole of the Cable Reel system for maintenance purposes.

4.52 Control Equipment

- 4.52.1 The main machinery house shall be suitably ventilated. The Operator Cabin and electrical rooms where PLC and drive panels are installed shall be air conditioned. Industrial type air conditioners shall be used. Normal conventional AC can also be used, provided that make and capacity shall be got approved by TPIA and CoPT. The temperature shall be adjustable between 18°C to 26 °C. The cooling capacity shall be based on full load conditions and for an outside maximum ambient temperature of 45 °C under full sun radiation and an outside maximum humidity of 98%. Heat load calculations shall be submitted for approval during detailed design stage. The crane heating, ventilation and air-conditioning systems shall be part of the lighting and auxiliary circuits, and thus independent of the main machineries. Industrial air conditioners shall be provided for electrical room (E-Room) only. For the crane operator's cabin, conventional / general air conditioners shall be provided.

4.53 Programmable Logic Controllers, HMI and VVVF Drives

- 4.53.1 The PLC shall handle all crane control functions except the emergency stop and utility circuits. PLC shall be capable to handle Digital I/Os and Analog I/Os. There shall be a minimum of 25% spare I/Os (digital and analog) available on the system itself after successful commissioning of the crane. Make and model of the PLC shall be mentioned in the technical bid.
- 4.53.2 All components of the PLC's shall be suitable for extended industrial use within the particular operating and climatic environment applicable to this crane. Power failure protection shall be provided to ensure continued safe operation. UPS (Minimum 4 Hr rating) shall also be provided for PLC, drive control unit and HMI. The PLC I/O ports shall have provision for adding additional I/O in the future. In this regard, spare I/O slots shall be available in the system.
- 4.53.3 The PLC's shall be provided with programming and monitoring facilities for maintenance and fault logging. Self-diagnostic capability shall be incorporated in PLC both on line during operation and when powered up. All faults shall be visually displayed and signaled by the sounding of an audible alarm, with mute facility, within the operator's cabin. There shall be provision for data storage facility, data transfer

facility with open protocol to the laptop (crane supplier's scope) from PLC room and Operator's cabin.

- 4.53.4 Only authorized users shall be permitted access for program amendments. The parameters shall be viewable without password. The PLC shall have internal hardware and software supervision checking. When a fault is detected, all outputs shall be set to zero and the program execution shall be stopped having an emergency stop as the result. The PLC system shall receive all operator's control signals, limit switch signals and the protection and status signals from the drive and field controls.
- 4.53.5 It shall perform the logical control functions and transmits the control signals. Analogue inputs shall include load measuring device in control room, wind speed monitor etc. The central unit of the PLC shall be located in an enclosure in the electrical control room. Programs and logic incorporated shall be disclosed and discussed with COPT/ ICG during the commissioning and required changes as per the job specific applications shall be incorporated in the program during commissioning. None of the rungs in the PLC program shall be locked. PLC programming shall be ensured for entire safe operations of the crane including avoidance of possible man made mistakes.
- 4.53.6 All the analogue signals connected to the PLC shall be converted and displayed in the HMIs. Separate load cum radius indicators display units are required in Operator's cabin. Required media converters, interfacing cables and media shall be considered open protocol scheme.
- 4.53.7 **Operator's control device:** Operator's desk shall be provided with crane motion controllers, buttons, indication lamps, fault reset, HMI, rail clamp operation switches, lighting switches, emergency stop, control on/off, meters, etc. The arrangement/ positioning of master controllers shall be similar to the existing Level Luffing Single Jib cranes in the yard.
- 4.53.8 **HMI:** Size of the HMI monitor shall be minimum of 15/16 inches (diagonal) and shall be provided as a touch screen system in Operator's cabin. HMI shall be capable to communicate with the PLC processor in open protocol and capable to handle all I/Os including analogue ones.
- 4.53.9 Mimic panel of the crane, if provided, shall be considered in the master display and subsequent screens shall be linked to the same for intuitive operation of the operator ergonomically from the seat. HMI shall be positioned suitably for the same. Alarms and fault history, operational status of machineries, all interlocks including limit switches, temperature of drive and PLC room, Operator room, anemometer speed, drive status- e.g. Current, speed, voltage and failure etc. shall be displayed in HMI. Prior to the testing of the crane, screen details shall be shared to COPT/ ICG for suggestions and any such suggestions from COPT/ ICG shall be incorporated in the system without any omission and without any price implication. Finalization of screen presentation and list of items for display are the sole right of COPT/ ICG and shall be complied in full by the crane supplier.

Drives And Controls: The drive system shall comprise of separate converter and inverter system for each of the motions. The converter system shall comprise of AFEs. All inverters shall be heavy duty, vector type catered for crane application with suitable

firmware. The heavy duty current rating of the drives shall be 1.25 times of the motor rated name plate current or as per calculations and standards, whichever is higher considering ambient temperature of 45 Deg C. 150% overload for 60 seconds and 200% overload for 3 seconds shall be ensured. The electrical drive controls shall provide power for the rapid and precise handling of lifting hooks by use of variable speed control system for hoisting, luffing, slewing and travelling motions. The AFEs shall maintain TDH <5% at input power side. AFEs shall be selected considering negative supply voltage tolerance also. Drives shall be provided with HMI for reading parameters like I, V, load, speed, etc and suitable communication modules for communication with control system. In case of frequency converters with AFE, displays shall be made to suite the conditions according to drive system. HMI system shall be capable to uploading and downloading parameters, hot swapping, etc. The drive units shall be located in the electrical control room in enclosures. All motions shall be controlled with speed feedback encoder as closed loop vector inverter control. The master controller shall generate a signal, which shall be led to the control unit. The control unit shall feed the motor with a frequency controlled by the signal from the master controller and with a voltage, which is dependent on the frequency. All VVVF drives with AFEs, ACBs, MCCBs, contactors shall be at least UL listed.

On Siemens frequency converters with AFE, such displays can only be installed on specialized control modules (there are 2 of them in the project). All the information of each frequency converter connected to this control module is displayed on them. Also, all information about the status of frequency converters can be displayed on the display in the cabin or in the electrical room. It is requested to accept this (abovementioned) solution.

4.53.10 Safety functions of the AC motor VVVF control: The control system of VVVF drives shall include detection of drive own faults. Each of the faults when detected shall cause the mechanical brake to be closed and the movement to be stopped. The faults shall be indicated on the inverter fault indicator such as LCD/LED keypad. The faults detected shall include the following as applicable:

- a) Speed supervision, over-speed, stall
- b) Supervision of currents in motor circuits, over current, earth fault
- c) Voltage failure, overvoltage, under-voltage, one phase missing
- d) Inverter and communication failures
- e) Reference value failure, failures in speed reference circuit
- f) Temperature failure, motor over-temperature, inverter over-temperature
- g) Interference and component failures
- h) Any additional requirements as per design codes, standards, classification, rules shall also be provided.

4.53.11 Tuning of drives: Drives shall be tuned for maximum parameterization in order to obtain smooth and safe operations. Commissioning Engineer shall have in depth knowledge or well conversant service engineers shall handle the tuning the drives by considering the firmware for crane applications. Curves of acceleration and

deceleration shall be considered for optimal tuning and perfect smoothness in the operation shall be obtained.

4.54 Main Switchboards, Motor Controls and Distribution Boards

- 4.54.1 All cabinets shall be considered and designed in line with industrial standards with good quality sheet metals, powder coated, quality workmanship and complying with the rules and guidelines. Statutory clearances as per CEA regulations shall be maintained around the panels.
- 4.54.2 As a minimum the following instruments shall be provided in a readily visible location(s) within the main control panel(s):
 - a) A non-re-settable “hours run” meter for each of the main crane drive systems.
 - b) Voltage and ampere meters monitoring the incoming supply shall be provided. KVAR and Kilowatt-hour meters for the crane shall be provided.
 - c) Harmonic filters to be provided.
- 4.54.3 All panel wirings shall be properly labeled and ferruled as per DIN standards. All power, control and communication cables shall be labeled as per standards. Rubber mats as per latest IS shall be provided in front of all panel boards.

4.55 Low voltage distribution centers and drive panels:

- 4.55.1 **General:** The low voltage distribution panels shall include the switching and protecting devices needed to divide and feed the power coming to the drives, control circuits and servicing appliances of the crane. Isolation arrangement (MCCBs) shall be provided such that maintenance personnel can disconnect power to all drives and individual drives. Additional semiconductor fuses, as required, shall be provided based on the design. Where multiple motors are connected from single inverter, isolation facility and thermal overload relays shall be provided before feeding power to individual motors from inverter. The essential services shall remain operational when the power to drives are disconnected.
- 4.55.2 **Air Conditioned Room:** IP22 shall be provided for drive and PLC panels. Indoor electrical panels separately provided containing breakers: IP52 Outdoor panels: IP56.
- 4.55.3 It is the responsibility of the crane supplier to keep temperature rise of all equipments within limits.
- 4.55.4 Chances of direct contact with electrical and control systems components including drives shall be fully avoided. The IP of control system field elements located outside shall be minimum IP56 or above. In the case of distribution boards of very low power and fault level, MCB shall be used.
- 4.55.5 All cabinets shall be designed with heaters, air circulating fans and/or air conditioning as required and specified to ensure that the possibility of condensation occurring within them when in or out of service is avoided and that the maximum operating temperature of installed components and equipment is not exceeded.
- 4.55.6 The electrical room shall be enclosed and positively pressured to preclude dust and dirt entry.

- 4.55.7 Control gear for the main crane motions shall include “hours run” meters, circuit testing capabilities and fault indication equipment keeping in view the requirement that fault can be easily isolated and pin pointed. Any such faults arising shall be relayed to a conveniently located central fault indication panel able to identify the motion in which the fault has occurred. A general fault signal shall also be provided in the operator’s cabin. HMI requirements mentioned shall also be followed.
- 4.55.8 The enclosing cabinets shall be fitted with automatic-on internal lights activated when the door is opened. All openings and glands shall be adequately sealed against the ingress of dust.
- 4.55.9 A wiring diagram of the specific cabinet components shall be provided on the inside of the cabinet doors.

4.56 Crane Management System

- 4.56.1 A Crane Management system shall be proposed by the Contractor. This system shall at a minimum comprise the following elements:
- a) Crane Operations Monitoring & Management.
 - b) Crane Fault Monitoring, Diagnosis and Rectification.
- 4.56.2 Crane Operations Monitoring & Management
- (a) For the first level each drive includes a LCD/LED display indicating the state of the drive. All drives shall be provided with diagnostic functions of the drive controller with LCD/LED keypad. The second level shall be executed in the PLC and displayed in the operator's cabin in HMI. The information shall be presented through different screens. The system shall monitor & record all movement and lifting operations undertaken by the crane. In particular it shall record problems caused by all operations errors e.g. excess loads being presented to any hoist, driver error - e.g. indicating the wrong height of lift when assessing whether winds are within in-service limits; moving controllers from rest to maximum instantaneously and relying on the ramp functions to control hoist speeds.
 - (b) The Management element of this system shall permit fine tuning of control systems to improve performance or economy of operation. Access to this element of the system shall be security coded such that major changes must be authorized by an Engineer keying in his \ her personal code.
- 4.56.3 Crane Fault Monitoring, Diagnosis and Rectification
- Circuit Diagnostic Facility** - A comprehensive installation of circuit monitoring shall be provided as an integral part of the control equipment. This shall be designed to provide circuit testing and rapid fault finding. This Facility shall give full details on a test board in the PLC room and a fault indication in the operator’s cabin. It shall cause the crane to stop, if the condition so warrants. It shall in any case warn an operator that either a serious fault that needs urgent attention or a lesser fault, that can be attended to later is present. All alarms and faults shall be displayed. All events e.g. operation of limit switch and all other safety devices including anemometer shall be displayed. Fault

and diagnose messages shall involve drive control internal, motor, interlocking and communication problems. The fault and diagnose messages shall be stored in a memory and are displayed in the order of occurrence.

4.57 Communications

- 4.57.1 Telephones shall be provided within the operator's cabin, electrical rooms, within the machinery house and at the portal base adjacent to the access stairs.
- 4.57.2 The operator's cabin shall be provided with amplifier, microphone/ loudspeaker and microphone/transceiver system so that he can communicate readily with people on the ground and on board ships alongside the basin wall. Foot switch with siren shall also be provided.
- 4.57.3 PA system shall be provided at Operators cabin

4.58 Lighting

- 4.58.1 All lights shall be LED type, white light except in the case of jib and revolving frame fixed lights. All main light fittings shall be provided with anti-vibration mountings. All lights and lamps shall be readily and safely accessible for replacement. The floodlights shall be positioned to allow such replacement be undertaken during normal crane operations safely, without the use of temporary platforms or scaffolding. Walkways and floodlights shall have provision to control from the operator's cabin and from selected access locations on the crane depending on the movement of man and material. All main lighting circuits shall operate on 240 V, 50 Hz supply. UPS system with battery backup (for 2Hours) and independent emergency lighting circuit shall be provided to enable personnel to safely exit the crane in the event of a total mains power failure. This emergency lighting shall give a minimum level of illumination 20 lux in all working and accessible areas of the crane including stairways, electrical control room and machinery room. Portable automatic recharging hand lamps including plug points for charging shall also to be provided in the operator's cabin, control room, machinery room(s).
- 4.58.2 Emergency lights with minimum 2 hrs backup shall be given with suitable batteries invertors etc.
- 4.58.3 Red dual LED aircraft warning lights (IP67) shall be fitted at the jib top and swing lever top at the highest point in accordance with the FAA Regulations applicable to the site. These aircraft warning lights shall be provided with continuously charged standby batteries, or other approved power source whereby the lights shall remain fully illuminated for a minimum period of 36 hours in the event of failure in the mains power supply to the crane. The mountings shall be of the anti-vibration type to give an overall lamp life expectancy of more than 20,000 hours.
- 4.58.4 A continuous illumination of 30 Lux shall be provided on all ladders, stairs, walkways and platforms. They shall be rough service, anti-vibration type. Lighting in the electrical control room and operator cabin and for maintenance and operational activities shall maintain an illumination of 300 lux. 6nos 250W (minimum) LED light fittings shall be provided in the fixed portion of slewing frame and 8 nos of 250W (minimum) LED light fittings shall be provided for jib. Floodlights shall include

reflectors, glass covers, anti-vibration mountings and stainless steel chain locking arrangement. Gantry lighting shall be provided with Four (4) numbers of minimum 250 W LED floodlights on each corner of gantry to illuminate the travel rail. IP grading of light fittings open to weather shall be minimum IP 66.

4.59 Socket Outlets

4.59.1 A range of socket outlets with plug tops is to be provided within the machinery house and operator’s cabin and at suitable locations inside and outside the crane structure as follows:

(a) 240 V, single phase, Min 32A (2 Nos.- each with socket & outlet) 50 Hz supply:

- 2 nos. –inside operator’s cabin
- 2 nos. - inside each electrical control room
- 2 nos. - inside machinery room
- 2 nos. - in crane tower/post

(b) 24V DC:

- 1 No.- inside operator’s cabin
- 1 No.- inside machinery house
- 1No. - inside each electrical control room

(c) 415 V, 3 phase, 50 Hz, 63A- Welding Set Supply:

- 2 Nos- inside machinery house

Combination of 16A, 32A, 63A, can be used as per requirements and approval from CoPT

4.59.2 All power outlets shall be protected with circuit breakers. Proper earthing shall be provided for power outlets. All fittings shall be suitable for working under heavy vibratory conditions and dusty atmosphere.

4.60 Lux Level

4.60.1 Minimum lux level at different locations shall be:

Sr. No:	Location	Minimum lux level
1.	Operator’s Cabin And Electrical Room	200
2.	Machinery House	150
3.	Walk Ways, Staircase, Ladder, & Platform	100
4.	General Area, Working zone	50
5.	Boom	100

4.60.2 Emergency light shall be provided at walkways, staircase, ladder, platforms, operator's cabin, electrical room and gallery etc .with controls at each location with automatic timer having specified interval for switching on.

4.61 Shore Power Supply and Other Power Supplies

4.61.1 The crane shall be equipped with 415V, 50Hz, 4 wires with earth system plug/socket arrangement to enable the alternate supply of shore power able to sustain all essential power such as for anti-condensation heaters, aircraft warning lights, access lighting and operator's cabin lights/ fans. Necessary interlocks to avoid back feeding shall be arranged for this alternate power supply. This supply is intended in case of power failures over a long period. Other voltages shall be as below.

- a) Aux. appliances –415V (3ph) or 240VAC, 50 Hz
- b) Lighting-240VAC, 50 Hz
- c) Control voltage -110V/24V AC.

If design standards/code/rules/regulations/ classification demands a particular voltage, the same shall be followed. Hand lamps shall be 24 V AC, 50 Hz.

4.62 FIRE ALARM PANEL

4.62.1 Fire alarm panel shall be wall-mounting type, located in operator's cabin. Enclosures of sheet steel (2mm), IP: 55-protection glass.

4.62.2 There shall be a number of zones, as per design requirements, with minimum one number spare. Each zone shall be monitored for fire with visual and audio annunciation system.

4.62.3 The panel shall also have the following signals:

- a) Battery voltage low.
- b) Battery charger failure.
- c) AC powers supply failure.
- d) DC failure.
- e) Battery earth fault

4.62.4 The panel shall house a battery charger operating on 240V / 110V AC supply, with capacity for boost charging the battery as well as supplying power for the system.

4.62.5 Nickel Cadmium battery of adequate capacity to supply power to the fire detection system for 48hrs on AC charges failure. At the end of 48hrs, it shall be able to take the load of all hooters of the system, with minimum 2nos. zones operating with visual signals.

4.62.6 A potential free change over contact suitable for switching 10A, 110V AC auxiliary contact shall be actuated on detection of fire for tripping of air conditioning and ventilation system.

4.62.7 Air conditioning is required in electrical house only, where drive control/ PLC panels are located and also in the operator's cabin.

4.63 EOT Crane for maintenance

Suitable capacity EOT crane shall be provided inside the machinery room with capacity suitable for handling the heaviest equipment for maintenance purpose.

4.64 APFC Panel

Suitably rated APFC panel shall be fitted in the crane for power factor measurement as per the requirements, for maximum energy efficiency measured at full load condition.

4.65 FIRE EXTINGUISHER:

4.65.1 Portable CO2 extinguishers of 4.5 kg capacity are to be installed at the following places for emergency fire fighting operations.

LOCATION	NOS:
Operators cabin	2nos. of 2kg
Portal/ Gantry.	2
Machinery house/ Electrical room	2

4.66 TEXT DISPLAY UNIT:

One display unit (HMI) shall be installed in the operator’s cabin. The display unit shall serve to provide necessary information required to the operator in English. One additional unit shall be installed in the electrical room below for maintenance and crane management purpose. The services shall be available in India having registered office in India. Services shall include programming, modification, additions if any etc.

PART E: HYDRAULIC EQUIPMENT AND LUBRICATION REQUIREMENTS

4.67 Hydraulic Equipment

4.67.1 Where fitted, hydraulic systems shall be designed and installed in accordance with DIN19705 or similar to provide smooth, controlled operation. Pipe diameters shall be generous and pressure relief valves are to be fitted at all necessary locations to avoid over pressure situations. Pressure gauges shall be installed on all systems as required. All design use of hydraulic components must comply with manufacturer’s recommendations (OEM).

4.67.2 The reservoirs shall have clear identification label showing fluid specification. All piping shall be amply supported to prevent vibration and all radii and bends proportioned to minimize the likelihood of cavitations. Bleeding points shall be provided at high points in each system and the necessary bleeding sequence instructions provided in the maintenance manual.

4.67.3 The maximum permitted oil hot spot temperature within any reservoir shall be 60°C.

4.67.4 Where possible hydraulic cylinders shall be parked in the retracted position and fitted with both pressure and wiper seals for the exclusion of dirt. If possible short stroke cylinders shall be fitted with gaiters.

4.68 LUBRICATION:

- 4.68.1 The crane shall be equipped with automatic centralized grease lubrication system at minimum two convenient locations of the equipment. The individual lubricating points grouped at convenient locations as follows:
- (a) Lubrication of traveling bogies at sea side and landside separately.
 - (b) Lubrication of slew bearing independently.
 - (c) Lubrication of 'A' frame, jib and rocker arm.
- 4.66.1. The luffing spindle shall be automatically lubricated through an automatic pump, which will ensure continuous lubrication with required quantity of pressure, and pump will trip in case of change in quantity and pressure.(Shall be given to all possible important areas)
- 4.66.2. Wherever possible all regular, routine lubrication requirements shall be automatic. Interlocks of lubrication system shall be connected to PLC and HMI. All individual grease lines shall be labeled indicating the item being lubricated.
- 4.66.3. Ideally the lubrication sequence should be initiated either at crane start up or immediately following crane shut down. In the event of continuous crane operation without clearly defined shut down and start up activities, lubrication shall be triggered by a timer system.
- 4.66.4. Where manual lubrication is retained all grease nipples etc. shall be brought to convenient and accessible central locations.
- 4.66.5. Lubrication and oil fill points shall be clearly and permanently labeled with the type of lubricant to be used. A list of all recommended lubricants and oils required for the crane shall be submitted to the COPT/ ICG/ TPIA approval that these lubricants and oils shall be readily available from stock within India. The Contractor shall be responsible for the first fill of all lubricants and for ensuring that the crane is correctly lubricated in all areas before commencement of testing and commissioning activities.
- 4.66.6. All pressure lubricated machinery shall be provided with renewable oil filters equipped with pressure drop blockage indicators.
- 4.66.7. To the extent practicable, the supplier shall provide catch trays or similar such that wherever Lubricants including grease and oil are ejected or otherwise removed from the system concerned, the resultant releases of the grease and oil can be captured and removed from the crane without spillage occurring such that they can be disposed of in a controlled manner.

4.67. Piping of Hydraulic and Lubrication Systems

- 4.67.1. Where pipe systems carrying hydraulic fluid or lubricants are run through the crane structure, access panels shall be provided for the inspection and maintenance purposes. All surface runs, whether exterior or interior, shall be adequately protected from accidental damage.
- 4.67.2. Each isolating valve shall be lockable. Each pipe and hose shall indicate direction of flow and fluid identification.

PART F: MISCELLANEOUS REQUIREMENTS

4.68. Machinery House

- 4.68.1. The machinery room with sufficient area shall be located on the revolving frame in which hoisting mechanism and each electrical device shall be equipped in order. The machinery room shall be closed and of all steel construction with steel or aluminum framed windows and doors. Ventilation fans shall also be provided as applicable.
- 4.68.2. The hoist and luffing machinery, together with the main electrical control panels shall all be housed in weatherproof steel framed and steel clad machinery house mounted on the slewing superstructure in case of rope luffing crane. Care shall be taken to ensure that where the ropes pass through the wall or roof of the enclosure they are protected from damage and the aperture shall be weatherproof. The electrical control panels are to be contained in one or more room with the mechanical equipment in a separate room. Access between the two rooms shall be through a lockable door. The machinery house in which hoisting mechanism and electrical device are located shall have provision for easy handling of parts/components by monorail with suitable capacity hoist, to enable inspection and repair of each machinery.
- 4.68.3. The machinery house shall have two personnel entrances. Each shall provide a completely separate exit route from the machinery house to the quay. Both doors shall be half glazed with wired glass and fitted with locks. Two nos. 4.5 kg CO2 portable fire extinguishers shall be provided on permanent brackets close to floor level, one at each entrance.
- 4.68.4. The machinery house shall be force ventilated through a filtered intake if such a measure is necessary to maintain ambient temperature within permissible limits. The ventilation system shall be designed to ensure low noise level for comfort of the technician during maintenance works or while the crane is in operation. Air filters shall be easily accessible and readily replaceable.
- 4.68.5. A fenced double trap door shall be provided in the floor for maintenance purposes. An alternative to this could be suitable arrangements for the removing and replacing of machinery items through the roof of the machinery house. The aperture shall be large enough to pass the largest individual item of machinery to cope level.
- 4.68.6. A foldable table shall be provided at Electrical Control Room for placing a computer.

4.69 Operator's Cabin

- 4.69.1 The operator's cabin shall be located in front of the revolving frame at a level to ensure clear view of the load and handling area. Access shall be from weather and waterproof naturally and artificially lit platform or staircase, not a near vertical ladder. Access to the operator's cabin shall be provided without the need to enter the rooms housing the electrical control panels or the machinery room.
- 4.69.2 The cabin shall be of standard make conforming to Indian Standards (IS). The material of the cabin frame shall be stainless steel or equivalent anticorrosive material suitable for marine environment, toughened glass shall be provided where possible to ensure clear view around the crane to facilitate the operation. It shall be closed and weatherproof of all steel construction and provided with steel/aluminum framed

windows and a door. Windows shall provide unobstructed view. The cabin roof shall be provided with necessary ceilings to reduce temperature.

4.69.3 The operator's cabin shall be air conditioned as specified. The front window and the windows on both sides shall have ultraviolet sheltering glass, sliding and fixed with protection bars. All glazing shall preferably be capable of being opened adequately or fully turned for ease of cleaning from the inside of the cab and should be tinted as necessary to minimize solar gain and provide ultra violet filtering. Dust and water tight seal shall be provided for windows and door of operator cabin. Any glazing not accessible for cleaning from the inside of the cab shall be provided with secure external access platforms, walkways and ladders as appropriate.

4.69.4 The operations of hoisting, luffing, slewing and travelling shall be controlled from the cabin and shall be provided HMI indicating operation status including status of safety devices, fault status and resetting provision .All the controllers and other equipment necessary for operating the crane shall be arranged so that the operator can control accurately and quickly without leaving his seat. The position of the master controllers shall match with the existing arrangement of level luffing cranes in COPT/ ICG yard.

Use of non-fixed (with self returning to zero position) stepless/ stepped joysticks for controlling the mechanisms of lifting, outreach slewing. For stepped joysticks, the speed change from one step to next step shall be smooth and jerkfree due to VFD. The direction of movement of joysticks coincide with the direction of movement of the working bodies/ mechanism of the crane. Joysticks allow the combination of movements, can be equipped with buttons such as deadman's switch to prevent inadvertent movements.

It is allowed to use non-fixed (with self returning to the zero position) stepless joysticks for controlling the mechanisms of lifting, outreach, slewing. The direction of movement of the joysticks coincide with the direction of movement of the working bodies / mechanisms of the crane. Joysticks allow the combination of movements, can be equipped with buttons such as "dead man switch" to prevent inadvertent movement.

4.69.5 The cabin shall be furnished with an electric fan, AC unit and a fire extinguisher, electrically operated wiper.

4.69.6 The driver's seat shall be comfortable, ergonomically designed and upholstered in a material suited to the climate. It shall be fully adjustable, fore & aft, up & down and 270 degree rotation. Operators' assistant seat shall also be provided. The main crane functions shall be operated by means of master controllers, switches, buttons etc. situated on or in close proximity of the chair arms.

4.69.7 The inside of the cab shall be shaded from direct sun as far as is operationally reasonable and a separate, false, overhanging canopy roof shall be provided. The operator's cabin shall be liberally sized and ergonomically designed for maximum visibility. All controls shall be conveniently grouped inside the cabin for ease of operation from the operator's chair. A safe load indicator and a radius indicator need to be provided in the cabin. Other accessories, like overload indicators for main motors, limit switches and indicators, interlock indicators and wind velocity indicators, shall be

provided in the cabin. Access to the cabin shall be from the Portal machinery house and second access will be from outside.

- 4.69.8 All controls such as, master controller for hoist/lower, luffing /slew and gantry motion on either side of the operator chair shall be provided, including selector switches, push buttons, indicating lights (shall be LED) etc., as required for all motions. Necessary highly legible and good quality labeling has to be provided for the switches and indicators.
- 4.69.9 A fault annunciation display with reset facility, audio/visual warning, emergency stop push button, etc. may be conveniently placed for easy operation from the operator's chair.
- 4.69.10 Press to talk communication system shall be provided in the operator's cabin to communicate with the ground staff, E-room and Machinery House.
- 4.69.11 The front portion of cabin glass shall be provided in such a manner so as to have ease in proper cleaning and not to obstruct straight eyesight of the operator while in operation. Electrically operated screen wipers shall be provided on the front window. Glass shall also be provided wherever possible in the floor. Windows shall be protected by a grill. Wipers shall be of such a type, which shall cover maximum area.
- 4.69.12 An alarm system shall be provided for alerting personnel at the ground and it shall be operated from the pedal switch placed near the Operator's chair.
- 4.69.13 Public Address System: Consists of goose-neck microphone and amplifier installed in the tower cabin and a marine type loudspeaker outside of the tower cabin shall be provided.
- 4.69.14 Camera with screen shall be provided for smooth operation and visual of the crane hooking systems while working inside the ship deck and shall be fitted at the jib end for proper viewing.
- 4.69.15 A 2 kg portable CO2 fire extinguisher shall be mounted in the cab within easy reach of the operator.

4.70 Safe Load Indicator & Anemometer

- 4.70.1 **Safe Load Indicator:** Composed by a display placed in the operator's cabin Showing the effective suspended load, the relative radius and angle and the load moment expressed in percentage.
- 4.70.2 An automatic cut -off, when load moment exceeds 110% of admitted load, will stop all the maneuvers causing a tipping load situation. Visual and audible alarms are also provided at 105% of admitted load.
- 4.70.3 **Anemometer:** A display placed in operator's cabin will show the wind velocity. An acoustical alarm is provided when the wind reaching the maximum admitted wind velocity. Regulation of admitted wind is possible.

Anemometer of marine quality shall be provided to indicate wind velocities. The anemometer shall be able to monitor wind velocity between 0-75 m/s with high accuracy of the full range. The anemometer shall indicate wind speed in HMI fitted in Operator cabin. For this, Anemometer shall have suitable output transmitters and media

converters to input information to PLC and then output of PLC in the HMI. The anemometer shall be suitable for rugged crane service. It shall be insensitive to crane vibration and a salt laden environment. The anemometer shall be reliable. Periodic maintenance shall not be required more than once per year. The anemometer shall provide a wind speed input to the PLC system of the crane and shall control the wind warning, stopping the crane travelling motions and operation of safety devices.

4.71 Emergency Stops

4.71.1 Any one of the emergency stops shall be capable of tripping all control circuits. The Emergency Stops shall be of robust construction and have red mushroom heads. When depressed, the red mushroom head shall not be released automatically. Implementation of Emergency stop shall be provided as per DIN standard by using safety relay. The crane shall be provided with emergency stop buttons on the following locations:

- a) Operator's cabin (1no.)
- b) Electrical control room/rooms(1no. each)
- c) Machinery house (2no.)
- d) 8 nos. on two legs-inside and outside

4.72 Access Preferences

4.72.1 Stairs, ladders, platforms and walkways shall be provided to make accessible all parts of the crane requiring service, maintenance or inspection. All platforms and decks shall be of structural steel and shall be braced rigidly to the crane. The floor of the decks shall be made of steel checkered plates. Safety hand rails shall be provided on the platforms and shall be of steel round bars and pipes. Necessary drain holes shall be provided on the platforms to prevent collection of rain water. Stair case shall be inclined type ladders with hand rails and platforms shall be provided up to swing lever (as applicable) for convenience of operation and maintenance personnel.

4.72.2 Wherever possible foot access to the crane shall be by stairs rather than ladders. Landings shall be provided to all stairways at not more than 9 meter intervals, GI gratings shall be provided for landing in outside areas.

4.72.3 All staircases and platforms shall have continuous toe boards (minimum height of 150mm), intermediate and upper handrails provided. The height of the handrail shall be minimum 1000 mm with intermediate hand rail of 500 mm. Spacing between verticals shall be 1000 mm. The intermediate and upper handrail tubes and supporting stanchions shall be purchased from a standard manufacturer of such systems and designed and installed in conformance with his recommendations.

4.72.4 The provision of access holes in platforms, walkways and staircases is not permitted for any purpose.

4.72.5 Ladders shall not be used unless there is no realistic alternative and the Purchaser's prior agreement is obtained. This requirement applies to both access and emergency escape routes. Where ladders are approved, safety hoops commencing at 2.2m above the foot of the ladder and continuing to a height of 2.2 m above the top landing shall be provided. Ladders shall be of the single rung type with rungs spaced not more than 230mm apart. Additionally, a swing up safety bar shall be provided at the height of the

upper handrail on the adjacent platform. The angle through which a swing up safety bar shall travel shall not exceed 85 degrees.

- 4.72.6 Alternative exit routes of walkways, platforms, stairways and ladders, shall be available to enable the operator and any maintenance personnel escape from the crane cabin and machinery house areas in an emergency.

4.73 Notices and Labels

- 4.73.1 The name plate(s) and caution plate(s) shall be written in English and indicated in metric unit, and shall be covered with cellophane tape for the temporary protection.
- 4.73.2 Safe working load notices shall be prominently displayed on the structure of the crane in English.
- 4.73.3 All major machinery, electrics and equipment shall be provided with identification name plates made from stainless steel/brass plates and label plates indicating equipment type, capacity, electric rating etc shall be fitted as per supplier's standard. This marking or description shall be linkable with the drawings or technical manuals furnished. Instrumentation shall also be indicated in metric unit.
- 4.73.4 All notices and labels within the operator's cabin shall be in English.
- 4.73.5 Filling points for water, lubricating oils and greases, tank capacities and other similar maintenance instructions shall be in English.
- 4.73.6 All equipment manufacturers rating and identification plates shall be in English.
- 4.73.7 The crane Manufacturer must submit the locations, styles and sizes proposed for all significant notices for approval by COPT/ ICG. Notices and labels shall be manufactured from steel, brass or durable plastic. External notices shall be painted and manufacturer's rating plates stamped. General labels shall be engraved from white/black/white sandwich plastic or similar to provide black lettering on a white background. Emergency labels etc. shall be engraved to provide red lettering on a white background. All labels shall be mechanically secured by screws, rivets or similar. Adhesive labels are not permitted.
- 4.73.8 Both side walls of the crane machinery house shall be painted with the COPT/ ICG logo and name in large blue lettering. The precise colour blue to be applied will be selected from a selection of colours watches provided by the supplier.
- 4.73.9 Before dispatch to site for assembly and erection all connecting items, whether mechanical, electrical or structural shall be suitably identified and, where appropriate, also carry orientation marks to prevent miss-assembly. Identification marks shall be positioned such that they will remain visible throughout the assembly or erection process. Small loose items shall either be securely wired to associated parts or bagged. All such items shall be clearly identified. Nuts, bolts and washers shall be bagged and identified by size and material specification.
- 4.73.10 The crane is to be marked by day marking and night marking during and on completion of construction as per ICAO standard Annexure 14, Chapter 6.
- 4.73.11 It is allowed to design with outside spiral staircase (for slewing part of the crane) around the column for easy access.

4.73.12 Closed drum-type parking brakes shall be used. Braking is carried out dynamically by motors.

4.74 SUPPLY , INSTALLATION , TESTING AND COMMISSIONING OF CRANE TRAILING CABLE PROTECTION SYSTEM :

4.74.1 The cable Protection system shall a proven system have a continuous semi-flexible belt, fabricated from rubber with inlaid steel reinforcement, which lies over channel cast in the quay. The size of the trench shall be 150mm (D)X150mm(W) for the entire crane travel length and shall be fixed in the cable trench proposed in the berth being under construction. Any modifications to be made for fixing the same shall be under the scope of crane supplier. The same shall be reverted/ firmly fixed to the quay surface along one edge, while the other remains free to be raised by a cable guide and belt lifting device fitted to the crane. Steel reinforcement has been incorporated to retain flexibility of the belt in all direction, except transversely to the channel axis, so that the cable inside the channel is totally protected from vehicles crossing the track and from objects falling into the cable duct.

4.74.2 It is possible to convert a hinged plate system both for conductor bars or cables reel supply to this more flexible covering system. The main components of the system shall consists of:

- a) Stainless steel rivets
- b) Pre-drilled fixing strip
- c) Steel reinforcement rubber cover
- d) Steel channel profile

A complete system consists of the following components:

- a) Either standard or super reinforced belt in rolls of approx. 50m, with joints at their ends.
- b) Stainless steel channel AISI 316, 1.5mm thick, 2 meter long sections.
- c) Hot dip galvanized 30×8mm fixing strips, with 13 pre-drilled holes per meter, in 2 meter long sections.
- d) Stainless steel or nickel copper rivets, 13 per meter.
- e) Earthing copper strips with screws and nuts.
- f) Anti-filling and alignment system with expanded polystyrene.
- g) Alignment brackets for channel sections.
- h) Shall capable for the vehicles passage.
- i) Channels, fixing rivets, etc are available on request.

4.75.3. The channel shall be customized as per concrete channel under construction. Total quantity is 200 meters approximately including all the accessories. The quote shall include supply, installation, testing and commissioning charges of the item at site and also responsibility for the technical support, supervision and fixing of item as per the requirements at site conditions. The fixing of same shall be done along with the civil work of the berth under construction. Full responsibility for fixing the channel with suitable fixing materials, cement concrete for height adjustment, filling the gaps under the duct/channel with suitable filling materials etc. for proper fixing comes under the scope of the crane supplier.

PART G: ERECTION & TESTING

4.76. Erection

4.76.3. The crane is intended to be installed at the 220 M long Jetty being constructed at the Mattancherry Channel. Jetty will be at a distance of 100 M from the shore line. Crane supplier shall submit the detailed erection procedure before commencing the erection activities at site. The procedure shall include details regarding the sequence of erection, capacity of cranes used for erection activates etc.

4.77. Tests at Works

4.77.3. Crane components/sub-assembly shall be tested and inspected at various stages during fabrication/manufacturing (prior to erection) by a Third Party Inspection Agency (TPIA) appointed by employer (CoPT). Inspection and witnessing of all test during erection and final test also shall be done by a third party inspector appointed by the employer.

4.77.4. The employer will deploy representative / TPIA for all major sub-assemblies ready to shipment. It is the responsibility of the contractor to inform in advance before shipment in-order to carry the witnessing and factory acceptance test by the employer. The factory acceptance test is mainly carried out to ensure the compliance of the sub-assemblies and witness their readiness to ship to the site. This is not a replacement for any other testing requirements.

4.77.5. The following minimum tests / inspections shall be undertaken at the Contractor's works or have been undertaken by main materials and equipment suppliers to the Contractor / crane supplier. Suitable certification shall be provided in all cases.

(a) Examination of material, its identification and issue of test certificates for compliance with the employer's requirement

(b) Checking the dimensions of the component/sub-assemblies/assemblies as per the manufacturers drawings and testing thereof.

(c) Physical properties tests in accordance with standards for:

i. Main structural and high tensile steel plates and sections.

ii. Shafts.

iii. Wire ropes - sample test .

(d) Visual Inspection.

(e) Non-destructive testing of hoisting hooks, welded structural members, castings and forgings. Non-destructive testing of welds includes radiographic testing also. Examination of radiographs including radiographic techniques, supervisions of other non-destructive test as required by the codes and specifications.

(f) Magnetic particle inspection on:

(i) All major castings.

(ii) All major forgings.

- (g) Weld Tests and Inspections:
 - i. For requirements refer Clause 33 Welding above.
 - ii. During fabrication.
 - iii. All records with respect to welding inspections, tests, defects and the rectification thereof shall be handed over to employer on commissioning of the crane.
- (h) Functional tests to demonstrate the correct operation of all control and alarm equipment shall be conducted.
- (i) The major crane structural components shall, where size permits, be trial assembled within the Contractor's works or, where this is not possible the erection interfaces shall be demonstrated to be compatible, one with another, by use of photogrammetry or similar techniques.
- (j) Insulation resistance test
- (k) Electrical and control system tests.
- (l) Ensuring that the relevant weld procedures and welder qualifications are in accordance with the stipulated code requirements.
- (m) Inspection of Electric motors for hoisting, slewing, luffing and long travel devices, all brakes, control panels, distribution boards, cables, safety devices etc.
- (n) Any other inspection that is required to be carried out as per the relevant standards, codes and as required by TPIA.
- (o) All machinery elements shall be assembled sufficiently to be capable of being tested under no load for proper operation and control of all speeds and directions and that feedback information and interlock functions are also correct.

4.77.6. Following successful testing all components requiring dismantling for transport and shipment shall have all their mating faces etc. marked to assist reassembly and where necessary, realignments ensured by use of doweled locations.

4.77.7. The Employer and/or his representative may wish to witness certain of the works/equipment tests. The Contractor shall provide a schedule of all the proposed inspection stages during the manufacture of the crane. The Contractor shall provide ample advance notification of all impending tests to the Employer.

4.78. Commissioning

4.78.3. The commissioning tests shall be conducted by the Contractor's personnel and demonstrate the overall suitability of the crane for the ship repair function intended together with proof of specified performance as required in Clause 78 below and amply demonstrating operational reliability.

4.78.4. Test loads will be made available at site by COPT/ ICG. Necessary labour for load testing shall be under supplier's scope.

4.78.5. Any breakages or component or equipment failures that arise during commissioning shall be rectified or replaced at the Contractors cost and without penalty to the overall crane guarantee. All tests associated with the breakage or failure shall be repeated.

4.79. Performance Tests

4.79.1. The Contractor shall perform fitness tests of the crane to include functional, load tests, endurance and trial operations type work.

4.79.2. Upon receipt of the intimation from the contractor, the Employers representatives and personnel will be available to witness the test. The contractor with his own engineers and operators will perform the performance tests under the supervision of the employer. The performance tests to include, inter alia:

- a) Insulation resistance tests on cables, transformers and motors.
- b) Operation of all emergency stops, interlocks and safety equipment.
- c) Long travel, luff, slew and hoist speed and function tests.
- d) Rated load tests.
- e) Over load test in accordance with design standard requirements.
- f) Noise level checks.
- g) Emulate satisfactory working of the wind speed monitoring and alarm system.
- h) Visual inspection
- i) Non Destructive Testing of welds.
- j) No load test of the crane for each motion in each direction.
- k) Full load test with 100% SWL of the crane for each motion in each direction.
- l) During full load test, operation of each equipment and controls shall be normal and operation speed of each equipment shall be within +/- 10 % of the design speed.
- m) Dynamic testing at 100% load.
- n) Over load test 125% static.
- o) Insulation resistance and electrical tests.
- p) All safety devices operation test.
- q) Current measurement of individual components at no load and full load.
- r) Speed measurement at no load and full load.
- s) Operation of Cable reeling system, control system and HMI
- t) Any other requirement of Competent Authority under the Factory Act.

4.79.3. The Contractor shall provide details of all proposed procedures and methods for each discrete test for discussion with and approval by the Employer, TPIA and other statutory agencies. Testing will be undertaken in accordance with the agreed finalized

procedures and methods and to the satisfaction of the Employer that the results are in accord with the Contract Specification.

4.80. Approvals:

4.80.1. All defects pointed out by COPT/ ICG and third party inspection agency shall be rectified.

4.80.2. The rectification of any defects and modifications pointed out by any of the above agencies shall be carried out without any additional cost to COPT/ ICG and approval shall be obtained. Comments/approval of the drawings by the COPT/ ICG/TPIA will not relieve the supplier of his responsibility with respect to the rectification works suggested by statutory authorities.

4.81. Durability

4.81.1. The crane will be subjected to a durability test after successfully completing all performance tests. Durability shall be proved by subjecting the crane to a period of continuous simulated operation at its maximum designed load. The test shall include representative deployment of the luff and slew motions and the portal long travel drive.

4.82. Setting To Work

Once the crane has successfully completed all formal testing it will be handed over to the Employer so that afloat ship repair activities can commence.

4.83. Certification

The Contractor shall supply to the Employer test certificates in accordance with the relevant statutory requirements following completion of all necessary tests.

PART H: MAINTENANCE

4.84. General

4.84.1. The Contractor should have a service network available in India to attend the crane breakdowns and repairs during and after the defect liability period. Details are to be included in the tender document. The service Engineer shall be present at site within 24 hours after a notification of a defect.

4.84.2. To simplify the spares holding and procurement aspects, materials, equipment and components shall be standardized as far as is reasonable within the design of the crane. All spare parts are to be fully interchangeable with the original parts and be manufactured to the same quality and standards. All spare parts and any associated special tools shall be suitably boxed and/or preserved to prevent deterioration whilst in storage. All such packaged items shall be clearly labeled in English for ease of identification.

4.84.3. Maintenance format with reference to the number of hours worked shall be provided in the Operation and Maintenance Manuals, as per the following:

- a) Shift-wise Inspection / Maintenance Schedule.

- b) 100 hrs schedule (weekly).
- c) 200hrs schedule (fortnightly).
- d) 400 hrs schedule (monthly).
- e) 1000 hrs schedule (three monthly).
- f) 2500 hrs schedule (six monthly).
- g) 5000 hrs schedule (yearly).

4.85. Specialist Tooling

- 4.85.1. Special tools for testing purpose required for installation shall be arranged by the supplier.
- 4.85.2. The Contractor shall supply to the Employer one complete set of special tools and fixtures necessary for the erection, removal, maintenance and subsequent replacement of all assemblies, components, spare parts and consumables including all lifting tackle, lifting beams and handling equipment required to ensure that no item exceeding 25 kg need be manually handled.
- 4.85.3. All special tools and fixtures shall be permanently marked as to their function and specific use. Size permitting, they shall all be stowed in secure portable metal tool chests or, if large, wall mounted on shadow boards within a suitably located compartment within the crane structure.
- 4.85.4. All necessary lifting equipment comprising slings, shackles, eyebolts etc. necessary for the safe and effective handling of crane components on arrival to site and during erection or to facilitate maintenance shall be provided by the Contractor.

4.86. Access to the Site

- 4.86.1. The Crane supplier shall duly make arrangements to obtain all necessary passes from ICG for vehicles and persons entering the ICG project site for the purpose of carrying out the Works.
- 4.86.2. The extent of the site will vary as the work progresses to suit the construction of the Works.

4.87. Instructions for outside agencies for working in the site

- 4.87.1. All Contractors and his employees working within ICG project site,. shall comply with the following rules and instructions:
 - (i) While employing workers in the ICG project site., the Contractor and subcontractor engaged by him shall take note that it is a critical installation and required gates passes for the employees of the contractor shall duly be arranged.
 - (ii) Granting permission to project site is fully under the discretion of ICG/ CoPT. All required documents shall duly be submitted to ICG for granting permission. However CoPT/ICG holds the right to suspend or revoke the pass to any employee or worker of contractor by issuing a letter disclosing the reason to do so.

4.88. Contractor's Plant, Equipment, Labour, Personnel, Fuel and Consumables

- 4.88.1. The Contractor shall provide and mobilize all necessary plant, equipment and labour for the completion of the works. He shall provide all necessary maintenance facilities for

the plant and equipment which shall not be demobilized and removed from site before the completion of the works without the written permission of ICG – Engineer-in-charge. All counter weights filling works are under the scope of the contractor.

- 4.88.2. The Contractor shall ensure that all work is undertaken by trained and competent personnel under the supervision of responsible persons, experienced in the particular aspect of the works being undertaken. Site engineers and supervisors shall be deputed as per requirements.
- 4.88.3. The Contractor shall arrange for required supervisory staff on Site as and when required.
- 4.88.4. Material handling equipments, Gas, Water, electricity and Compressed air shall be arranged by the crane supplier/contractor and necessary approvals shall be obtained from local statutory authorities and ICG as applicable. Space for providing site office, assembly, erection shall be provided by ICG, free of cost as per the availability.
- 4.88.5. Contractor/supplier has to make his own arrangements for unloading the crane parts as well as for erection purpose.

4.89. Safety, Health and Welfare; Protection, Life-Saving Etc.

- 4.89.1. The Contractor shall fully comply with all relevant Indian health and safety legislation in force at the date of tender submission.
- 4.89.2. The Contractor shall fully comply with the General HSE. All precautions and permits not limited to the following shall be complied with in connection with the erection, testing and commissioning of the crane.
 - a) Hot work permit
 - b) Permit for work at height
 - c) Permit for Scaffolding
 - d) Electrical shut down permit
- 4.89.3. The Contractor shall give prompt and due consideration to any matters to which ICG/CoPT may find it necessary to call attention, for the purpose of ensuring compliance with ICG / ICG requirements.
- 4.89.4. The Contractor shall provide handrails, scaffolding, and take such other safety precautions as are consistent with normal good safety practice. Warning signs shall be displayed at relevant locations in English and Hindi.
- 4.89.5. Site operatives shall be fully conversant with the use of safety equipment. The Contractor shall provide all necessary personal protective equipment (PPE) to his workforce and that of his sub-contractors. This shall include, but shall not be limited to; safety boots, hard hats, gloves, lifejackets, eye protection, ear defenders, high visibility vests, harnesses etc.
- 4.89.6. All safety rules to be observed while working on live electrical system or installation as stipulated in the Factories & Boilers Act, Indian Electricity Rules, Central Electricity Authority Rules & Regulations and as per ICG standards. Any approvals required from ICG and statutory authorities shall be obtained in this regard. Work permits/ electrical power shutdown permits shall be obtained from ICG wherever required.

- 4.89.7. In the event of any casualty or accident occurring on the site during the execution of the works, the Contractor shall comply with all existing legal obligations requiring him to give notice of the casualty or accident to any person or persons and shall notify as soon as possible both the Employer's safety and medical departments and ICG of any such occurrence.

Contractors shall ensure release of payments to all personnel deployed by them for the project as per government rules and ICG Guidelines.

4.90. Advance Notification of All Operations

- 4.90.1. In addition to his general obligations under the Contract, full and complete notice shall be given by the Contractor of all operations to be carried out on the site. Such notice shall be provided in sufficient time for ICG/ TPIA to make all necessary arrangements for inspection and checking. Such inspection and checking shall not relieve in any way the obligations of the Contractor under the Contract.
- 4.90.2. Work on holidays/ Sundays/off-working hours planned by contractor is to be intimated to Co. P.T/ ICG at least one day in advance.

4.91. Regulations of Statutory Authorities and Customs

- 4.90.1 Without limiting his obligations under the general conditions of the contract, the Contractor shall be responsible for meeting obligations of all statutory authorities, including but not limited to, local representatives, the Indian Electricity rules and Act, Central Electricity Authority rules and regulations, Fire Insurance Regulations, Kerala State Electricity Board, Cochin Port Trust.
- 4.90.2 Should any of the statutory authorities request an inspection of the installation, equipment or the final works, the Contractor shall co-ordinate with ICG / TPIA in carrying out such inspection. Any modification suggested by the authorities shall be carried out by the Contractor, on the advice of ICG / TPIA at no additional cost.
- 4.90.3 The Contractor shall comply with all regulations imposed by the Customs authorities in respect of the passage of all imported Contractor's Equipment, Plant, Materials and vehicles and personnel through Customs barriers (Land and Water).
- 4.90.4 Crane manufacturer shall understand and comply the following Indian Acts / Rules scrupulously and ICG hereby firmly and solemnly informs and declare that any noncompliance or issue comes in this connection or as a dispute on these Acts / Rules is fully under the risk and cost of crane manufacturer during the entire period of this project either at crane manufacturers works or at ICG site or during transportation and ICG is therefore no way responsible or at risk. Relevant Act /Rules are:
- a. Contract Labour (Regulation and Abolition Act)
 - b. Employees Compensation Act
 - c. ESI Act
 - d. EPF Act
 - e. Minimum Wages Act
 - f. Payment of Gratuity act
 - g. Any other acts/rules/norms stipulated by Govt. Authority during the period of contract.

4.92. Contractor's Working Area

- 4.92.1. The crane supplier shall undertake fabrication of the structures at supplier's works or elsewhere (in view of constraints of space for the same within ICG premises) complying to all terms and conditions stipulated herein with this RFQ including all annexure, transporting and delivering the same at ICG project site, assembling, erection and commissioning at site.
- 4.92.2. If the equipment is delivered fully assembled, the Contractor is kindly requested to consider delivery of crane within a nominated window to minimize disruption to other site activities. In this regard, contractor has to study the ICG layout and take all necessary precautions so that maximum loading limit insisted for the jetty civil structure is not exceeded at any point of transfer of crane from the vessel to the track rails. In case of any untoward incident involving damage to Jetty, it is the responsibility of the crane supplier to rectify the damages without any cost to ICG.
- 4.92.3. The Contractor is responsible in ensuring that any equipment used on site for the final assembly work & erection, such as mobile cranes, is compatible with the underlying civil structure.
- 4.92.4. Before work is allowed to commence on site, the Contractor is required to demonstrate adequate provision has been made to prevent permanent damage to the site. The Contractor is required to make good any damage caused during the assembly, commissioning and testing phases of the equipment on site.
- 4.92.5. The Contractor is responsible for all costs involved in movement of the cranes across site and onto their working rails. All temporary works in connection with installation of crane shall be under the scope of crane supplier.
- 4.92.6. Hot work shall only be carried out on site with the permission of ICG. Suitable PPEs (Personal Protective Equipments) are to be used.

4.93. Site Clearance, Make Good etc. on Completion

- 4.93.1. The Contractor shall on completion of the works at his own expense restore, reinstate or make good the surfaces of all ground disturbed by his operations; remove any rubbish, surplus materials etc, and leave the Site clean and tidy to the satisfaction of the Engineer/ ICG.
- 4.93.2. The contractor shall have the right to take back all excess steel / steel scrap after completion of the job on certification by ICG. Any tax / duties applicable in this regard, has to be borne by the contractor.
- 4.93.3. Work area and specific site shall be cleared daily or regularly so as to avoid any sort of dangerous conditions. A proper waste disposal scheme shall be ensured in concurrence with ICG, as per IMS guidelines.

4.94. Relationships with Other Contractors

The Crane Supply Contractor shall afford all reasonable co-operation to other Contractors carrying out other works for ICG in the project site. This will include allowing other Contractors all reasonable access required to perform their work and conferring with them regarding connections and interfaces (if any).

4.95. Progress / Review Meetings

- 4.95.1. During manufacturing process at factory and site work, the Contractor shall appraise the work duly to Co. P.T/ ICG and have to attend progress meetings on site, weekly unless otherwise approved by the ICG, to report on progress and to discuss any issues. Meetings will be held at a location to be nominated by CoPT/ICG in their headquarters. A designated officer who is in charge of the project and authorized to take decision shall attend the meeting. Suggestion for improvements/instructions of CoPT/ICG within the scope of project shall be duly implemented by the contractor.
- 4.95.2. The Contractor may be required by ICG/CoPT to attend other meetings, as necessary.

4.96. Maintenance Tools, Plants & Test Equipments.

- 4.96.1. The tenderer shall furnish a list of tools, plants & test equipments (both mechanical & electrical, shall include local programming tools) for the proper maintenance & upkeep of the crane, which shall be supplied along with the crane. The cost of these equipments/ items shall be deemed to have been included in the tendered amount for the supply of cranes.
- 4.96.2. List of Maintenance Tools and equipments to be provided by the supplier along with the crane.

No.	Name	Quantity
1	<ul style="list-style-type: none"> 1. Sets of heads and accessories 1/4” 2. Sets of heads and accessories 3/8” 3. Sets of heads and accessories 1/2” 4. Sets of combined spanners from Smaller size to 27-32 (Ring and Open end) 5. Impact Tool instrument in the cradle 6. Set Of files 7. Set of Allen keys 8. Set of sockets with handle and accessories 9. Screwdriver set in tool tray (Plus and Minus) having grip handle. 10. Set of Pliers instrument 11. Set of pullers snap ring pliers in a tool box. 12. Drum set head 1/2 “ 13. Set Head TROX internal and external. 	1

	<p>14. Set Of heads ½” with hexagon</p> <p>15. Set of end wrenches in a tool tray (6-27mm)</p> <p>16. Set of hexagonal screw drivers with T handle</p> <p>17. Tal 1.5T/3M</p> <p>18. Tal 3T/3M</p> <p>19. Sledge hammer 1.5, 4 KG</p> <p>20. Key torque wrench with integrated ratchet 700-1400 PVTR-2000 50-225 Nm, 1/2”</p> <p>21. Key torque wrench 700-1400 Nm,1”.</p> <p>22. Adjustable wrench 8”.</p> <p>23. Cutter.</p> <p>24. Multimeter Fluke.</p> <p>25. Clamp Meter with required rating.</p>	
2	Heavy duty grease box (Graphite lubricant) 3	1
3	<p>Set Of wrenches in boxes , covering the whole range of necessary torques</p> <p>1. Torques wrenches 60-360 Nm.</p> <p>2. Torques wrenches 200-1000 Nm</p> <p>3. Torques wrenches 60-360 Nm with multiplier (is included in the delivery) , 1000-300 Nm.</p>	1
4	Kits of bearing puller for pulling the bearings	1
5.	Set of rope reel load stand/bars and any other equipment for changing the wire ropes	1

4.97. Spares:

Following spares shall be supplied along with the crane.

(i) Travelling Machinery:

Brake lining – 4nos

Driving wheel assembly including wheels and bearing- 1 set

(ii) Hoist Machinery:

- Brake lining – 1 set.
- Rope pulley with bearing-2nos
- Full Brake set – 1No
- (iii) Slewing Machinery:
 - Brake lining – 1set.
 - Full Brake set – 1No
- (iv) Luffing Machinery:
 - Brake lining – 1set.
 - Full Brake set – 1No
- (v) Wire Ropes for crane -1 set each for hoist & luffing
- (vi) LT motor with brake unit-1 no.
 - Full Brake set – 1No
- (vii) Rectifier for magnet disc brake – 2nos
- (viii) Solenoid valve for rail clamp-2 nos
- (ix) Encoder -1no for each motion
- (x) Control contactors of each motion- 2 nos each for each motion
- (xi) Emergency stop-2nos
- (xii) Long travel, luff, hoist limit switch-2nos each for Luff & hoist and 2nos for long travel
- (xiii) Aviation light- 1nos.
- (xiv) Jib light fitting-3nos
- (xv) Slew frame light fitting-1nos
- (xvi) Long travel warning horn-1no
- (xvii) Long travel warning light-1 no
- (xviii) Cable reel motor – 1 no.
- (xix) Control system:
 - a. Programmed PLC-1 no.
 - b. Power supply module-2 nos
 - c. PLC D/I module-2 nos
 - d. PLC D/O module-2 nos
 - e. PLC analog input module -1 no.
 - f. PLC Analog output module -1 no.

- g. PLC communication module-1no
- h. Fiber optic converter-1no as applicable
- (xx) VVVF drive
 - a. Common power module – 1 set (for same chasis)
 - b. Common Control module – 1 set(for same chasis)
- (xxi) Sensors Optical or Proximity: 2 each.
- (xxii)Operators cabin console items – 1 set (each unit 1 no.)

Note:

1. List of recommended spares for 5 years operation shall be submitted by bidder along with Price which should hold for next 5 years.
2. Spare availability for next 10 years to be ensured by Supplier.

4.98. GUARANTEE AND SATISFACTORY OPERATION

- 4.98.1. The contractor shall give guarantee of satisfactory operation of the cranes for a period of 24 months from the date of taking over the cranes in satisfactory working condition by Cochin Port Trust. However, if during guarantee period ,any rewinding work or repair works to the electric motors, thrusters, etc., is required to be carried out, the same shall be attended and shall be under the supervision by the contractor. The contractor shall arrange all tools, tackles and precision instruments for carrying out the work.
- 4.98.2. The following minimum skilled and supervisory staff will be posted for the above purpose.

1	Electrical & Electronic Engineer	:	01 in day shift only
2	Skilled Staff	:	02 in each shift

- 4.98.3. During the guarantee period if any of the spare from insurance spares provided with the cranes is used by the contractor, the same shall be replenished within reasonable period. On completion of guarantee period complete inventory of insurance spares supplied with the crane should be available for AMC.
- 4.98.4. Procurement, stocking and use of maintenance spares as well as consumable wire ropes, lubricants, electrical lamps & switch gears, seals, brake liners, etc. required for satisfactory performance during guarantee period is the responsibility of the contractor.
- 4.98.5. During the guarantee, the contractor has to give assured availability of crane, which should not be less than 95%. However, if requisite availability of 95% is not achieved, the contractor has to pay a penalty, which shall be computed as under:

95% availability of each crane shall be computed on quarterly basis. Each crane should be available for 95% of total hours of respective quarter. Any of short falls in availability shall attract, penalty of Rs.3500/-per hour (short fall hours) per crane for

that quarter. The BG in lieu of security deposit will be released only after adjusting these amount.

4.99. INSPECTION AND TEST BY THIRD PARTY INSPECTION AGENCY:

4.99.1. The entire manufacture, supply, installation, testing, of the cranes shall be carried out under supervision of an inspection agency and will be appointed by Cochin Port Trust from ABS /DNV/ IRS / LLOYDS / Bureau Veritas/ TUV etc. The TPIA will be appointed by Cochin Port Trust by inviting separate tender . The TPIA will be one of the approved classification societies for the inspection of crane during assembly, erection, field testing, & commissioning. Cost of deputation of CoPT/ICG officers for inspection shall be borne by CoPT/ICG. In case of foreign supply CoPT/ICG will depute its officials at ICG/CoPT's expenditure for inspection at the respective place in foreign country.

4.99.2. The scope of work of this third party inspection agency is as follows:

- a) The third party has to go through the tender document and the standards and Norms mentioned in the tender document for various structures and mechanism, electrical items, welding, painting, general structures etc. and submit the finalized standards which will be considered and incorporated in the design of the crane. He has to also confirm that the design of the crane is of proven design. (The definition of proven design is mentioned in the tender document).
- b) The third party will also conform and submit a certificate to Engineer-in-charge at every stage of design, construction and testing of the crane that the crane is being constructed as per the standards and the requirements of the tender document, with supporting certificates of the manufacturers or as the case may be.
- c) The third party inspection agency shall also issue the stage wise completion certificate confirming that the stage has been completed as per the requirement.

4.100Condition for Guarantee period and Comprehensive Annual Maintenance Contract

4.100.1Definition

The Annual Maintenance Contract (AMC) will be commenced as soon as the defect liability period/Comprehensive guarantee/Warrantee period of 2 years is successfully completed to the satisfaction of the employer or after the expiry of extended period of guarantee period as decided by the employer.

4.100.1.1Condition given in the AMC shall also applicable for guarantee period .

The scope of works to be carried out during AMC period by the contractor is comprehensive in nature and the contractor is responsible for carrying out the Preventive and Breakdown maintenance if any, inclusive of supply of spares and labour for the period of five years after completion of warrantee period. AMC shall be carried out/done as per manufacturer's maintenance schedule.

4.100.1.2Contract price

- a. The rate for the comprehensive AMC shall be quoted in Indian rupees in the scheduled attached in the price bid document for each year from date of

commencement of AMC and remain frozen and will not be subjected to any escalation for any reason whatsoever.

- b. The rate of comprehensive AMC shall be considered for the purpose of evaluation of tender . Extension of comprehensive Maintenance contract beyond 5 years period on mutual acceptance between ICG and Contractor as per the same terms and conditions of contract.

4.100.2 Contractor obligation

- a. The scope includes supply of all consumables, repair / replacement of all spares, motor, gear boxes, all bearings, wire ropes and all accessories fitted to the crane, including trailing cable required for smooth functioning of crane including labour.
- b. Contractor shall carry out all preventive maintenance/ breakdown maintenance as per the manufactures service/ maintenance plan. Maintenance shall be carried out as per the manufactures standard procedure and according to the instruction manuals. The crane has be cleaned externally and internally.
- c. The responsibility of the contractor during the guarantee period and Comprehensive maintenance contract includes procurement, stocking, use of maintenance spares as well as consumables and providing required maintenance staff for the satisfactory performance of crane. Maintenance spares as well as consumables, wire ropes, lubricants, electrical lamps & switch gears, VVVF drives , PLC systems, Motors , seals, brake liners, etc. Including all accessories fitted in the crane required for satisfactory performance during the period is the responsibility of the contractor
- d. As per the requirements, calibrate and set meters, safety devices, protection devices, measuring instruments, gauges etc. periodically to ensure accuracy.
- e. Contractor has to maintain records regarding the maintenance and shall submit the same to the employer for verification.
- f. Establish emergency procedures, which shall include actions during cyclone, fire, natural calamities and such exigencies etc.
- g. Contractor shall engage duly qualified team (skilled and semi skilled), any subcontractor etc. required for carrying out maintenance comprising of at least one Experienced Engineer a apart from others. The contractor has to post enough staff so that the cranes are maintained /looked after properly round the clock , the employer has got the right to request the contactor to increase the staff if not found sufficient. The contractor Engineer will report to the Engineer in Charge of the employer for day to day activity.

- h. The contractor shall ensure that the crane shall available for smooth operation except during the preventive maintenance period, which shall be arranged at pre fixed time schedule.
- i. Safety certificate shall be obtained for the crane from authorized testing agency. For getting Safety certificate, the crane will be spared for one day for the purpose. Load will also be arranged by the contractor for load testing. All statutory tests shall be conducted through the statutory agencies by the contractor without any extra cost to employer or user.
- j. Telephone communication shall be arranged by the contractor at site.
- k. On completion of guarantee period complete inventory of insurance spares supplied with the crane should be available for AMC with permission of the Employer.
- l. Sufficient number of skilled technician and engineers shall be deployed for the maintenance of the crane round the clock. Whenever break down of the crane occurs then supervisors and skilled technicians shall soon report to the employer's representative within ½ an hours after receipt of the breakdown information from the client / employer , failing which they will be declared absent and penalty as decided by the employer shall be imposed.
- m. The contractor will ensure to give the crane fit for the service as soon as possible so that it does not hamper the work of ICG / Employer. The repairs and rectification of the gantry track does not form the part of this AMC contract. The storage facility will be provided by employer / client for safely keeping the Contractor's tools.
- n. The contractor has to arrange necessary tools and tackles, manpower, other infrastructure for maintenance and testing of the equipment and shall arrange the required cleaning material such as grease , soap, kerosene, petrol or diesel at their cost. The Employer / client will arrange the required, power supply at free of cost if any required for carrying out AMC.
- o. Any wear & tear of components/spares should be rectified by replacement if required. Reasonable time will be allowed for break-down attention depending on the nature of the break-down
- p. When violation of attending the service is noticed or when work is found to be unsatisfactory or if heavy delay in executing the work is noticed or if operation is affected due to more time taken for completion of work or if hampering operation is noticed due to any delay, then the employer may impose appropriate penalty as decided by the employer which is binding to the contractor.
- q. The contractor shall carry out all the functions as per the provision of the agreement and in accordance with the laws of the Government of Kerala, wherever applicable as well as major Act, Dock Safety Rules and Regulation and

all application laws, rules and regulation from time to time and in accordance with prudent work practices.

- r. Availability of Cranes: During comprehensive maintenance contract period of 5 years, the crane should be available min 90% of total hours per quarter.

4.100.3 Obligation of Employer

- a) Electrical supply up to the crane pit will be made available by the ICG. ICG will provide adequate space for parking and maintenance of the crane and shall also provide the space for storage of spares, tools, tackles etc. and for maintenance staff free of cost at convenient location during the guarantee period as well as for the period of comprehensive maintenance contract for carrying out the work.
- b) Water and electricity power will be provided by the ICG FREE OF COST.
- c) ICG shall carry out necessary load test and annual examination as per the norms.

4.100.4 Payment Terms

- a. Payment of will be in Indian Rupees.
- b. Payment will be made on the basis of Detailed Billing Schedule and it should be submitted along with the tender.
- c. Payment for Comprehensive AMC will be released half-yearly (every 6 months) subject to satisfactory submission of relevant documents, service records and adjustment of the penalty in each quarter.
- d. Contractor is liable to pay all applicable taxes, duties, levies, GST etc. However, for the tax deducted at source under Income Tax, the TDS certificate will be issued accordingly.

4.100.5 Penalty during Guarantee Period of 2 years and CAMC of 5 years

- a. During the above period, the contractor has to give assured availability of crane, not be less than 90% of total hours per quarter. However, if requisite availability of 90% is not achieved, the contractor shall pay penalty, which shall be computed based on availability asunder;
- b. Availability per quarter =90% of (no. of days in a quarter x 24 Hrs.)
Any short fall in availability of crane shall attract penalty of Rs.2000/- per hour (short fall hours) for the crane for that quarter and shall be recovered from the Performance Guarantee / Retention Money during the Guarantee Period and from bills during the comprehensive maintenance contract period.

4.100.6 Disputes

In the event of the two parties not agreeing on the repairs necessary, the question will be treated as a dispute and will be referred to a classification society such as LRS/ IRS/ Bureau Veritas/ ABS and their decision shall be final and mandatory

on the parties. The cost towards such expenses shall be borne by the contractor as well as the Employer half each.

4.100.7 Insurance

- a. The contractor shall be responsible to insure all his assets at site against damages including breakdowns, theft etc.
- b. No claim/ compensation whatsoever will be entertained by the ICG or CoPt for any loss of property or injury or loss of life during the occurrence of any accident to the contractor's maintenance staff/ officials. Contractor has to have his own arrangement of insurance for their staff and property at their own.

5 Termination of contract

- a. In case of the performance of the contractor is not found to be satisfactory, ICG reserves the right to terminate the comprehensive maintenance contract with one month notice. In such event, BG of the contractor shall be forfeited by the employer.
- b. The performance of the contract means availability of crane below 90% in three immediate preceding quarters, then the contract is liable for termination.

4.100.8 Taking over of Assets

The contractor shall,

- a) Handover peaceful possession of the project site, assets, the project and project facilities and services to ICG
- b) Transfer all its rights, titles, and interest in the assets comprised in the project facilities and services which are required to be transferred to ICG in accordance with the Agreement and execute such deeds and documents as may be necessary for the purpose and complete all legal or other formalities required in this regard.
- c) Handover to the employer, all the documents including built drawings, manuals and records relating to maintenance of the project facilities and services.
- d) The contractor shall start the mobilization for handing over the crane 90 days prior to the expiry of 3 years comprehensive maintenance contract after expiry of 2 years guarantee period.
- e) Meantime, CoPT engage TPI agency for inspecting the crane and any deficiency is observed, same will be rectified and hand over the crane in satisfactory working condition before expiry of the contract.

PART- J

4.101 Make List of Major Components

SL	ITEM	MAKES
1	MOTORS	SIEMENS / ABB/ FUJI ELECTRIC / SUMITOMO / YASKAWA / ALLENBRADLY/ IC BAUER/ SEW EURODRIVE / VEM
2	ACB, MCB, MCCB, EARTH LEAKAGE DEVICES, SWITCHES	SIEMENS / SCHNEIDER / ABB / L&T/ALLEN BRADLY / FUJI
3	LT POWER AND CONTROL CABLE	LAPP / NIPPON / FURUKAWA / TRATOS / NEXAN / FUJIKURA / ITALIAN CABLE COMPANY S.P.A / KEI / ASIAN / HELUKABEL / TKD / HELKAMA / IGUS / UNIVERSAL/APAR(UNIFLEX)/KEC/ KABELTEC / ELETTROTEK
4	CONTROL/ SIGNAL/ COMMUNICATION CABLES FOR CONTROL SYSTEM, INSTRUMENTATION,TELEPHONE, FIRE DETECTIONSYSTEM, CAMERA SYSTEM	TKD / KABELTEC/ LAPP / HELUKABEL/ FURUKAWA/ FUJIKURA/ ITALIAN CABLE COMPANY S.P.A/ HELKAMA
5	POWER CONTACTORS, RELAYS,TIMERS, LAMPS, BUTTONS	SIEMENS / ABB / SCHNEIDER / ALLEN BRADLY / OMRON
6	LIGHTS	WISKA/ PHILIPS / GE/ CROMPTON / BAJAJ / WIPRO / OSRAM / PHOENIX (USA) /LUNEX
7	VVVFDRIVES & PLC	SCHNEIDER ELECTRIC/ ALLEN BRADLEY / SIEMENS / FUJI / YASKAWA / ABB/SCHNEIDER
8	LIMITSWITCHES	KOINO / SCHNEIDER / STROMAG / AB / SIEMENS / SAKAMOTO / YASUKAWA / SCHMERSAL /OMRON / TURCK / PEPPERL-FUCHS / SPEED-O-CONTROL/ GESSMANN / SICK / GIOVENZANA / MICROSONIC/ SOC/ EPCC/ OMEGA

9	ENCODER	SICK/ BAUMER/ Linday-Linsaly/ BAUMER / KUBLER / SIEMENS / HUBNER/ LEINE & LINDE
10	HMI	SHARP / HONEYWELL / ALLEN BRADLEY / ABB / SIEMENS / FUJI / THOSHIBA
11	LOAD CELLS/ INDICATOR	SHINHAN / MAGTROL / TRAIGHTPOINT USA / ROBWAY / FUTEK / HONEYWELL / FLINTEC/ TAMTRON / SCHENCK/ SHINHAN / MAGTROL / TRAIGHTPOINT USA / ROBWAY / FUTEK / HONEYWELL / FLINTEC/ TAMTRON / SCHENCK
12	GEAR BOX	SIEMENS / SEW EURO DRIVE / DAVID BROWN / WOORIM / HYOSUNG / KONE / PIV / KREISKOTT / SEISHA /SIEBENHAAR(GERMANY)/ ELECON/ Bongfigoli/ IC Bauer/ Premium (Greaves Cotton)/ ROSSI
13	BRAKES & BRAKE DRUM	SHB / STROMAG/ SVENDBORG / BCH / SIBRE / APEX / PINTSH BUBENZER / ELECTROMAG/ FUJI ELECTRIC / ICAN
14	WIRE ROPE	TEUFELBERGER/ USHA MARTIN/ KISWIRE/ MANHO / FORT WILLIAM/ V ROPES / CASAR / DIEPA/ DRAHTSEILWERK
15	INDUSTRIAL/CONVENTIONAL AIR CONDITIONER	TOSHIBA/ CARRIER/ DAIKIN/ MITSUBISHI / GENERAL / BLUESTAR / LLYOD / SAMSUNG / LG FRIGORTEC/ KERIM/ KENTATSU
16	PRIMER &PAINT	JOTUN / HEMPEL / AKZO NOBEL / SIGMA /PPG / CHUGOKU / INTERNATIONAL / KCC/ NEROLAC/ BERGER/ ASIAN PAINTS
17	BUFFER	OLEA / GANTREX / KOBA/ EREDEN
18	ANEMOMETER	YOUNG MARINE / LILLY & GILLY / THIES/KANA/ELECTROMECC
19	ANTI FRICTION BEARINGS (OF MECHANICAL COMPONENTS)	SKF / FAG / NTN / KOYO
20	HT BOLTS &FASTNERS	UNBRAKO, BOLT MASTER/ TVS

21	CABLE REELING DRUM	CAVOTEC / BTPL / EMM / MITOOL/ WAMPLIER/AUXEMMA/STEMMANN(M EPSERVE)
22	SLEW BEARING	ROTHERDE OF GERMANY / ROBELLO OF U.K/ INA OFGERMANY/ ROLLIX OF FRANCE/ LIEBBER
23	TRAILING CABLE PROTECTION SYSTEM	CAVOTEC / WAMPLIER/ STEMMANN(MEPSERVE)
24	ELECTRIC MOTORS (MOTORS)	SIEMENS / ABB/ FUJI ELECTRIC / SUMITOMO / YASKAWA / ALLENBRADLY/ IC BAUER/ SEW EURODRIVE / VEM
25	TRAILING CABLE	PANZERFLEX /LAPP / CAVOTEC/ WAMPLIER
26	LT POWER & CONTROL CABLE EXCLUDING TRAILING CABLE	LAPP / NIPPON / FURUKAWA / TRATOS / NEXAN / FUJIKURA / ITALIAN CABLE COMPANY S.P.A / KEI / ASIAN / HELUKABEL / TKD / HELKAMA / IGUS / UNIVERSAL/APAR(UNIFLEX)/KEC/ KABELTEC / ELETTROTEK
27	CONTROL / SIGNAL / COMMUNICATION CABLES	TKD / KABELTEC/ LAPP / HELUKABEL/ FURUKAWA/ FUJIKURA/ ITALIAN CABLE COMPANY S.P.A/ HELKAMA
28	LAMPS AND SEARCHLIGHTS (LIGHTS)	WISKA/ PHILIPS / GE/ CROMPTON / BAJAJ / WIPRO / OSRAM / PHOENIX (USA) /LUNEX
29	FREQUENCY CONVERTERS AND PLCS (VVVF DRIVES & PLC)	SCHNEIDER ELECTRIC/ ALLEN BRADLEY / SIEMENS / FUJI / YASKAWA / ABB/SCHNEIDER
30	LIMIT SWITCHES	KOINO / SCHNEIDER / STROMAG / AB / SIEMENS / SAKAMOTO / YASUKAWA / SCHMERSAL /OMRON / TURCK / PEPPERL-FUCHS / SPEED-O-CONTROL/ GESSMANN / SICK / GIOVENZANA / MICROSONIC/ SOC/ EPCC/ OMEGA
31	ENCODERS	SICK/ BAUMER/ Linday-Linsaly/ BAUMER / KUBLER / SIEMENS / HUBNER/ LEINE & LINDE

32	LOAD CELLS / INDICATOR	SHINHAN / MAGTROL / TRAIGHTPOINT USA / ROBWAY / FUTEK / HONEYWELL / FLINTEC/ TAMTRON / SCHENCK/ SHINHAN / MAGTROL / TRAIGHTPOINT USA / ROBWAY / FUTEK / HONEYWELL / FLINTEC/ TAMTRON / SCHENCK
33	BRAKES & BRAKE DRUM	SHB / STROMAG/ SVENDBORG / BCH / SIBRE / APEX / PINTSH BUBENZER / ELECTROMAG/ FUJI ELECTRIC / ICAN
34	INDUSTRIAL AIR CONDITIONER	FRIGORTEC / KERIM / KENTATSU15
35	MASTER CONTROLLER	SIEMENS/OMEGA/SPEED-O-CONTROL/ SCHNIEIDER/ABB/GUESSMANN/SPOH N-BUKHARDP
36	One base station(VHF) along with two hand held sets are to be supplied and installed.	

ANNEXURE--- 4.01

LIST OF DOCUMENTS TO BE FURNISHED WITH BID BY THE BIDDER

1.	Drawing	Main drawings of the crane shall be submitted by bidder which includes The bidder shall submit the relevant drawings, photographs of supplied cranes with proposed control systems, operators cabins details, drives, motors, auxiliary systems/items etc. and also items mentioned in the tender details.
2.	Certificate	Performance certificates from user of the cranes for verification.
3.	Drives and Auxiliary motors	Details shall be submitted by the bidder
4.	Protective devices.	Details shall be submitted by the bidder
5.	Spare parts required for as mentioned in the tender 5 years operation	Other than insurance spares
6.	Quality assurance plan	
7.	Plan for maintenance, based on latest condition Monitoring Strategy Procedures	
8.	Staffing plan for Maintenance Operation, guarantee and AMC separately.	
9.	Connected load and maximum demand of power supply.	
10.	Time schedule for the work	

<p>11.</p>	<p>Erection plans.</p> <p>A., Shall clearly show the area required</p> <p> i., on the jetty</p> <p> ii., covered area for storage of electrical and other costly materials.</p> <p>B., Equipments proposed to be deployed for erection with size & weight.</p> <p>C., Method of erections</p> <p>D., Accommodation for erection & maintenance staff.</p> <p>E., Power supply for erection (shall be given by CoPT): - Low voltage power supply will be arranged by CoPT of 415V, 3Phase, 50 cycles on payment basis. The contractor shall, however, indicate the power requirements.</p> <p>F., Entry pass shall be arranged by CoPT to the staff of contractor till the completion of contract on chargeable basis.</p> <p>G., Similarly for AMC, the Tenderer shall indicate to CoPT the requirements of spares, accommodation, power etc.</p>	
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NOTE: Following standards shall be ensured if not specified in the individuals items in the technical specifications and make list . BIS / Equivalent International standards are also applicable. However, specifications of materials and components shall not be, in any case, inferior to those mentioned.

ANNEXURE --- 4.02
CODES AND STANDARDS

SRNO:	CODE	APPLICATIONS
1.	Indian Standards (IS)	Design, manufacturing and testing of cranes
2.	BIS 5049 /1 1980 BIS 800—1976	Bulk equipment and mobile equipment for design structures
3.	BIS 2062—1992/2006	Steel welded construction like bridge girders, end carriages, rope drum, gear boxes etc
4.	A ISI—410 / 304	Stainless steel plates
5.	BIS 1271--1985	Classification of insulating materials for dry type transformer
8.	IEEE STD 141	Recommended practice for electrical, power distribution for industrial plants
10	4691—1985	Degree of enclosure protection for the motors
12.	CLASS 'F'	Insulation winding for motors
13.	IC 0141 (TEFC) or IC 0151(TETV) or IC 0161(CACA)	Method of cooling OF motors
14.	BIS 8130—1984	Power cable
15.	IEC 341	Duty cycle of the motors
16.	European Standard and IEC / VD4E/VDE	AC Drives for drives and other electrics.
17.	Class IV degree IEC 146	Overloading capacity of inverters
<p>NOTE: Following standards shall be ensured if not specified in the individuals items in the technical specifications and make list . BIS / Equivalent International standards are also applicable. However, specifications of materials and components shall not be, in any case, inferior to those mentioned.</p>		

ANNEXURE--- 4.03

SPECIFICATIONS OF MATERIALS AND COMPONENTS

	ITEM		SPECIFICATIONS
A	MATERIALS		
1.	Cast iron	:	BIS: 210 Grade 20, excepting counter weight
2.	Cast steel for gears. Cast steel for pressure pin assembly cast steel for general use.	:	BIS: 2644, Grade1. BIS: 2644 Grade 4. BIS: 1030-1978/2707-1973, Grade 23-45
3.	Wrought steel	:	BIS: 1570, C40, Cold drawn specified
4.	Forged steel	:	BIS: 1875
5.	Structure steel	:	BIS: 226 (std quality), IS: 2062 (Fusion welding quality)
6.	High tensile steel	:	BIS: 961 (Fusion welding quality)
7.	Case hardened steel	:	BIS: 1570, C-14
8.	Ductile Iron	:	BIS: 1865, Grade 1
9.	Tubes & Fittings	:	BIS: 1239, IS: 1161
10.	- Bronze Gunmetal - Phosphor bronze - Aluminum bronze	:	BIS: 306, G2 BIS: 28 BIS: 305, Grade 2
11.	Stainless steel	:	BIS: 6911
B	COMPONENTS		
1.	Gears & Pinions	:	Metric system
2.	Wire ropes	:	BIS: 2266 - 2002
3.	Drum	:	BIS: 3177
4.	Wheels	:	BIS: 3177, IS: 1136
5.	Sheaves	:	BIS: 3177
6.	Idler Assembly	:	BIS: 9295 / IS: 8598
7.	Thread	:	Metric system as per ISO
<p>NOTE: Following standards shall be ensured if not specified in the individuals items in the technical specifications and make list . BIS / Equivalent International standards are also applicable. However, specifications of materials and components shall not be, in any case, inferior to those mentioned.</p>			