



Mazdock Modernisation Project

100T Level Luffing Jib Crane Contract

Volume III - Employer's Requirements

Mazagon Dock Ltd.
Mumbai
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Final
3H6543

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Volume III – Employer’s Requirements

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Mazdock Modernisation Project

100T Level Luffing Jib Crane Contract

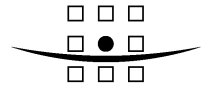
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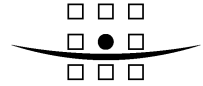
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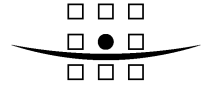
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MAZDOCK MODERNISATION PROJECT

100T LEVEL LUFFING JIB CRANE EMPLOYER'S REQUIREMENTS

A: PARTICULAR SITE CONDITIONS AND REQUIREMENTS

1. SITE LOCATION AND LAYOUT

The following drawings are provided to the Contractor:

- Drawing H6543/TD/0018 rev-T0 - Site Layout
- Drawing H6543/TD/0019 rev-0- Crane Rail Details
- Drawing H6543/TD/0020 rev-0 - Site Layout and Bathymetric Survey.
- Drawing H6543/TD/0022 rev-0 – Level Luffing Cranes: Layout of Site Showing Constraints
- Drawing H6543/TD/1657 rev-0 - Wet Basin South Quay
- Drawing H6543/TD/7601 rev-0 – Buildings and Wet Basin Electrical Services General Arrangement
- Drawing H6543/TD/7216 rev-0 – Buildings Line Diagram for Sub-Station-B and Cradle Assembly Shop and Stores-Main L.T.Panels Part-1

2. BATHYMETRY AND SURVEY

- 2.1 The site bathymetry survey undertaken by Messrs Coastal Marine Construction & Engineering Ltd. in July 2003 is included in the Drawings as above.
- 2.2 The Contractor shall, at his own expense provide and maintain Survey Stations which he may require to carry out the works, and shall remove the same on completion of the works.
- 2.3 Prior to commencing the works, the Contractor shall submit to the Engineer, for approval, details of the equipment (the minimum to be total work station digital or above version) and method to be used for primary setting out of line and level, measuring rail gauge, etc.
- 2.4 The checking of any setting out or of any line or level by the Engineer or the Engineer's representative shall not in any way relieve the Contractor of his responsibility for the correctness thereof.

3. CLIMATIC DATA

- a) **Air temperature:** mean min. 16 °C, mean max. 36 °C, extreme max 40 °C
- b) **Rainfall:** average annual rainfall 2080 mm, average 71 days with 2.5 mm or more. Highest averages June (520 mm), July (709 mm), August (419 mm), lowest averages December, January, February, March and April all less than 10 mm. Abnormal rain of 934mm in one day in July 2005.
- c) **Relative humidity:** range 62 to 86 %
- d) **Barometric pressure:** at mean sea level, monthly means range from 1004 to 1013 mb.
- e) **Wind:** General direction of wind is from the North to the West quarter, with seasonal variations as shown below:-

Seasonal Wind Variations

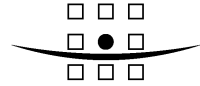
Months	Directions	Speeds
Feb-May	Mainly from N.W.	(Max. 8 to 10 Beaufort. Substantial 4-6 Beaufort)
June-Sep.	Mainly from W.N.W.	(Max. 8 to 10 Beaufort. Substantial 6-8 Beaufort)
Oct-Jan	Mainly from W.N.W.	(Max. 6 to 8 Beaufort. Substantial 2-6 Beaufort)

- f) **Cyclones:** These may occur in the period of May/June or October/November. The last severe cyclonic storm was experienced in 1982.
Occasionally, sudden, high winds also occur during the fine weather period from N.E.

4. SITE DATUM AND TIDAL DATA

- 4.1 The datum for all works shall be zero Mumbai chart datum. Bench marks have already been established within the working area by the Employer and shall be verified by the Contractor before commencing the works.
- 4.2 All the levels shown on the drawings or referred to in the Specifications are related to the Chart Datum, unless mentioned otherwise.
- 4.3 Tidal data for the site is as follows:-

Highest Recorded Tide	HRT	+5.40m CD
Highest Astronomical Tide	HAT	+5.04m CD
Mean High Water Spring Tides	MHWS	+4.42m CD



Mean High Water Neap Tides	MHWN	+3.30m CD
Mean Sea Level	MSL	+2.51m CD
Mean Low Water Neap Tides	MLWN	+1.86m CD
Mean Low Water Spring Tides	MLWS	+0.76m CD
Lowest Astronomical Tide	LAT	-0.46m CD
Mumbai Chart Datum and Site Datum	CD	+/-0.00m CD

5. CURRENTS AND WAVES

- 5.1 The currents at the site of the proposed Works are essentially caused by the tides, and are not influenced to any extent by monsoons etc. The strength of both the ebb and flood currents are similar (1.5 to 2 knots, equivalent to 0.75 to 1.10 m/sec) and the directions are generally North to South / South to North respectively
- 5.2 The predominant waves entering the site of the proposed Works are the swell waves generated by deep sea storms. These mainly arise just before and during the South West monsoon. The wave height at the site of Works is not expected to exceed 1.5 m. The statistical analysis also indicates that most wave periods fall between 6 seconds and 10 seconds.
- 5.3 During the continuance of the North-east monsoon, north-easterly winds known as "Elephantas" blow for short duration during the months of October-November. As the fetch and duration of these winds are limited, the "Significant height" of the resulting waves is not likely to exceed 1 metre with period ranging from 3 to 5 seconds.

6. ACCESS TO THE SITE

- 6.1 The Contractor shall at all times make use only of the Contractors site entrance as instructed by the Engineer for access to the site. Vehicles and persons will be restricted to the Contractor's working area only. Except for making deliveries, Contractor's vehicles shall be parked outside the yard.
- 6.2 The Contractor shall make arrangements to obtain from the Employer all necessary passes for vehicles and persons entering the shipyard site for the purposes of carrying out the Works.
- 6.3 The extent of the site will vary as the work progresses to suit the construction of the Works. In general the site comprises a number of discrete areas within and outside Mazagon Dock. The Contractor shall gain access to the various site areas through shipyard operational areas. The Employer shall in general provide clear access for the Contractor to the various site areas; however the Contractor shall expect at times to have restrictions in access due to shipyard operations.

7. INSTRUCTIONS FOR CONTRACTORS WORKING IN MAZAGON DOCK LTD.

7.1 All contractors working within Mazagon Dock Ltd. shall comply with the following rules and instructions:

- (i) While employing workers in Mazagon Dock Ltd., the Contractor shall bear in mind that it is a vital Defence Installation.
- (ii) The Contractor shall be responsible to produce a Police Report regarding checking of antecedents and verification of character of his employees, if so required by the Security Department.
- (iii) The Contractor shall declare in the Security Office all tools, equipment or any other items brought by him for work in Mazagon Dock. In case of electric cables, its measurement is to be written properly. The paper containing list of items declared in the Security Office shall be retained by the contractor properly. For items of stores / material resembling that of Mazagon Dock Ltd., precaution will be taken to mark their clear identification of colour code and/or serial number and / or clear marking on each item of stores / material including tools.
- (iv) All the items / material required to be taken out of Mazagon Dock Ltd. after completion of work is to be removed only during working hours. This shall be supported by the original paper / document completed at the time bringing the material / items inside Mazagon Dock Ltd.
- (v) At the time of entry / exit, the Contractor's employees shall display their entry passes issued to them. As far as possible, temporary workers passes shall be collected and kept by the Supervisor of the Contractor at the time of his workers going out after completion of work in the Yard. On the next day, these passes shall be reissued to the workmen who are required for work inside Mazagon Dock Ltd. In respect of those workmen who are not required to report on the following day or who are discharged, their passes shall be deposited in the Security Department's Pass Issue Cell.
- (vi) If the Contractor's employee is required to work in Mazagon Dock Ltd. for a period of 89 days or more, he shall produce 3 copies of photographs of each of his employees and other detailed information as may be required, which will be informed to him by the Staff of Pass issue Cell of Security Department.
- (vii) If the period of work in Mazagon Dock Ltd. is less than 89 days, then the Contractor has to furnish the following information in a register as per the labour challan issued by the Personnel Department:

Sl.

Address

.....

No.

Name

Age

Distinguishing mark on the body, if any.....

Designation

Local address

Permanent address

- (viii) The Contractor shall take adequate care while completing the labour challan (ESIS formalities from Personnel Department). The names of his employees who are required to work in the Yard are to be written in the labour challan. The Labour Challan must be signed by the Proprietor / Manager / Site Engineer of his concern. ESIS formalities in respect of his / his sub-contractors workers have to be completed every month without fail.
- (ix) Cost of Security Passes / Identity Cards will be recovered from the Contractor at the existing rate per Security Pass / Identity Card. For re-issue of Security Pass / Identity Card, in case of loss of the same, the Contractor will be charged extra as per prevailing rates. The amount shall be deposited to the Cash Department of Mazagon Dock Ltd. A/c Code No. 440-00.
- (x) The Contractor must ensure that all the Security Rules of Mazagon Dock Ltd. are observed by his employees.
- (xi) The Contractor shall give strict instructions to his or his Sub-Contractor's employees not to step on board ships under construction / repairs.
- (xii) The Contractor shall ensure that his / Sub-Contractor's employees remain at the place of work assigned to them and do not loiter around any other ship or working area. If any such infringement is observed, the employee is liable to be barred from further entry to Mazagon Dock Ltd.
- (xiii) In case the Contractor finds any difficulty in compliance of above Security instructions, he may call on the Chief Security Officer for the necessary guidance.

8. CONTRACTOR'S PLANT, EQUIPMENT, LABOUR, PERSONNEL, FUEL AND CONSUMABLES

8.1 The Contractor shall provide and mobilise all necessary plant, equipment and labour for the Construction of the Works. He shall provide all necessary maintenance facilities for the plant and equipment which shall not be

demobilised and removed from site before the completion of the Works without the written permission of the Engineer.

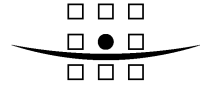
- 8.2 The Contractor shall ensure that all work is undertaken by trained and competent personnel under the supervision of responsible persons, experienced in the particular aspect of the works being undertaken.
- 8.3 The Contractor shall arrange for required supervisory staff on Site as and when required. He shall submit on award of the Contract for the approval of the Engineer in the form of bar chart showing numbers of supervisory staff needed at various stages of construction.
- 8.4 The Contractor shall provide and pay for all fuel, lubricants, gas and other consumable stores required for his plant, equipment and transport and for the execution of the Works.

9. SANITARY PROVISIONS

- 9.1 The Contractor shall provide on site and remove when directed by the Engineer, adequate sanitary accommodation, including, if necessary, septic tank(s) to the approval of the Statutory Authorities for the use of persons employed on the Works and provide proper attendance to the satisfaction of the Engineer.
- 9.2 The Contractor shall, at all times, during the continuance of the Contract adopt such precautions as may be necessary to prevent soil or water pollution on the Site (including any area occupied by temporary accommodation) and shall compel his and his Sub-Contractors' employees and labour to use the facilities provided which shall be carefully maintained by the Contractor throughout the currency of the Contract to the satisfaction of the Engineer.

10. SAFETY, HEALTH AND WELFARE; PROTECTION, LIFE-SAVING ETC.

- 10.1 The Contractor shall comply with the regulations of the Statutory Authorities in respect of safety, health and welfare requirements. All facilities provided shall be subject also to the approval of the Engineer in respect of siting, type, quality, maintenance and cleanliness.
- 10.2 Contractor shall adhere to safe construction practices and guard against hazardous and unsafe working conditions and shall comply with Employer's Safety Rules.
- 10.3 The Contractor shall give prompt and due consideration to any matters to which the Engineer may find it necessary to call attention, for the purpose of ensuring compliance with the foregoing requirements.
- 10.4 The Contractor shall provide handrails, scaffolding, and take such other safety precautions as are consistent with normal good safety practice.



- 10.5 Site operatives shall be fully conversant with the use of safety equipment and drills shall be carried out sufficiently frequently to ensure that all necessary procedures can be correctly observed.
- 10.6 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.
- 10.7 All safety rules to be observed while working on live electrical system or installation as stipulated in The Indian Electricity Rules and other relevant rules.
- 10.8 The Contractor shall in all dealings with labour in his employment have due regard to all recognised festivals, days of rest and religious or other customs and observe days of rest as applicable to the outdoor staff of the Employer.
- 10.9 The Contractor shall not, otherwise than in accordance with the Statutes, Ordinances and Government Regulations or Orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his personnel or Sub-Contractors.
- 10.10 The Contractor shall recognise the freedom of his work people to be members of trade unions.
- 10.11 All personnel employed by the Contractor and any of his sub-contractors' shall carry an identity card which shall be clearly visible at all times on the Site.

11. FIRE-FIGHTING EQUIPMENT AND STORAGE OF DANGEROUS MATERIALS

- 11.1 Suitable fire-fighting equipment shall be provided and maintained on the Site to deal with any outbreaks of fire on the site of the Works.
- 11.2 All possible precautions shall be taken to provide for the safe storage of petroleum, gas bottles, or other dangerous materials. Permits shall be obtained for the storage of such materials wherever this is required by the regulations of the relevant authorities, and the Contractor will be deemed to have included for all costs arising from such regulations within his tender prices and for providing the level of security required for storage and for arranging for the safe delivery to site of such materials.
- 11.3 The Contractor shall observe and abide by all fire and safety regulations of the Employer before starting and during execution of construction work. The Contractor shall consult with Employer's Safety Engineers or Engineer and must make good to the satisfaction of the Employer any loss or damage to any portion of the work done or to be done under this Contract or to any of the Employer's existing property.

12. ADVANCE NOTIFICATION OF ALL OPERATIONS

- 12.1 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 the Engineer 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.
- 12.2 Where the Engineer is required by the specification to give approval to the supply of materials, plant or methods to be used in any part of the Works, this notice shall be sufficient to allow time to carry out inspections, checks or tests prior to giving such approval.

13. REGULATIONS OF STATUTORY AUTHORITIES AND CUSTOMS

- 13.1 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, Fire Insurance Regulations, Brihanmumbai Electricity Supply and Transport Undertaking (B.E.S.T.) and the Central Electricity Authority (CEA) and Mumbai Port Trust (herein referred as MbPT).
- 13.2 Should any of the statutory authorities request an inspection of the installation, equipment or the final works, the Contractor shall co-ordinate with the Engineer in carrying out such inspection. Any modification suggested by the authorities shall be carried out by the Contractor, on the advice of the Engineer at no additional cost.
- 13.3 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.

14. WORKS NOT TO INTERFERE WITH EMPLOYER'S NORMAL BUSINESS

- 14.1 The Contractor shall not interfere in any respect with the normal business of the Employer and shall co-operate with him/them if and when special measures become necessary as a direct consequence on the progress of the Works.
- 14.2 The Contractor, shall co-operate, by temporarily removing any of his Equipment, floating craft, obstructions, etc. which may cause hindrance to the launching of a newly built ship till the process of launching has been completed, as per direction of the Engineer / Employer.
- 14.3 All such arrangements are to be made in writing through the Engineer and any extra work which may be involved paid for at appropriate scheduled rates or as Daywork if approved by the Engineer in writing. No claim for interference or impedance arising from the Employer's normal operations will be considered.

15. SITE CLEARANCE, MAKE GOOD ETC. ON COMPLETION

- 15.1 The Employer will clear away all plant and materials, scrap steel and rubbish from areas to be used by the Contractor, prior to commencement of the Contract.
- 15.2 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.

B: TECHNICAL REQUIREMENTS

Technical requirements of the 100T Level Luffing Jib crane required by the Employer are broadly given below. The Contractor is requested to submit detail specifications of the crane offered, which should include the type, make, capacity, rating, material specifications etc. of major components

16. SCOPE OF SUPPLY

16.1 The scope of supply shall include:

- a) The design, manufacture, delivery, off load and move to erection site, on-site assembly and erection, installation, testing, commissioning and setting to work of the crane (one in number) and all necessary peripherals inclusive of all necessary temporary works (inclusive of associated civil works for erecting crane are part of Tenderer's scope of work) required.
- b) Crane rails shall be supplied and laid by other contractor who has been assigned the work of wet basin.
- c) The Electrical installations will be carried out as per Indian Electricity Act Rules and Regulations..
- d) The provision and mounting of the cable reeling drum and associated power supply cable together with the cable turn over device, cable anchor device and crane isolation switch/connection box within a cable turnover pit. The Employer shall make provision for the turnover pit. The specifications and size of supply cable, cable reeling drum to be given by crane supplier to decide the size of pit. Isolation switch / connection box should have locking arrangement.
- e) A stepdown transformer to locate within the yard sub station 'B' and the necessary connecting cable between the yard sub station 'B' and the isolation switch/connection box. Voltage rating and size of transformer to be given by crane supplier, for making arrangements for locating transformer in sub-station 'B' and fabricating H.T panel. A stepdown transformer shall be supplied by crane supplier.
- f) The provision and installation of any necessary step down transformer(s) and all medium and low voltage distribution equipment and cables there from on the crane.
- g) The supply of an initial stock of operating spare parts.
- h) Recommendations for additional spare parts necessary to maintain the crane in service over the initial 5 years of operation.
- i) The provision of comprehensive operating, maintenance and spare parts manuals for the crane. All such manuals to be in English.

- j) The provision of all necessary operating and maintenance training at site for Employer's nominated personnel.
- k) A Guarantee against damage or failure due to defects in design, material and workmanship for a period of 36 months from the date of final acceptance of the crane.

17. CRANE LOCATION, SITE CONDITIONS AND LIMITATIONS

17.1 The crane is to be delivered to, installed and operated within the Mazagon Dock Ltd. Shipyard, Mumbai, India. Companies wishing to tender for the supply of the crane shall visit the shipyard to fully familiarise themselves with the intended location, the prevailing site conditions and any possible constraints in advance of submitting their offer.

17.2 It should be noted that access to the Site will be subject to limitations and restrictions. In addition, the availability of working areas will be reduced due to other contractors working in the vicinity of the dockyard area generally. Companies wishing to tender are to ensure that they are fully conversant with any limitations and restrictions on access and the work being undertaken by other contractors.

a) The Employer draws to the attention of the Tenderer that there is no space available on site to carry out fabrication works.

b) Tenderer should fabricate the components of the crane at contractor's workshop and transport these components to the MDL site and assemble these components at site in the area demarcated as shown in the drawing no- **H6543/TD/0022 rev-0**.

c) Transportation of the fabricated components of the crane from the contractor's workshop to MDL site is a critical activity and Tenderer may require to transport the crane components from workshop to the erection site by barge. Components that are as large as practical will be imported/transported to site by barge and assembly will take place on the new South Quay as indicated on drawing **H6543/TD/0022 rev-0**.

d) It is required that the Tenderer should study the requirement by visiting the site, carry out the detailed site constraints, finalise the transport method for the 100 T LL crane. It is therefore required that the Tenderer should finalise and submit the transportation method in the technical bid and is also required to give a technical presentation of the Transportation Methodology at the time of Technical Negotiation.

e) The Erection of shipyard type Level Luffing Jib Crane is a difficult & complex activity, in view of the physical constraints at the site. It is therefore required that the Tenderer finalises the experienced agency to perform this activity and confirm in the technical bid. The Tenderer should study the requirement by visiting the site, carryout a detailed site constraints, finalise the Erection Methodology for erecting the Crane. Tenderer should confirm the feasibility of erecting the shipyard type Level Luffing Jib Crane and submit the Erection Methodology along with all

necessary inputs, information etc to demonstrate the same. It is required to give a technical presentation of the Erection Methodology at the time of Technical Negotiation. Also all the Temporary works (including the associated civil works) for Erecting Crane are part of Tenderers Scope of Works and to be quoted without any exceptions.

- 17.3 Work being undertaken by other contractors identified above includes but is not limited to:
- (a) Construction of new Wet Basin
 - (b) Construction of new crane rail beams, Module Shop, Cradle assembly shop and Stores Building.
 - (c) Construction of new Ancillary Buildings, roads, drainage and paving
 - (d) Re-profiling of existing quay walls
 - (e) Supply and erection of 300 tonne Goliath gantry crane
 - (f) Supply and erection of 15 tonne Level Luffing Jib Crane.

18. DRAWING APPROVAL PROCEDURE

- 18.1 Three (3) copies of all design drawings, specifications, literature, erection, testing, commissioning and setting to work programmes are to be supplied to the Engineer for approval purposes. The Engineer will respond within three (3) weeks of receipt of such information advising of each item approved or those being returned for amendment. The approval procedure for amended items will be the same as for the original submission. However, comments / approval of the drawings by the Employer or Engineer or their representatives will not relieve the Contractor of his responsibility for the correctness, adequacy of design and completeness of his work as per the Contract.
- 18.2 The Contractor shall submit any 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.
- 18.3 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 three sets of "as built" prints together with two sets drawings, each on a CD-R disc in a PC compatible AutoCAD/MS Windows format.
- 18.4 The Contractor shall be responsible for preparing all necessary electrical drawings as requested by CEA or any other authority through a licensed electrical contractor and submit the same to the Engineer for obtaining approval from CEA or any other authority.

19. MINIMUM DRAWING REQUIREMENTS

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

- a) General arrangement drawings
- b) Machinery assembly drawings with itemised parts lists and component ratings as appropriate.
- c) Structural arrangement drawings with materials and quantities.
- d) Layout drawings of machinery control room(s)
- e) Control cabin layout and arrangement showing operators seat, windows, limiting sight lines, location of operating controls and all other significant features.
- f) Schematic diagrams of rope reeving systems for all rope motions.
- g) Structural erection drawings
- h) Machinery/mechanical erection drawings

19.2 In addition the Contractor will 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 turn over anchor 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 turn over pit to the yard power supply.

20. HEALTH AND SAFETY

- 20.1 Permanent safe access must be provided for all operating and routine maintenance functions on the crane. Safe access means stairways, ladders, 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 / European practice.
- 20.2 Stairways, ladders, platforms shall be made from steel and tread areas are to be provided with a non slip finish or be constructed from galvanised expanded metal sections of approved design. All guard rails and toe boards shall similarly be of steel construction. The angle of rake of the stairways shall be such that a man can descend the flight while facing away from the staircase.
- 20.3 The maximum permitted noise levels that may be generated by crane operation, at ground level, on walkways outside enclosed machinery spaces and within the cab with open windows is 75dB(A). Within the cab with windows closed the maximum noise level shall not exceed 60dB(A). Note: These values should be in line with Indian H&S legislation requirement.
- 20.4 The crane structure and each individual hook shall be prominently marked with their respective safe working load.
- 20.5 The Contractor must fully comply with all relevant Indian health and safety legislation in force at the date of tender submission.

21. DESIGN, CONSTRUCTION AND TESTING STANDARDS

- 21.1 The International System of measurement units (SI) shall apply throughout.
- 21.2 The design, manufacture and testing of all elements of the crane structure and machinery, together with all equipment and components of sub contract and/or external supply shall comply with the appropriate recommendations or requirements of recognised international standards and codes such as:
- a) Federation European de la Manutention (FEM)
 - b) British Standards Institute (BSI)
 - c) International Electrotechnical Commission (IEC)
 - d) Deutsches Institut für Normung e.V. (DIN)
 - e) Indian Standards Institution (IS)
- 21.3 The Contractor will be responsible for ensuring compliance with any other relevant standard or code as appropriate and may propose other or alternative equivalent internationally recognised standards provided they are published in

English and prove acceptable to the Employer. All Standards shall be the latest version of the relevant Standard.

- 21.4 A complete schedule of standards and codes that it is intended to employ shall be submitted with the bid (in Part 1 – Techno-commercial Bid) for consideration and approval by the Employer. Changes to approved standards following acceptance of the bid will not be permitted.
- 21.5 An English language copy of all such approved standards to be employed will be provided to the Employer/Engineer after contract signing and before commencement of the design and procurement activities.

22. OPERATOR TRAINING AND MAINTENANCE STAFF TRAINING

- 22.1 Full training at the site in the safe operation and maintenance of the crane and all equipment shall be provided to the Employer's nominated personnel by a suitably qualified person, or persons, employed by the Contractor and approved by the Employer. 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.
- 22.2 The necessary training programmes will be developed jointly with the Employer to ensure that the specific operational requirements of the yard and workforce are adequately addressed.
- 22.3 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.
- 22.4 Maintenance training shall include, inter alia:
- routine examination and maintenance
 - fault diagnosis
 - removal, dismantling and replacement of parts and components.
 - basic electrical checks, safety routines and component replacement.
 - approach to hydraulic systems overhaul
 - maintenance planning records and procedures.
 - Instruction and familiarisation regarding the overall operation and maintenance of the crane including Health and safety provisions incorporated (including the operation etc. of items such as load weighing and limit switches etc.).
- 22.5 Operational training shall include, inter alia:
- a) safety procedures
 - b) practice at the control and synchronisation of the main crane motions, long travel, luff, slew and both hoists.
 - 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 familiarisation regarding the overall operation and maintenance of the crane including Health and Safety provisions incorporated (including the operation etc. of items such as load weighing and limit switches etc.).

23. OPERATIONAL AND MAINTENANCE MANUALS

- 23.1 Separate illustrated manuals shall be provided by the Contractor covering the operation, maintenance and parts identification for the crane and associated equipment and components. Proprietary equipment manufacturer'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.
- 23.2 The operator's manuals 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.
- 23.3 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 tasks. 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 Contractors manufacture and of all sub contractors and suppliers manufacture, shall be provided.
- 23.4 Copies of all manuals and illustrations etc. shall also be provided on CD-R discs compatible with a PC system running Microsoft Windows.
- 23.5 In total four sets of paper based and two sets CD-R disc based copies of all manuals shall be provided. The covers of each paper copy of the operating manuals and the boxes for the CD-R discs of the operating manual shall carry the following clear title:

“OPERATING INSTRUCTIONS FOR 100 TONNE LEVEL LUFFING JIB CRANE”

- 23.6 The comparable sets of manuals and CD-R discs for the maintenance instructions shall be marked using the same format.

24. PACKING MATERIALS

- 24.1 All the packing material (which shall include hay, straw, wood shavings, wood chips, sawdust, wood waste, wooden pallets, dunnage mats, wooden packages, coir pith, peat or sphagnum moss etc.) made of plant origin used for packing shall require treatment including Heat-kiln treatment at 56 degree centigrade for a minimum of 30 hours or Methyl Bromide fumigation at 48 g/cum for 32 hours or

chemical impregnation of wood with wood preservatives such as copper arsenic or any other approved treatment as per international standards.

- 24.2 All the shipments coming into India shall be packed in packaging material confirming to the above standard and shall carry a Phytosanitary certificate issued by an authorised officer at the Country of Origin of the consignment in the format prescribed under International Plant Protection Convention of the Food & Agriculture Organisation.

25. ENVIRONMENTAL AND CLIMATIC CONSIDERATIONS

- 25.1 All elements and components of supply for the crane shall be suited to performing to reliably and to specification within the environmental and climatic conditions that prevail in the yard as summarised below.

- a. Climate – marine / tropical
- b. Annual temperature range – typically 15°C to 45°C. Temperatures in direct sunlight may be considerably higher and consideration shall be given to this possibility in the location and specification of any potentially affected elements or components.

- c. Relative humidity - Ranging between 50% and 95%.

- d. Wind Speeds the crane shall be designed for a maximum in service wind speed of 20m/sec. The crane and storm anchors shall be able to withstand the maximum out of service wind speed for Mumbai calculated in accordance with IS 875 (Part 3) 1987. The assessment shall adopt the following site specific (ref IS 875 Part 3 Clause 5.3) parameters

- $V_b = 44\text{m/s}$
- $K_1 = 1.07$
- Terrain category = category 2
- $K_3 = 1.0$

- e. Earthquake Provision The crane shall be able to resist the lateral acceleration forces generated by earthquakes of the severity and frequency defined for Mumbai in IS 1893 – 1984 (Fourth Revision).

26. CRANE RAILS

- a) The rails are duplex ISCR 80 type to suit centre flanged wheels.
- b) The maximum allowable wheel load is 60 tonne/wheel
- c) The maximum allowable UDL upon the two rails is 60 tonne/metre

- d) Rail gauge – 10 metre.
- e) There is no height difference between the rails.
- f) Supply and laying crane rails is not in scope of supply of the tender.

27. MATERIALS AND WORKMANSHIP

- 27.1 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 sub standard materials or equipment shall be employed.
- 27.2 The country of origin and manufacture for all major materials, equipment and systems shall be identified by the Contractor for approval by the Employer/Engineer.
- 27.3 It is expected that the fabrication of the crane structure will be undertaken in India by the fabricators under guidance and supervision from the Contractor. However the Contractor shall be fully responsible for the work done by the fabricator. Prior approval of the fabricator is essential from the Employer/Engineer. The Contractor shall provide all required details of the intended fabricator meeting the qualification requirements to the Employer/Engineer.
- 27.4 The Contractor shall provide details of the Quality Assurance system operated that 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/Engineer.

28. CRANE DETAILS

- 28.1 The crane will be rail mounted, of the portal level luffing slewing type with a single boom jib and equipped with main and auxiliary hoists. The specified minimum required performances are as below:
 - a) Main Hoist
 - 100 tonnes at 20 metre radius
 - 80 tonnes at 35 metre radius
 - 60 tonnes at 50 metre radius
 - b) Auxiliary hoist
 - 15 tonnes at 50 metre radius.
 - c) Minimum radius
 - 10 metre – both hoists
 - d) Crane rail centres
 - 10 metre
 - e) Height of lift:
 - above rails
 - 30 metre (main and auxiliary)
 - at all radius
 - below rails
 - 7 metre (all hooks)

precautions to be provided to protect the cable against any damage in the reeling drum.

- 29.3 The crane shall be equipped with rail earthing brushes sized to accommodate both welding return currents and lightning strikes. The brushes are to be mounted on the crane structure. Contractor shall provide full details of the system.

The flexible supply cable shall be provided with an earth conductor. Adequate protection to be provided on the entire crane structure against any accidental electric shock to the personnel and materials.

30. CRANE DESIGN CLASSIFICATION

- 30.1 The crane structure and machinery is to be designed in accordance with the following standard specifications:

FEM/I 3rd Edition 1998

- 30.2 Alternatively the crane can be designed to BS 2573 – Part 1 1983 and Part 2 1980 and / or BSEN 13001, or any other comparable recognized international crane design standard subject to Employer's/Engineer's acceptance and approval.

30.3 Classifications

- a) Structure and complete crane

Classification of Utilisation	U5
State of Loading	Q2
Group Classification	A5
Duty Factor	0.95
Impact Factor	1.3

- b) Main Machinery

Main hoist	Classification of Utilisation	T5
	State of Loading	L2
	Group Classification	M5
Aux. hoist	Classification of Utilisation	T6
	State of Loading	L2
	Group Classification	M6

- c) Slewing Group Classification
- | | |
|-------------------------------|----|
| Classification of Utilisation | T6 |
| Loading Spectrum | L2 |

d)	Luffing Group Classification Classification of Utilisation Loading Spectrum	M6 T6 L2
e)	Travel Group Classification Classification of Utilisation Loading Spectrum	M6 T6 L2

31. OPERATING CONDITIONS

- 31.1 The crane is to be stable in still air conditions with 160% of the safe working load upon the hook.
- 31.2 The maximum permissible linear rail loading specified in Clause 26 shall not be exceeded for any possible load, outreach and operating or out of service combinations including, inter alia, dead loads, live load, inertia forces and wind and storm loadings. The highest loading for any condition shall always remain within the permitted rail load.

32. OUT OF SERVICE SECURING AND STORM ANCHORS

- 32.1 The crane shall be equipped with clamp, 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 energised until the clamps have been released.
- 32.2 The crane shall also be equipped with some form of mechanical locking device(s), by stowage pins for example, locating into special reinforced anchor location or similar to secure against movement during storm conditions. 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 pins 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 energised until the storm anchors have been released.

33. STRUCTURE

- 33.1 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 and the operator's cabin. The crane portal is to have a minimum clear height of 10m to permit vehicle access to the quay.
- 33.2 All structural elements shall be made from low carbon weldable steel in accordance with 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 in excess of 8mm.

- 33.3 The structural members of the crane shall be of rolled steel plates and sections and shall be constructed using electric welding. Counterbalance weights shall be concrete, cast iron or cast steel.
- 33.4 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.
- 33.5 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 are 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.
- 33.6 Platforms, walkways and stairs shall be designed to accommodate a live load of 3.5 kN/m² and a concentrated load of 100 kg at any point. All such components shall be hot dip galvanised to BSEN/ISO 1461 or equivalent internationally recognised standard.
- 33.7 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.
- 33.8 Steel mill cast or batch properties certificates relating to all major structural steel shall be provided to the Employer by the Contractor. 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.

34. WELDING

- 34.1 All welding shall be undertaken using the 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.
- 34.2 Structural welding shall only be undertaken at the Contractors works or within the premises of appointed sub contractors.

- 34.3 All weld spatter 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 4mm to prevent premature failure of the coating system applied.
- 34.4 Only adequately qualified welders able to demonstrate their competence through recognised examination or work record shall be employed on the fabrication of the crane.
- 34.5 All welds will 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 and ultrasonics 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 Engineer. Any significant weld defects identified shall be rectified by the most appropriate means.
- 34.6 Testing will be carried out by an independent agency approved by the Engineer. Copies of test certificates shall be provided to the Engineer within 7 days of testing.

35. MECHANICAL CONNECTIONS

- 35.1 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 recognised 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.
- 35.2 All structural fastenings shall be 12mm diameter or larger and no connection transmitting a design load shall employ less than two fastenings. 5% excess quantities of all types and sizes of site construction fastenings shall be supplied and delivered in total, timed to coincide with the delivery of the first crane element(s) to site.

36. COATING SYSTEM

- 36.1 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.
- 36.2 All steel work, both structural and non structural, shall be blast cleaned to Swedish standard SIS 05900 grade Sa 2.5 and immediately painted with a zinc based primer. 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.

- 36.3 A four-coat system shall be employed for all external steel work providing a minimum dry film thickness (DFT) of 240 microns. The external finish top coat shall be gloss golden yellow.
- 36.4 A two or three coat system providing a minimum DFT of 75 microns shall be employed for all internal steel work protected from the weather. The interior of the machinery house and other areas man accessed shall be gloss white.
- 36.5 The supplier shall provide suitable colour swatches to enable the precise paint colours to be identified in advance.
- 36.6 The overall systems shall be designed to provide 05 year coating life with minimum degradation of the top coat colour over this period.
- 36.7 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/Engineer may reject unsatisfactory paint work which shall then be rectified to the Employer's/Engineer's satisfaction.
- 36.8 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 stepped back, coat by coat, to allow the overall coating system integrity to be achieved on site. The same acceptance criteria as used for the workshops will apply.

37. OTHER PROTECTIVE REQUIREMENTS.

- 37.1 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 recognised standard.
- 37.2 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.

38. MACHINERY

- 38.1 The machinery design and selection shall be in accordance with those standards identified in Clause 21 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.

- 38.2 All critical items of machinery demanding precise alignment one with another shall be located by means of dowels or fitted bolts.

39. GEARBOXES

- 39.1 All gearboxes shall, wherever possible, be of reputable proprietary manufacture from standard components. 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. The criteria and supporting calculations used in selecting the individual gearboxes shall be submitted with the tender documentation.

- 39.2 The gearbox casings shall all 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.

- 39.3 The gearboxes shall be of oil-tight welded or cast steel construction and provided with suitable lifting lugs to both halves. Enclosures shall be split horizontally and so arranged that the top half can be easily removed for inspection and repairs without disturbing the bottom half.

- 39.4 Easily visible external oil level and oil temperature indicators shall be provided on each gearbox. Vibration monitors shall also be provided, in two planes 90o apart, located adjacent to both the input and output shafts of each gearbox. The oil level and temperature and the gearbox operating vibration signature is to be constantly monitored by the crane management system and a driver alarm given in the event of concern.

- 39.5 All gearboxes shall be equipped with oil drainage gate valves with the outlets piped to a convenient central spent oil collection reservoir. The spent oil collection reservoir shall be fitted with a visible external oil level indicator and a "full" alarm wired to a warning light on the crane operator's control panel linked to the crane management system. It shall either be readily removed from its operational position and designed for easy handling by the service crane to the ground for emptying and cleaning prior to reinstallation. An alternative adequate system for the removal and handling of the waste oil from the spent oil collection reservoir may be proposed by the Tenderers. Any drainage valve(s) shall be protected from accidental damage.

40. BEARINGS

- 40.1 All rotating bearings shall be of the anti 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.

40.2 Pre lubricated sealed for life bearings shall not be used on any of the major crane components. Grease nipples shall be provided as defined in Clause 67.

40.3 Temperature indicators for bearings to be provided.

41. ROPE DRUMS

41.1 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 to be used and as specified in the design standard employed.

41.2 There shall be a minimum of 2.5 dead turns remaining on the drums when the hooks are at their lowest point. 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 either a drum groove or the second rope layer (if applicable) during slack rope conditions shall be prevented by a control roller extending the full width of the drum.

41.3 No more than two layers of rope shall be permitted on the drums although single layer drums are preferred. At least one spare full wrap of the drums shall be available when the hooks are in the fully raised position.

41.4 A full width and depth drip tray shall be provided beneath each rope drum to catch and contain any rope lubricant spill.

41.5 All drums shall be mounted in ball or roller bearings and fitted with fail-safe electro hydraulic or electro mechanical thrustors operating on a full wrap lined band brake. The brakes shall be able to securely hold the design maximum test overload load of the individual winches. Provision shall exist to safely control the progressive release of such brakes to effect the lowering of any load.

41.6 The external brake drums shall form an integral part of the rope drums.

42. WIRE ROPES

42.1 Wire ropes shall be of the pre-formed non-galvanised type of approved construction and from a reputable supplier. The ropes should conform to ISO 2408 Standard and be supplied in the pre-lubricated condition. The designed maximum rope load shall be no more than 20% of the Safe Working Load (SWL) of the rope. The SWL shall be defined as 60% of the breaking load of the rope.

42.2 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.

43. ROPE SHEAVES

- 43.1 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 standardised 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.
- 43.2 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.
- 43.3 The sheaves shall be fitted with suitable covers and collectors to contain, as far as is 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.

44. BLOCKS AND HOOKS.

- 44.1 The main hoist hooks are to be manufactured from high tensile steel and be of the ram's horn type to BS 3017 or equivalent mounted on roller bearings and fitted with gravity type safety catches generally to BS 2903. The hooks can be manufactured either from steel forgings or by steel fabrication.
- 44.2 The auxiliary hoist hook shall be of the 'C' type manufactured from a steel forging and equipped with a gravity safety catch generally in accordance with BS 2903 or equivalent. The hook shall be mounted on a ball or roller bearing.

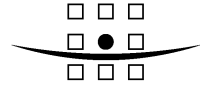
MAIN CRANE MOTIONS

45. GENERAL

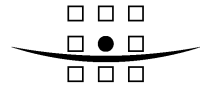
- 45.1 The crane shall be provided with independent machinery units for hoisting, luffing, slewing and long travelling, each operated by their independent motor(s) with PLC frequency controlled drive. The crane shall be capable of performing all operations at one time.

46. LONG TRAVEL

- 46.1 When developing their designs for this element of the crane Tenderers shall read this section in conjunction with Clause 26 Crane Rails - giving particularly attention to any limited operational clearances identified.



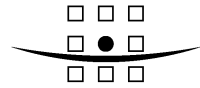
- 46.2 The long travel machinery shall consist of a number of identical bogie mounted drive units installed at the corners of the portal leg structures. Typically the drive units will be powered by intermittently rated totally enclosed AC motor driving at least one crane wheel through a geared reduction drive via a flexible coupling. The total installed power shall be capable of moving the crane at 75% of rated speed into the maximum in-service wind.
- 46.3 The drive units shall be provided with stepped variable speed with variable voltage and variable frequency control over the full torque / speed range available with six notches. Regenerative or counter current braking is to be provided for speed control under normal dynamic operation.
- 46.4 Each drive 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.
- 46.5 All brakes shall be installed within weather proof covers provided with a space heater and a humidistat to ensure proper operation after long periods of idleness in a location of very high humidity as defined in Clause 3
- 46.6 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.
- 46.7 All crane wheels shall be of the centre flange type. All wheels and gears shall run in anti-friction bearings. Pinned connections on the crane bogie frames and any load equalising structures can be mounted in plain, non ferrous bushes. The loading on each group of wheels shall, as far as can be realised, be made equal.
- 46.8 Jacking hard points to the concrete surfacing of the crane track will be provided by the Employer to permit the safe jacking of the crane to allow bogie maintenance to be performed. The Contractor shall provide the Employer with details of the jacking system being provided within 4 weeks of award of the Contract including;
- a) the area of the baseplate of the jack.
 - b) the maximum anticipated vertical load on each jack (including for all potential windloads).
 - c) the "in plan" position of the jacking pedestals on the crane bogie and of the jack baseplate when jacking is undertaken.



- 46.9 A weatherproof travel control station is to be provided near ground level at opposite corners of the portal to allow the crane to be moved during maintenance. These control stations to be interlocked to prevent attempted control from both stations at the same time. The stations are both to be automatically isolated from use when the driver's cab is occupied during normal crane operation.
- 46.10 Audio visual alarms shall be fitted at eye height on the four ground corners of the crane to 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.
- 46.11 The following interlocks and limit devices shall be fitted.
- The limits of track travel in both directions shall be regulated by means of two sets of limit switches. These shall operate in parallel with the cable reel over travel switches to provide a two stage protection, initially reducing the long travel speed to some 10% of maximum before the drive is switched off and the brakes applied.
 - Crane long travel motion will be inhibited if the storm anchor pins and/or bracing is deployed or if the bogies maintenance jacking points are being used.
 - 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.
- 46.12 Compressible buffers of the Oleo type are to be provided at each corner of the crane compatible with the track end stops. Brushes shall be fitted to the leading edges of each outer bogie to clear the rails of minor debris.

47. LUFFING MOTION

- 47.1 The luffing motion of the jib may be operated either by hydraulics or a ball nut and screw or a multi sheaved rope system, and shall be powered by an intermittently rated AC motor. The luffing motion control system shall be provided with a frequency controlled variable speed control over the full motor speed / torque range with six notches or steps.
- 47.2 The jib must be capable of being lowered to the ground for rope changing and maintenance.
- 47.3 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.



- 47.4 Two sets of fail safe brake assemblies shall be installed on the drive each provided with a positive mechanical link between the applied load and the brake components.
- 47.5 Normal braking shall be dynamic or regenerative, regulated by the control system to provide smooth, 6 steps operation. An over-speed sensing system shall be provided that will automatically shut down the motion and apply the brakes if activated.
- 47.6 The travel of the luffing motion shall be controlled by limit switches that regulate the inner and outer extremes of movement. On approach to either extreme of permitted travel the switches shall cause the speed to reduce to 30% of normal speed before the drive is switched off via the normal control system. After actuation of either limit switch the luffing control system shall only allow movement of the jib in the opposite direction.
- 47.7 As a safeguard against possible failure of the normal limit switches extra ultimate travel switches shall be installed wired directly in to the luff motor contactor. Mechanical stoppers to be provided at both ends in the case of a luffing screw mechanism in addition to limit switches and structural buffers.
- 47.8 Emergency braking should be sufficient to quickly stop the luff motion with minimum shock in the event of over-travel interlock actuation, reaching the tonne-metre limit of the crane, mains power failure or the application of and Emergency Stop button.
- 47.9 The luff position of the crane is to be continuously monitored and factored with the hook load information from the main hoist to provide actual tonne-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.
- 47.10 The Tenderer shall identify the means adopted to comply with all the luffing operating and safety aspects as defined in this section.

48. SLEWING MOTION

- 48.1 The crane slewing system shall consist of multiple, intermittently rated AC motors operating through reduction gear sets to rotate the superstructure assembly through 360 degrees relative to the portal base. The motor capacities shall be such as to enable the crane to be safely slewed in the event of the failure of one of the drive units.
- 48.2 The drive motors, or first stage gearboxes input shafts, shall each be fitted with twin external shoe spring / electromagnetic brakes.
- 48.3 The slewing motion control system shall provide stepped variable speed frequency control over the full torque / speed range available with 6 notches. The motor speed is to be co-ordinated with the jib luff position to ensure excessive load travel speeds and centrifugal forces are avoided.

- 48.4 The crane superstructure shall be equipped with some form of mechanical locking device, by stowage pin for example, locating into an anchor location in crane base structure or similar to secure against rotational movement when the crane is unmanned and out of service. Electric interlocks shall be provided such that the slewing machinery cannot be energised until the locking device has been released.
- 48.5 A fluid coupling is to be provided for the slewing drive to absorb shocks

49. HOISTS (MAIN AND AUXILIARY)

- 49.1 The hoist machinery shall consist of a winch driven by a continuously rated AC motor through an enclosed reduction gearbox driving the rope drum. Normal braking shall be dynamic or regenerative and regulated by the electrical control system to produce smooth stepless electrical braking.
- 49.2 A rope tension or drum torque measuring devices shall be provided on all winches to provide continuous load indication readout to the driver'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.
- 49.3 Normal lowering operations shall be by means of regenerative or counter current braking so as to provide continuously variable speed control. In addition the hoists shall be equipped with electro mechanical or electro hydraulic brakes 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.

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 driver's cab shall be provided with readouts depicting either the rope or the hook speed for each winch.

- 49.4 Two sets of fail safe brake assemblies shall be fitted on the drive 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. The brake systems shall/be designed for at least 2 times the hoist load. There shall be a positive mechanical link between the winch component that generates the braking effect and the supported load.
- 49.5 The winch barrel shall be fabricated in steel and flanged at the ends. The ropes shall be accommodated in one layer and have at least two unclamped wraps remaining on the drum when the rope for normal operations is passed out. The drum shall have one full wrap available when for normal operations the rope is

fully wound in. An over-speed switch shall be fitted to the drum that, in an over-speed condition, will shutdown the motion drive and apply the brakes.

- a) Operation of the hoist motion shall be regulated by the following limits and interlocks:
 - i) 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 overhoist limit shall be provided at a short distance beyond the normal stop limit and be wired into the main hoist contactor;
 - ii) 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;
 - iii) 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.

49.6 The drive unit is to be equipped with a speed control system providing frequency controlled variable speed control over the full torque / speed range with six notches (6 steps). 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.

ELECTRICAL EQUIPMENT

50. GENERAL

- 50.1 All electrical installation work shall comply with the current edition of the IEE (Institution of Electrical Engineers, UK) Regulations for Electrical Installations, and / or other comparable Indian or international standard.

51. POWER SUPPLY

- 51.1 The contractor shall provide, install and commission a suitable step down transformer (11 KV / 3.3 KV) of proper rating (KVA) in the sub-station 'B'. The power supply of 3.3 KV, 50 Hz, 3 phase to the crane shall be from this transformer. The contractor shall lay cable through duct from this transformer to the Isolation switch / connection box in the cable anchor pit (duct shall be made by other civil contractor). Confirmation of the locations of these elements will be provided when the associated Civil Engineering details are finalised. The transformer secondary voltage shall take cognizance of the total voltage drop between sub-station and crane isolation switch / connection box".
- 51.2 A switch or similar device shall be provided adjacent to the cable reel to allow isolation of the crane from the incoming supply. It shall be possible to lock off this isolating switch. Additionally all motion drives and all auxiliary circuits shall similarly be equipped with isolating switches to be located on the crane.
- 51.3 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. The Contractor shall provide full details of the protection system(s) to be installed.
- 51.4 All electrical installations shall be adequately earthed to protect from the consequences of lightning strikes. Lightning arrestors shall be provided at the upper extremities of the crane and the crane structure shall be electrically bonded to the rail as defined in Clause 29. Use of the long travel bogies and wheels as the conduction path is not permitted. Contractor shall provide full details of the system.
- 51.5 All power distribution cables employed on the crane shall be of adequate size and grade with approved insulation and sheathing. All external cable runs shall be enclosed in conduit, all other runs can be on cable trays, within trunking or in conduit. All cable terminations shall be made through suitable watertight glands. Design provisions shall be made to minimise the probability of condensation occurring at any point in the electrical installation whether in conduits, junction boxes, control cabinets etc.
- 51.6 Small wiring in control cabinets and consoles shall be made up into replaceable harnesses.
- 51.7 All electrical cables shall be protected from the possibility of mechanical damage and shall be clearly marked to coincide with the wiring diagrams to be supplied

for all systems by the Contractor. Fuses shall conform to BS 88 or equivalent and be of the h.r.c type.

- 51.8 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.

52. CABLE REEL SYSTEM

- 52.1 The cable reel shall be of the bi-directional, mono-spiral type operating at a constant cable tension throughout the full extent of travel in either direction. The cable is to be terminated at a central turn over anchor. The reel shall be driven by a suitable electric motor. The crane long travel drive shall be interlocked with cable reel drive such that it is able to temporarily slow the crane on approach to the turn over position if required.
- 52.2 The reel and associated gearbox shall be fitted with over temperature and over tension protection interlocked to shut down the long travel drive in the event of problems.
- 52.3 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.
- 52.4 A minimum of 3 dead turns shall remain on the cable reel at the extremities of travel. The cable shall be sized to compensate for voltage drop along its length.
- 52.5 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 slipping collector. The enclosure shall be provided with an anti-condensation heater and weatherproofed to protection code IP 65. A dedicated separate earthing slipping shall be provided for the cable reel itself. Appropriate sliprings for the communications etc. together with as number of spare rings for future needs shall also be provided. Adequate precaution to be taken for insulation and high moisture content in the atmosphere.
- 52.6 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.
- 52.7 Adequate access by staircase and platforms shall be provided to the whole of the Cable Reel system for maintenance purposes.

53. ELECTRIC MOTORS

- 53.1 The electric motors fitted to all the crane motion drives shall comply with applicable relevant parts of BS 4999 and / or BSEN 60034 or comparable recognized International / Indian Standards. Individual hours run meters shall be provided for each motor, or group of motors, associated with each crane motion.
- 53.2 The hoist motors shall be capable of withstanding an over speed of 10%.
- 53.3 Motors operating under cover from the weather shall have a protection code of IP 54 whilst any motors exposed to the weather shall be protected to IP 65 standard. All motors shall be of the totally enclosed type. Cooling can be provided by separate external fan or by integral fan depending on rating and duty.
- 53.4 All motors shall have their windings suitably impregnated to withstand tropical duties and to insulation Class F. suitable for variable frequency drives.
- 53.5 All motors shall be equipped with anti condensation heaters and be provided with over temperature protection by means of embedded thermistors.
- 53.6 Type of motors – AC squirrel cage induction motor suitable for speed control of variable frequency drive.

54. LIMIT SWITCHES AND EXTERNAL INTERLOCKS

- 54.1 All main motions of the crane shall be protected from over travel by means of limit switches. All such limit switches shall be of robust construction and totally weather proof.
- 54.2 Non critical applications may employ non contacting or proximity devices if preferred.

55. CONTROL EQUIPMENT

- 55.1 The main machinery house in which the electronic controls and systems are installed shall be suitably ventilated.

56. PROGRAMMABLE LOGIC CONTROLLERS

- 56.1 Modern Programmable Logic Controllers (PLC's) shall be employed for all drive sequencing and system interlock functions interconnected and networked with each other through Open System Interconnection (OSI) architecture with a formally organised and structured standardised communication system. Details of the communication structure proposed in support of these requirements shall be included within the tender.
- 56.2 All components of the PLC's shall be suitable for extended industrial use within the particular operating and climatic environment applicable to the crane. Power

failure protection shall be provided to ensure continued safe operation is maintained and all PLC's shall also be provided with a degree of component and memory redundancy. The memory capacity shall be sufficient to contain control algorithms for more than one function and space shall be available to extend the memory to support future developments. The PLC I/O ports shall be capable of being individually programmed to be either input or output and provision shall be provided to provide additional I/O ports if required in the future.

- 56.3 Access to the series links of the PLC's shall be provided within the driver's cab and the machinery house(s).
- 56.4 The PLC's shall be provided with programming and monitoring facilities for maintenance and fault logging. Off line revision and development of programmes and documentation production shall also be possible.
- 56.5 PLC expansion shall be by plug in modules to a common rack. Self diagnostic capability shall be incorporated in all PLC's both on line during operation and when powered up. All faults shall be visually displayed and signalled by the sounding of an audible alarm, with mute facility, within the driver's cab.
- 56.6 The programming language employed shall be compatible with international MS DOS and shall allow the identification of individual devices by alpha numeric names. Only authorised users shall be permitted access for program amendments. The system shall be capable of providing real time display of programs and equipment status information to remote sites.

57. MAIN SWITCHBOARDS, MOTOR CONTROLS AND DISTRIBUTION BOARDS

- 57.1 All cabinets shall be designed with heaters, air circulating fans and/or air conditioning as required 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.
- 57.2 Control gear for the main crane motions shall include "hours run" meters, circuit testing capabilities and fault indication equipment. 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 drivers cab.
- 57.3 The enclosing cabinets shall be made from galvanised and painted sheet steel and 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.
- 57.4 A wiring diagram of the specific cabinet components shall be provided on the inside of the cabinet doors.

58. WIRING

- 58.1 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. All surface runs, whether exterior or interior, shall be adequately protected from accidental damage.

59. CRANE MANAGEMENT SYSTEM

- 59.1 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
- c) Crane Condition Monitoring

- 59.2 The systems provided shall be capable of informing a remote interrogation facility of the full results of the diagnostic and condition monitoring i.e. the information displayed on the Electrical Equipment House VDU – and enable remote rectification where the problem is not hardware related – or can be ameliorated by adjustments to settings embedded in the software.

a) Crane Operations Monitoring & Management

This system shall monitor & record all movement and lifting operations undertaken by the crane. In particular it shall record problems caused by lifting 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.

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 authorised by a Senior Manager keying in his \ her personal code

b) 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 machinery house and a fault indication in the operators 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.

c) Crane Condition Monitoring Facility

In conjunction with the Circuit Diagnostic Facility referred above, a condition monitoring facility shall be installed on the crane to provide a more comprehensive aid to fault diagnosis.

- 59.3 The prime purpose of the proposed condition monitoring is to pre-empt component failure by the interpretation of trends in, or deterioration of, performances as well as the initiation of alarms from sensors introduced at the appropriate points in the structure or mechanical and electrical components.

60. INSTRUMENTATION

- 60.1 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 as well as the individual power demands of the individual crane drive systems.
 - c) KVAR and Kilowatt hour meters for the complete crane.
 - d) Harmonic filters to be provided

61. COMMUNICATIONS

- 61.1 Telephones shall be provided within the drivers cab, within the machinery house and at the portal base adjacent to the access stairs.
- 61.2 The driver's cab shall be provided with a 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. In addition to the fixed transceiver 5 portable personal sets shall also be supplied. The Employer shall obtain all licences required and provide details of the frequencies and operating channels authorised.
- 61.3 The portable personal sets shall be small, robust and sufficiently rugged to be compatible with the duties undertaken by the users. Durable carrying cases incorporating belt or shoulder support for these sets shall be provided for each set. An adequate number of spare rechargeable batteries and battery chargers (to be agreed) shall also be provided.

62. TRANSFORMERS

- 62.1 Power transformer(s) shall be suitable for the high humidity prevalent at the site and located within a suitable ventilated weather proof protective enclosures provided with suitable warning notices and approved security locking systems. If the power transformer(s) is exposed to weather it should be classified for outdoor duty. The transformer(s) shall comply with BSEN 60076 or comparable

recognized International Standards / Indian Standards. Rating of transformer(s) to be given by the contractor.

62.2 Isolation transformers shall be provided for the control circuits.

63. LIGHTING

63.1 The crane shall be equipped with exterior floodlights able to illuminate the crane working area to an average illumination level of 50 lux.

63.2 Access lighting for stairs, walkways and platforms etc. shall be enclosed in weatherproof bulkhead or overhead fittings and shall be able to provide adequate illumination without dazzling users.

63.3 Interior lighting shall be designed to provide for maintenance and operational activities and provide an intensity of not less than 300 lux overall. Lighting to compartments containing moving machinery must not produce any stroboscopic effect.

63.4 Red neon aircraft warning lights shall be fitted at the highest point of the jib in the fully luffed in condition in accordance with the FAA Regulations applicable to the site. The lighting enclosure shall conform to IP67. The mountings shall be of the anti-vibration type to give an overall lamp life expectancy of more than 20,000 hours. These warning lights shall be fitted 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.

63.5 All lights and lamps shall be readily and safely accessible for replacement of the bulbs or tubes. The floodlights shall be positioned to allow such replacement be undertaken during normal crane operations safely, without the use of temporary platforms or scaffolding.

63.6 Walkway lights and floodlights shall be controlled from the driver's cab, from the machinery house and from selected access locations on the crane.

63.7 All main lighting circuits shall operate on 240 V, single phase, 50 Hz supply.

63.8 Continuously trickle charged battery or powered emergency lighting shall be provided to enable personnel to safely exit from the crane in the event of a total mains power failure. This emergency lighting shall give a minimum level of illumination 50 lux in all working or accessible areas of the crane. Portable automatic recharging hand lamps are to be provided in the driver's cab and machinery house and any other locations where maintenance personnel are likely to be active. Ampere hour of battery / battery capacity to be stated.

64. SOCKET OUTLETS

64.1 A range of socket outlets are to be provided within the machinery house and driver's cab and at suitable locations inside and outside the crane structure as follows:

a) 240 V, single phase, 50 Hz supply.

2 – inside driver's cab
4 - inside machinery house
1-near cable reeling drum

b) 110 V (55 V to earth), single phase. 50 Hz supply

4 – on outside of crane structure

c) 25 V DC.

1 – inside driver's cab
1 – inside machinery house

d) 415 V, 3 phase, 50 Hz, 10 kVA – Welding Set Supply

1 – inside machinery house

64.2 All supplies are to be protected with overload and residual current device (RCD) circuit breakers or suitable switch/fuse arrangements.

65. SHORE POWER SUPPLY

65.1 The crane shall be equipped with a Employer approved type of plug/socket arrangement to enable the supply of shore power 415V, 3 Phase, 50Hz able to sustain all essential power such as for anti-condensation heaters, aircraft warning lights, access lighting and driver's cab control functions. The supply shall be adequate to also operate either/or the long travel, slew and luff motions of the crane at creep speed as well as control the lowering of any load to safety in the event of a mains power failure. The Contractor should provide the details of the 415V, 3 phase plug / socket or alternate arrangement for the above system to be approved by Engineer.

HYDRAULIC EQUIPMENT AND LUBRICATION REQUIREMENTS

66. HYDRAULIC EQUIPMENT

66.1 Where fitted, hydraulic systems shall be designed and installed in accordance with DIN 19705 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 piping shall be amply supported to prevent vibration

and all radiuses and bends proportioned to minimise the likelihood of cavitation. Bleeding points shall be provided at high points in each system and the necessary bleeding sequence instructions provided in the maintenance manual.

- 66.2 Oil reservoirs shall be of generous capacity, baffled internally to minimise surge and fitted with magnetic drain plugs. They shall be vented to atmosphere through filtered breathers with desiccants and water drains shall also be provided.
- 66.3 The maximum permitted oil hot spot temperature within any reservoir is 60 °C.
- 66.4 Pump flow and return lines are to be fitted with full flow filters of 10 microns filter capability or better to suit the components employed. Filters shall be fitted with pressure drop blockage indicators and integral bypass as elements of the control/alarm system.
- 66.5 The Contractor shall provide catch trays or similar such that wherever hydraulic fluids are to be bled or drained from the system, the resultant releases of hydraulic fluid can be captured and removed from the crane without spillage occurring such that they can be disposed of in a controlled manner.
- 66.6 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.
- 66.7 All design use of hydraulic components must comply with manufacturer's recommendations.

67. LUBRICATION

- 67.1 Wherever possible all regular, routine lubrication requirements shall be mechanised, employing small bore piping to pressure distribute lubrication from central reservoirs to all necessary locations. All individual grease lines shall be labelled indicating the item being lubricated. Grease reservoirs shall be suitable for accepting a standard grease pail (25 litre minimum capacity, 300mm outer rim diameter).
- 67.2 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.
- 67.3 Where manual lubrication is retained all grease nipples etc. shall be brought to convenient and accessible central locations. All nipples shall conform to BS 1486: Part 4.
- 67.4 Lubrication and oil fill points shall be clearly and permanently labelled 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 Employer's approval that these lubricants and oils are all 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.

- 67.5 All pressure lubricated machinery shall be provided with renewable oil filters equipped with pressure drop blockage indicators.
- 67.6 To the extent practicable, the Contractor shall provide catch trays or similar such that wherever Lubricants including greases and oils are ejected or otherwise removed from the system concerned, the resultant releases of the greases and oils can be captured and removed from the crane without spillage occurring such that they can be disposed of in a controlled manner.

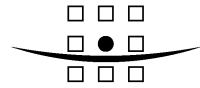
68. PIPING OF HYDRAULIC AND LUBRICATION SYSTEMS

- 68.1 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.

MISCELLANEOUS REQUIREMENTS

69. MACHINERY HOUSE

- 69.1 The main hoist, auxiliary hoist, and luffing machinery, together with the main electrical control panels shall all be housed in a single weatherproof steel framed and steel clad machinery house mounted on the slewing superstructure. 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.
- 69.2 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 10 kg CO2 portable fire extinguishers shall be provided on permanent brackets close to floor level, one at each entrance.
- 69.3 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 and for comfort of the technician during maintenance works while the crane is in operation. Air filters shall be easily accessible and readily replaceable.
- 69.4 A rope reeving winch or similar consideration shall be provided to assist with rope changing. The design and layout shall be such as to facilitate rope changes for each of the rope drives.
- 69.5 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 quay level. A travelling overhead crane, which will be capable of transferring items of machinery to and from the trap door, shall be provided. The travel and cross traverse motions shall be electric, with enough chain to lower to quay level and rated for a SWL sufficient to lift the heaviest individual item of equipment.

- 69.6 Sufficient space shall be provided for a work bench, with engineers vice, storage space for lubricants and a cabinet with lock for tools and small electrical spare parts.

70. DRIVERS CABIN

- 70.1 The Drivers Cabin shall be fully weatherproof and located at the front of the slewing frame at a level that provides the optimum visibility for the driver. Access shall be from weather and waterproof naturally and artificially lit platform or staircase, not a near vertical ladder. The rake of the staircase shall be such that a man can descend the flight while facing away from the staircase.
- 70.2 The cab shall comprise a fully enclosed rigid steel framed and clad structure. It shall also be suitably insulated and trimmed inside and fitted with a lockable weatherproof access door positioned to the rear. The minimum clear unobstructed height within the cabin shall be 2.2m above floor level. The minimum clear unobstructed height of the door shall be 2.0m over any cill provided. The floor shall be covered with a suitable non-slip finish capable of easy cleaning out.
- 70.3 The cab windows shall all comprise flexibly mounted safety glass and should be positioned so as to provide excellent vision and unobstructed lines of sight ahead, below and to both sides. Any roof or floor glazing installed shall be fitted with a hinged protective grid. 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 minimise solar gain and provide ultra violet filtering. 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. Electrically operated variable speed wipers shall be provided together with screen washers to all main windows.
- 70.4 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.
- 70.5 The driver's seat shall be comfortable, ergonomically designed and upholstered in a material suited to the climate. It shall be fully adjustable, fore and aft and for height. The main crane functions shall be operated by means of joystick controllers, switches, buttons etc. as appropriate situated on or in close proximity of the chair arms. A lift up seat, for a driving instructor or second person, shall be provided and fixed to the rear or side walls of the cabin.
- 70.6 All electrical contactors, relays etc. within the cab shall be collectively mounted within a single sheet steel enclosure fitted with a locking door. A small

document cabinet and work top shall also be provided. A 3kg portable CO2 fire extinguisher shall be mounted in the cab within easy reach of the driver.

70.7 A low power fixed radio transceiver and microphone shall be located in the cab as detailed in Clause 61

70.8 The cab shall be provided with an emergency door unless an immediately convenient emergency escape exists adjacent to the existing exit at cabin level.

71. SAFE LOAD INDICATOR

71.1 Safe load indicators for the main hoist and auxiliary hoist shall be fitted in the driver's cab providing dial scale information on the loads on each hoist. A visual indicator and audible alarm shall be provided to advise once 95% of the designed working load for any hoist has been reached. An audible alarm shall be sounded if 105% of the designed working load is reached.

71.2 Automatic overload safety cut-off switches to be provided by the contractor.

72. EMERGENCY STOPS

72.1 Emergency stops shall be provided at the following locations on the crane.

- a) at ground level adjacent to the crane access points on the portal
- b) at ground level at the extremities of the long travel bogies
- c) in the driver cab
- d) in the machinery house
- e) at the ground travel control station
- f) at the crane power supply isolator.

72.2 Any one of the emergency stops shall be capable of tripping all control circuits.

72.3 The Emergency Stops shall be of robust construction and have yellow bodies and red mushroom heads. When depressed the red mushroom head will not be released except from the Drivers Operating Panel. Depression of the red mushroom head will immediately activate an Emergency Stop in all motions. A red light indicating which Emergency Stop was depressed on the Drivers Operating Panel to be provided. When the cause of the Emergency Stop being depressed has been investigated and corrected, the driver may restart his crane using the appropriate security system and start up procedure and release the depressed Red Mushroom Head Emergency Stop.

73. ACCESS PREFERENCES

- 73.1 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 metre intervals. Staircases shall not exceed 38.5 degrees from the horizontal.
- 73.2 All staircases and platforms shall have continuous toeboards, intermediate and upper handrails provided. The intermediate and upper handrail tubes and supporting stanchions shall be purchased from a specialist approved manufacturer of such systems and designed and installed in conformance with his recommendations.
- 73.3 The provision of access holes in platforms, walkways and staircases is not permitted for any purpose.
- 73.4 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 metre 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.
- 73.5 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.

74. WIND SPEED MONITORING

- 74.1 The crane shall be fitted with an anemometer to continually monitor and display to the driver the 3-second average wind speed. An audible alarm shall be sounded in the driver's cab in the event of the wind speed exceeding the maximum allowed for crane operation.
- 74.2 The alarm shall be repeated by claxon or similar, external to the cab, such that all personnel on the ground beneath the crane are made aware of the situation.

75. NOTICES AND LABELS

- 75.1 Safe working load notices described in Clause 75.5 shall be prominently displayed on the structure of the crane in both English and Hindi.
- 75.2 All notices and labels within the driver's cab shall be in both English and Hindi.
- 75.3 Filling points for water, lubricating oils and greases, tank capacities and other similar maintenance instructions shall be in both English and Hindi.
- 75.4 All equipment manufacturers rating and identification plates shall be in English and Hindi.

- 75.5 The crane Manufacturer must submit the locations, styles and sizes proposed for all significant notices for approval by the Employer. 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.
- 75.6 Both side walls of the crane machinery house shall be painted with the MDL logo shown below and the following legend in large blue lettering. The precise colour blue to be applied will be selected from a selection of colour swatches provided by the supplier.



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- 75.7 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.

TESTING

76. TESTS AT WORKS

- 76.1 Crane components / sub-assembly shall be tested and inspected at various stages during fabrication / manufacturing (prior to erection) by Classification Society (such as American Bureau of Shipping or Bureau Veritas or Det Norsk Veritas or Germister Lloyds or Lloyds Register of Shipping or Indian Register of Shipping or similar agency). Inspection / test during erection and final test shall be done by the Engineer.
- 76.2 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. Suitable certification shall be provided in all cases.
- 76.2.1 Examination of material, its identification and issue of test certificates for compliance with the employer's requirement,
- 76.2.2 Checking the dimensions of the component / sub-assemblies / assemblies as per the manufacturers drawings and testing thereof
- 76.2.3 Physical properties tests in accordance with standards for:

- a) main structural and high tensile steel plates and sections.
- b) shafts.
- c) wire ropes – sample test to destruction.

76.2.4 Magnetic particle inspection on:

- a) all major castings.
- b) all major forgings.

76.2.5 Weld Tests and Inspections:

- a) for requirements refer Clause 34 Welding above
- b) during fabrication
- c) all records with respect to welding inspections, tests, defects and the rectification thereof shall be retained by the Contractor until the crane is ultimately removed from service and demolished.

76.2.6 Functional tests to demonstrate the correct operation of all control and alarm equipment shall be conducted.

76.2.7 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.

76.2.8 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.

76.2.9 Any other test as required by the Classification Society.

76.3 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.

76.4 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.

77. COMMISSIONING

- 77.1 The commissioning tests shall be conducted by the Contractor's personnel and demonstrate the overall suitability of the crane for the shipbuilding function intended together with proof of specified performance as required in Clause 78 below and amply demonstrating operational reliability.
- 77.2 The Contractor is responsible for providing certified test weight(s), slings, lifting beams and load frames such that a variety of test loads up to the overload test weight can be securely assembled and safely used in all Tests undertaken at the Shipyard and during the Setting to Work period outlined below.
- 77.3 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.

78. PERFORMANCE TESTS

- 78.1 The Contractor shall perform fitness tests of the crane to include functional, load tests, endurance and trial operations type work. After the crane has successfully completed all such tests to the Contractor's satisfaction a certificate of crane competence will be issued to the Employer including a certificate from a Competent Authority under the Factory Act.
- 78.2 Upon receipt of the certificate the Employers representatives and personnel will conduct the performance tests together with, and under supervision from, the Contractor's own engineers and operators. 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) Any other requirement of a Competent Authority under the Factory Act
- 78.3 The Contractor shall provide details of all proposed procedures and methods for each discrete test at the tender stage for discussion with and approval by the Employer. Testing will be undertaken in accordance with the agreed finalised

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

79. DURABILITY

79.1 The crane will be subjected to a durability test after successfully completing all performance tests. Durability shall be proven 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.

80. SETTING TO WORK

80.1 Once the crane has successfully completed all formal testing it will be handed over to the Employer so that shipbuilding and operations can begin.

80.2 It must be recognised that the Employer's workforce and crane drivers have no prior experience of cranes with the size, complexity and operational capability of the 100 tonne level luffing crane.

80.3 The Contractor is therefore required to provide a three months period of extended on site support and on the job training for the drivers, over and above that defined in Clause 22, during which time the crane is set to work and the driver's acquire adequate levels of competence.

81. CERTIFICATION

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

MAINTENANCE

82. GENERAL

82.1 The Contractor should have a service network available in India to rapidly attend to crane breakdowns and repairs during and after the defect liability period. Details are to be included in the tender document.

82.2 At the tender submission stage an itemised price listing of the manufacturer's recommended additional spare parts considered necessary to support the crane during the initial 5 years or 10,000 hours of operation. This listing shall not include consumables except where the Contractor has been unable to identify a source in India. Where this is the case he shall provide full details of such items giving the justification for the Specification used which necessitates the import of the consumable involved.

82.3 To simplify the spares holding and procurement aspects, materials, equipment and components shall be standardised 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.

82.4 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 labelled in English and Hindi for ease of identification.

83. SPECIALIST TOOLING

83.1 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.

83.2 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.

83.3 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.