FLOATING CRANE
TECHNICAL SPECIFICATIONS (PRELIMINARY)

1. SCOPE: This specification covers the design, construction, test, and delivery of one non-self propelled, electrically driven floating crane for the Autoridad del Canal de Panama (ACP). The floating crane shall be fully revolving, with a capacity not less than 350 tons at 18 meters from fender side\(^1\). The floating crane design and construction shall be suitable for the general activities in and out of the navigation channel of the Panama Canal including the Gatun lake (fresh water), as well as in the ports and approach channels (salt water).

1.1 Objectives: The Contractor’s work under this contract shall cover, but shall not be limited to, the following:

1.1.1 Crane Barge: Design, manufacture, test and deliver a heavy steel barge, with double bottom as required with free deck space for caring with a capacity of not less than 10 ton/square meter, in compliance with Class requirements, regulations, and in accordance with these specifications.

1.1.2 Crane: design, manufacture, test and deliver a heavy duty and fully revolving crane in compliance with Class requirements, regulations, and in accordance with these specifications.

1.1.3 Test: Conduct required factory tests, sea trials, and loading tests. Provide support facilities and services to ACP personnel at the factories and shipyards. Conduct field testing of delivered floating crane in Panama together with Panama Canal Authority.

1.1.4 Delivery: The floating crane shall be delivered to the Port of Balboa (Pacific Ocean) or the Port of Cristobal (Atlantic Ocean), Republic of Panama, within 20 months after award of the Contract complete and ready for operation. The Contractor shall deliver the floating crane fully assembled, and in a seaworthy condition in accordance with Class and applicable regulations. It shall be delivered in a semi-submersible vessel from the building site to the place of delivery. The ACP will tow the floating crane from the port of arrival to the Dredging Division in Gamboa, Republic of Panama for the lifting tests and final acceptance.

1.1.5 Training: The Contractor shall provide thorough training to not less than 10 ACP personnel in the Republic of Panama, including lifting operators, engineers, electricians, and maintenance personnel, so that the floating crane can be operated and maintained efficiently and effectively.

1.1.1 Floating Crane Operations: The Contractor must consider planned operation intervals of at least 12-14 times per year; each time requires in average four 24-hours days. The unplanned services are emergencies or special jobs. The Floating crane will be used for (but not limited to):

---

\(^1\) It is the horizontal distance from the pontoon or barge hull or fender to the point of load suspension.

August 2017
Floating Crane Technical Specifications (Preliminary)
1.1.5.1 Removal /replacement of miter gates from their location at the Locks. Gate dimensions vary from 15 to 27 m in height, and approx. 20 m width and 2.1 m depth. Average lift weight. 250 tons (12 to 14 times per year). At the existing Panamax Locks (width 110 feet), floating crane will be inside the chamber to remove / replace a miter gate. Reference angle is 1:2.

1.1.5.2 Lifting of heavy equipment, with large lifting volume (such as launches, workboats, barges, caissons, Geo bags, Locks Curtain Panels, Panama Canal Locomotive, locks track cranes, spillway gates, tugs, lifting equipment components, like spuds, ladders, sticks & monoblocks, upper works, spud carriers and others).

1.1.5.3 Emergency and salvage operations, in case of accidents, for instance, sunken tugs & launches and salvage operations of a container ship. In case of a salvage operation of Neopanamax vessel (for instance a 13050 TEU Container ship) that is grounded in a beaching area in the Canal, the floating crane should be able to remove containers of the ship. In that scenario, the attachment 4 shows a partial cross section of a Neopanamax, with an air draft of about 42.4 meters (56.4 m is the height of the container above base line of the vessel – 14 m is the draft of this vessel). The beam of this vessel is 48.4 m. It is assumed that the height of the pedestal on the barge will play an important role, as also the boom length and the design of a special auxiliary jib crane for this purpose. Floating crane could work alongside (side to side) of the container ship, at either to starboard or port sides. In the worst case, it should reach the containers from the far side and for the near side from that location.

1.1.5.4 Removal/replacement of the Lower Trackway from the bottom of the flooded Neo Panamax Locks. The operation shall consist on a tandem lift of the Lower trackway with the Floating Crane. Attachment 5 shows a sketch for this operation.

1.1.5.5 Services at the ACP’s shipyard.

1.1.6 Optional Critical Spares and Spare Parts: Furnish critical spares, and spare parts for at least one year of operation (estimated 2000 hours of operation per year). See paragraph 5.1, Spare Parts for One Year of Operation and Critical Spares (Optional).

2. APPLICABLE DOCUMENTS:

2.1 Rules and Standards:

2.1.1 Class Requirements: The hull of the floating crane shall be designed, built, tested and placed under the survey of a member of the International Association of Classification Societies (IACS), such as the American Bureau of Shipping or Bureau Veritas, relevant for this type of special crane. The Class shall review and approve the vessel hull design. The Class shall survey the building of the vessel hull in accordance with these specifications and Class rules, and shall be responsible for the quality of works under survey. The Contractor shall bear all expenses associated with the acquisition of the required classing and certification:

Class Symbol: I Maltese Cross (✠) A1 Barge Crane CRC or equivalent

August 2017
Floating Crane Technical Specifications (Preliminary)
Service Notations: Special Service/ Floating Crane
Navigation Notation: Unrestricted navigation

2.1.1.1 Rules and Regulations: The floating crane shall be designed based on the rules and regulations, including amendments in force and applicable for this type of cranes. All required Certificates shall be handed over to the Owner at the Contractor’s expense with the delivery of the floating crane.

2.1.1.2 Registry and Flag: Design and construction shall satisfy the requirements for registration in the Republic of Panama, as appropriate to the vessel type and service. The vessel shall be registered under the Panamanian flag with all pertinent documentation, with all costs associated with registering the floating crane under the Panamanian flag to be borne by the Contractor.

2.1.1.3 Standards: The following is a list of organizations and codes that publish the standards and specifications referenced in this Contract. Whenever compliance with any standards is cited in these specifications, the Contractor shall use the applicable section of the currently valid (as of date of award) standard reference.

- American Bearing Manufacturers Association (ABMA)
- American Bureau of Shipping (ABS)
- American Gear Manufacturers Association (AGMA)
- American National Standard Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
- American Welding Society (AWS)
- Federal Communications Commission (FCC)
- Institute of Electrical and Electronic Engineers (IEEE)
- International Association of Classification Societies (IACS)
- International Convention for the Prevention of Pollution (MARPOL)
- International Convention for the Safety of Life at Sea (SOLAS)
- International Convention on Tonnage Measurement of Ships
- International Electrotechnical Commission (IEC)
- International Labor Organization Convention (ILO) 92/133 (concerning Crew accommodation on Board ships)
- International Load Line Convention (1966) as amended
- International Maritime Organization (IMO)
- International Regulations for Preventing Collisions at Sea
- International Standard Organization (ISO)
- International Telecommunication Union (ITU)
- National Electric Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
National Marine Electronics Association (NMEA)
National Fluid Power Association (NFPA)
Panama Canal - ACP Marine Safety Standards: including but not limited to 2600ESS-301; 2600ESS-303; 2600ESS-311; 2600-ESS-312 and 2600ESS-313. See the following address: http://www.pancanal.com/esp/legal/reglamentos/security/marine/. English versions of these regulations are available upon request
Panama Maritime Authority
Permanent International Association of Navigation Congress (PIANC)
Steel Structures Painting Council (SSPC)
Society of Automotive Engineers (SAE)
Underwriters Laboratories, Inc. (UL)
United States Coast Guard (USCG)

If the Contractor proposes standards or codes from organizations other than those listed above, it shall submit, for the Contracting Officer’s (CO) approval, an English or Spanish translation of those specific sections that are applicable to the referenced sections in this specification. The Contractor may be required to prove that the proposed standard is applicable to the performance requirements of these specifications, prior to the Contracting Officer’s approval of the substitution.

3. REQUIREMENTS OF THE FLOATING CRANE:

3.1 General Requirements:

3.1.1 The Contractor assumes full responsibility for the design, construction and testing of the floating crane.

3.1.2 The floating crane shall be designed and built according to good shipbuilding practices and latest, high quality, well recognized Western European, North American or Japanese production and building standards.

3.1.3 The floating crane, and all systems, shall be reliable and easy to maintain with low maintenance and operation costs, with spare parts readily accessible in the market, and high safety and availability performance.

3.1.4 The design of the system components shall be standard, simple and incorporate current proven technology and use as many commercially available high quality parts where feasible.

3.1.5 The floating crane design and construction shall comply with mandatory and advisory requirements of these specifications, Class rules and Panama Canal regulations http://www.pancanal.com/eng/procsales/buy.html.

3.1.6 The outfitting shall be standard for this type of vessel and as necessary for its correct functioning.
3.1.7 The floating crane shall be designed and constructed to prevent damage to or from the existing Panama Canal navigation channel, locks and docks system.

3.1.8 Hull, structure, spuds, machinery, and outfit shall be designed and constructed for optimum, efficient performance in the Panama Canal, and shall have an expected life of not less than 30 years, with an estimated operating time of the floating crane of 2000 hours per year. The floating crane construction shall have a reinforced structure (thicker hull plating and heavy internal stiffeners).

3.1.9 Deck space shall be arranged for carrying with a capacity of not less than 10 ton/square meter. The Contractor must consider a free deck space not less than 25 x 30 m.

3.1.10 Each manned area and its contents, including seats, controls and instrumentation, shall be arranged ergonomically and logically in accordance with recognized industry standards, such as ASTM F 1166, Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities and/or ABS Guidance notes for the Applications of Ergonomics to Marines Systems.

3.1.11 The Contractor shall guarantee warranty terms and technical support as specified. The Contractor shall give to the ACP 12 months (minimum) warranty after acceptance of the floating crane in Panama, for the entire operation with all the equipment.

3.1.12 All materials shall be of quality complying with the requirements of the Class and/or according to relevant ISO standards.

3.1.13 The design and construction of the floating crane shall apply proven engineering and technology to limit vibration and noise levels within the floating crane to the requirements indicated in the specifications. Vibration shall not cause damage to the systems nor cause damage or malfunction of other onboard machinery and equipment.

3.1.14 The Contractor shall perform, before delivery of the floating crane, testing and inspections for the complete delivery of the floating crane and its equipment. Testing and inspection shall include factory testing and inspection, building yards testing and inspection, crane certification, inclining, trim & stability test.

3.1.15 The floating crane shall meet the requirements of SOLAS with regard to the life saving and fire fighting equipment, as far as applicable to this type of floating crane.

3.1.16 Environmentally friendly design shall be used where practically possible.

3.2 Operating Conditions of the Floating Crane: The floating crane and its equipment shall be designed and built to operate satisfactorily, securely and stably under all conditions that it may encounter and to withstand the highest forces resulting during lifting operation. This shall include, but shall not be limited to: environmental conditions; fatigue; forces or conditions caused by acceleration, deceleration, vibration, shock loads, heat, current, wind, wave and swells; and, wakes and suction of passing vessels in the Panama Canal.
3.2.1 Panama Canal Limiting Features: Refer to Panama Canal Marine Director’s Notice to Shipping No. N-1, shown in web site: https://www.pancanal.com/eng/op/notices/2017/N01-2017.pdf.

3.2.2 Operating Locations: The new floating crane shall be capable of working effectively in all locations of the navigation channel of the Panama Canal, including Gatun Lake, (fresh water), Miraflores Lake (slightly brackish water), and the ports and approaches on the Atlantic and Pacific coasts of Panama (salt water).

3.2.3 Environmental Conditions: The new floating crane shall be designed to operate in marine tropical coastal sea conditions. These conditions include, but are not limited, to the following:

<table>
<thead>
<tr>
<th>3.2.3.1</th>
<th>Maximum outside temperature</th>
<th>40°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.3.2</td>
<td>Minimum outside temperature</td>
<td>15°C</td>
</tr>
<tr>
<td>3.2.3.3</td>
<td>Maximum sea water temperature</td>
<td>32°C</td>
</tr>
<tr>
<td>3.2.3.4</td>
<td>Minimum sea water temperature</td>
<td>15°C</td>
</tr>
<tr>
<td>3.2.3.5</td>
<td>Engine room temperature</td>
<td>50°C</td>
</tr>
<tr>
<td>3.2.3.6</td>
<td>Other operating conditions</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Operating Conditions

<table>
<thead>
<tr>
<th>Fresh Water Temperature of Central Cooling Water System</th>
<th>40°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant wave height</td>
<td>0.5 - 1.5 m</td>
</tr>
<tr>
<td>Current Speed</td>
<td>1 – 2 knots</td>
</tr>
<tr>
<td>Wind Speed</td>
<td>22 – 27 knots</td>
</tr>
</tbody>
</table>

The floating crane shall operate under any combination of these operating conditions. However, as a minimum, the floating crane design shall contemplate the lifting operation during simultaneous occurrence of the above current and wind speed, acting on the lifting in the same direction.

3.2.4 Crane Duty: The crane and its equipment and machinery shall be designed and manufactured for heavy duty operation, not less than 2,000 hours of effective operation a year.

3.3 Performance Requirements

3.3.1 Crane lifting capacity: The crane shall be capable of lifting a load of not less than 350 metric tons (3435 kN), according, but not limited, to the following:

Fully Revolving Main Hoist Capacities
Table 2. Main Hoist Capacities

<table>
<thead>
<tr>
<th>Load (metric tons); not less than</th>
<th>Reach, from fender side or end (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td>18</td>
</tr>
<tr>
<td>300</td>
<td>20</td>
</tr>
<tr>
<td>100</td>
<td>40</td>
</tr>
</tbody>
</table>

Headroom (from the waterline to the hook) Not less than 60 m at 35 m lifting radius
Free Air height (w/boom at minimum angle) Not more than 61 m

3.4 Principal Features of the Floating Crane

3.4.1 Barge

3.4.1.1 Form: The Hull shall be of the barge type and propulsion shall be by towing on a hawser for ocean moves and by tugs either pushing or towing alongside for short moves within the Panama Canal and its approaches.

3.4.1.2 Construction: The hull shall be designed and built to withstand the forces that result from the lifting activity under all conditions and any other forces it will be exposed to. It shall be built of heavy duty steel, of welded construction, with heavy sides to withstand collision, with double bottom as required (service life not less than 30 years). All required tanks, including fuel and potable (drinking) water tanks.

3.4.1.3 The pedestal for the crane shall be designed and built with the necessary reinforcements to withstand the reaction forces of the crane for not less than 30 years of operation without cracking or breaking. The Contractor shall be responsible for a structurally sound connection between the hull components and crane foundation structure. None piping, hose or cable shall pass through the pedestal.

3.4.1.4 Maximum hull beam: 30.5 m (including fenders)

3.4.1.5 Maximum full length: between 75 & 92 m (preferred, closed as possible to 75 m)

3.4.1.6 Maximum draft: 3.7 m

3.4.1.7 Classification: ABS, BV, DNV or Lloyds, (IACS member); design and built in accordance with Class; service: floating crane; service notation: operations in inland waters (within Panama Canal and its approaches).

2 Depending on the crane model, its maximum capacity shall be available at the closes radius (no downgrading)

3 It is the horizontal distance from the pontoon or barge hull or fender to the point of load suspension.

August 2017
Floating Crane Technical Specifications (Preliminary)
3.4.1.8 **Accommodations for crew:** No sleeping accommodations required; arrangements for crew must include offices, one for each officers (total of 4) and 1 for the Captain, mess rooms (one for the officers and one for the crew), galley, store room, change rooms (two for the crew and one for the officers), etc.

3.4.1.9 **Free deck space:** For carrying with a capacity of not less than 10 ton /square meter.

3.4.2 **Machinery & Equipment & Special Features:**

3.4.2.1 **Wheelhouse and facilities:** Located at bow; around and below the crane pedestal.

3.4.2.2 **Generators and equipment:** Two each main generators; each generator shall have the required capacity to operate the crane at full capacity plus a reserve capacity for any other auxiliary equipment or about 40%. Located below deck. Two each auxiliary generators; each generator shall have the required capacity to operate all auxiliary services plus a reserve capacity of 60%. Located below deck.

3.4.2.3 **Winches on deck:** One winch and one capstan at each deck corner; winches with two drums each. The capstan shall be coupled to one of the winch drum, specifically to the forward drum.

3.4.2.4 **Others:** Mooring and towing arrangements, Fendering system, Ship systems, Navigation and Communications Equipment, Sewage treatment plant.

3.4.2.5 **Spud System:** The floating crane shall have 3 identical spuds, two spuds shall be used during normal operation and the third one shall be a spare unit. The spuds shall be of welded steel design. Four spud wells shall be designed to accommodate spuds for anchoring the floating crane at a certain location, for free float operation, and for working depth of approximately 20 m maximum, considering approx. 1 to 2 meters submerged at the bottom. Spuds are not used for lifting the floating crane of its flotation.

3.4.2.6 **Shape of pontoon:** Pontoon shape shall be in general straight and rectangular, all four corners rounded (radius not less than 500 mm.).

3.5 **Design Criteria:**

3.5.1 **Lubrication:** Lubrication shall be in accordance with the equipment manufacturer’s recommendations and in accordance with these specifications. All new parts requiring lubrication shall be lubricated prior to delivery and tagged to show the type of the lubricant used. The Contractor shall supervise the complete lubrication of all systems prior to starting of any equipment. Lubrication fittings for bearings shall be easily accessible and, where necessary, piped to a convenient location.
3.5.1.1 **Lubrication Monitoring and Warning Systems:** Each lubricating system shall have monitoring and warning devices to ensure that the proper level of lubrication is maintained. All warning devices shall be connected to the alarm system. In addition, each lubricating system using oil shall include oil sampling points in suitable locations for the purpose of oil condition monitoring.

3.5.1.2 **Lubricants:** Lubricating oil for components shall be in accordance with manufacturer recommendations. The Contractor shall provide the generic specification for any lubricant oil and grease to be used on the floating crane in accordance with API, AGMA, ASTM, or other recognized industry accepted standards.

3.5.1.3 **Hydraulic Fluid:** Hydraulic fluid shall be in accordance with manufacturer recommendations. Each hydraulic system shall include fluid sampling points in suitable locations for the purpose of fluid condition monitoring. The Contractor shall provide the generic specification for any hydraulic fluid to be used on the floating crane in accordance with API, AGMA, ASTM, or other recognized industry accepted standards.

3.5.2 **Safety and Health Protection:**

3.5.2.1 **Safety:** The equipment specified herein shall conform to the applicable mandatory and advisory safety requirements of CLASS and recognized industry standards and regulations. Pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts, located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation. Steps, ladders, walkways, grab handles, handrails, and other safety devices required, but not specifically stated, shall conform to recognized industry standards, such as ASTM F 1166, Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities and/or ABS Guidance notes for the Applications of Ergonomics to Marine Systems.

3.5.2.2 **Noise Limits:** Unless otherwise indicated in these specifications, the steady state noise levels on decks and compartments while operating shall allow voice communication at normal speech levels on the main deck outside the deck house and in the offices, mess rooms, and galleys, the crane operators cabin shall not exceed the limits specified in applicable ISO regulations or IMO Code on Noise Levels.

3.5.2.2.1 **Accommodation Spaces:** The steady state noise level at the Accommodation Spaces shall not exceed the 70 dB (A). Impulse noise with no hearing protection shall be within the established limits of ISO regulations or IMO Code on Noise Levels.

3.5.2.2.2 **Machinery Control and Workshops:** The steady state noise level at any enclosed machinery control room (if provided) and workshop shall be maintained as low as possible, and shall not exceed the 80 dB (A). Impulse noise shall be within the established limits of ISO or IMO regulations.

3.5.2.2.3 **Machinery Spaces and Work Repair Areas:** The steady state and impulse noise level at the machinery spaces and work repair areas shall be maintained as low as possible,
and shall not exceed limits specified in ISO and IMO regulations for personnel working 8 hours in these areas.

3.5.2.2.4 Crane Cab: The steady state noise level at the crane operator cabin shall be maintained as low as possible, and shall not exceed the 60 dB (A). Impulse noise shall be within the established limits of ISO regulations.

3.5.2.2.5 Noise Reducing Measures: The design of the floating crane shall include noise reducing measures, including but not limited to:

- Resiliently mounted accommodation unit and observation house
- Resiliently mounted equipment and exhaust piping
- Floating floors, insulation, and other noise reducing measures in accommodation unit and observation house
- Noise reducing exhaust silencers
- Noise reducing measures incorporated in crane construction.

3.5.2.3 Use of Hazardous Materials: Prior to incorporating any hazardous material in the design of the floating crane, the Contractor shall submit to the Contracting Officer for approval a list of all hazardous materials proposed. The use of asbestos, lead base coatings, PCB and CFC are prohibited.

3.5.2.4 Electrical Grounding: The floating crane shall be properly electrically grounded as per IEEE 45 requirements or equivalent accepted marine standards.

3.5.3 Vibrations: The floating crane shall not have any annoying vibrations that may jeopardize the lifting operation, its habitability or its components lifetime. The operator’s cabin on the crane shall be free of harmful vibration that can jeopardize the operation and the equipment. The Contractor shall locate and correct unsatisfactory vibration conditions arising during tests and trials, or subsequently during the warranty period. The standard ISO 6954, “Mechanical Vibration and Shock – Guidelines for the Overall Evaluation of Vibration in Merchant Ships” or equivalent approved shall be used for guidelines for the acceptance criteria of vibration levels in all spaces.

3.5.4 Tanks Capacities: Tank capacities and arrangement shall be in accordance with the requirements. The capacities of some tanks shall be estimated based on the following:

<table>
<thead>
<tr>
<th>Min. Quantity</th>
<th>Type</th>
<th>Basic criteria for sizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Main Fuel Oil Tank</td>
<td>For at least 12 days of 24 hours of operations</td>
</tr>
<tr>
<td>2</td>
<td>Potable Water Tank</td>
<td>With sufficient capacity for 12 days of operation, 24 hours/day, and based on a consumption of 250 liters/man/day, minimum</td>
</tr>
<tr>
<td>1</td>
<td>Fuel Oil Day Tank</td>
<td>Sufficient capacity to run the one generator during 24 hours</td>
</tr>
<tr>
<td>1</td>
<td>Hydraulic Oil Tank</td>
<td>With sufficient capacity for two fillings of the complete system</td>
</tr>
</tbody>
</table>
4. System Requirements

4.1 Materials and Production Techniques

4.1.1 Materials: For the floating crane, normal shipbuilding steel qualities shall be used according to the requirements of the Class, American Standards or equivalent. The steel hull material shall be of a Type Approval as per Class. The hull structure is made of normal shipbuilding steel qualities, and where advantageous high tensile steel, fully welded. All structural scantlings shall be determined for the heavy operation condition of the floating crane.

- Normal shipbuilding steel, yield strength minimum: 235 N/mm²
- High tensile steel, yield strength minimum: 355 N/mm²

4.1.2 Production Standards: Steel construction shall be according to NEN 2140 and NEN 2141, German shipbuilding Industry “Last Edition”, JSQS Japan Shipbuilding Quality Standard, ABS / BV Shipbuilding Quality Standards, or equivalent approved for tolerances of:

- flatness of plates and stiffeners
- geometry of shaped plates and stiffeners
- assembled hull units
- Alignment of structural members, etc.

4.1.3 Welding: The Contractor shall use standard qualified welding procedures, which shall be in accordance with Class requirements and recognized industry standards covering but not limited to:

- Alignments
- edge preparation
- undercutting
- gaps
- welding sequences and methods
- permissible defects
- inspection

In addition:

- Plate panels shall be welded, where practical, using one-side welding techniques, using qualified welding procedures
- Double continuous welding shall be applied where required by the Class.
- Welding in all tanks and all outside welding (above deck) shall be continuous.
- After CO’s review of the Contractor’s Hull Inspection Plan approved by Class for the construction, as a minimum, the ACP may indicate, in conjunction with Class, additional non-destructive testing of welds (ultrasonic or radiographic testing) in early building stage for the purpose of verification of the compliance with the requirements.
4.1.4 Workmanship: Workmanship, quality and performance of the Contractor and Subcontractors, shall be of the best quality, acceptable to Class and as stated in these specifications. Best quality means the application of current Western European, Japanese or North American shipbuilding practices. The Contractor shall be specifically responsible for the workmanship, quality, and performance of all work done in accordance with these specifications and requirements of Class. All welding shall be executed only by skilled and able welders. Unless otherwise specified, the Contractor shall apply best quality standards (with Class approval) for

- Constructional details like welds, scallops, bolts, flanges, pipe fittings, walls in accommodation etc.
- Outfitting like bollards, railings, manholes, bottom plugs, etc.
- Steel construction tolerances according to Class requirements
- Piping

4.2 Hull: The floating crane hull shall be in general of single deck and double bottom type with heavy sides to withstand the mooring of barges along sides and forward. Double bottoms shall be provided below all oil and fuel tanks. An accommodation deckhouse shall be installed on the forecastle. The part of the hull below of the crane shall be of heavy construction.

4.2.1 Construction: The hull shall be designed and built for not less than 30 years of service life, with not less than 2,000 hours of effective lifting operation per year. The barge hull shall be of all welded construction. The design and construction shall provide the necessary resistance for the hull to withstand all forces created by the lifting operation and other forces, and optimal stiffening continuity in order to prevent stress concentrations and vibrations. It shall be designed and built with longitudinal framing combined with transverse web frames in double bottom, decks and shell, from aft to fore of the barge. The hull shall be sub-divided into watertight and/or oil tight compartments. All places where specific loads are present shall be reinforced adequately, for instance, spudcasings, winches, auxiliary crane, masts, foundations, etc.

4.2.2 Shell: Shell plating stiffened longitudinally (deck, bottom and sides), supported by transverse web frames. Building frame spacing: in whole barge not more than 600 mm. Plate thicknesses in way of sea chests and inlet of suction pipe shall be increased. The hull plate thickness shall be not less than 20 mm, extending from light water line up to main deck.

4.2.3 Bottom Structure: The barge shall be in general of a single bottom type, and double bottom construction shall be present below oil and fuel tanks, as a minimum. Bottom tanks shall have vertical manholes in the vertical bulkheads. Bottom tanks height: Not less than 1200 mm.

4.2.4 Deck Structure: The main deck of the barge shall be without sheer and camber, and parallel to the barge’s baseline. The main deck shall be reinforced with thicker plates at corners of openings, under winches, and heavily loaded places. Deck shall be stiffened with longitudinal profiles, supported by web frames.
4.2.4.1 The deck on which the crane is mounted shall be heavy constructed and shall preferable remain at the same level of the main deck. The strength of the hull must consider, but not limited to, the uses of the floating crane. See paragraphs 1.1.6 and 4.3.1.

4.2.5 Bulkheads: Transverse bulkheads shall be of flat construction stiffened by vertical profiles, all constructed according to the rules of the Class. The main transverse bulkheads shall reach from shell to shell.

4.2.6 Small Bulkheads, Casings, Coamings:

- Small bulkheads, casings and trunks shall be of the corrugated or the plane type, depending on space available.
- Bulkheads of sanitary or domestic spaces in the deckhouse and bulkheads in other wet rooms, stores and workshops shall be of the plane type. Where practical, the stiffeners shall be located outside the spaces.
- Flat steel coamings with a height of at least 50 mm shall be fitted around openings in the engine room floor, intermediate platforms and stair-platforms.

4.2.7 Frames and Stiffeners: Frames and stiffeners in general shall be of Holland bulb type or equivalent standard structural shape.

4.2.8 Longitudinal Girders and Transverses: Longitudinal girders and transverses in general shall be built up out of plates.

4.2.9 Pillars: Pillars in general shall be square shaped or equivalent standard structural shape.

4.2.10 Scantlings: The scantlings of the hull and the superstructure shall exceed, by 10% at least, the relevant rules of the Class. The hull is strengthened by a combined longitudinal frame system. The scantlings of the hull amidships section and superstructure shall not be less than:

<table>
<thead>
<tr>
<th>Table 4. Scantlings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck, general</td>
</tr>
<tr>
<td>Deck, insert plates</td>
</tr>
<tr>
<td>Bottom insert plates</td>
</tr>
<tr>
<td>Bottom, general</td>
</tr>
<tr>
<td>Deck, around and under the crane</td>
</tr>
<tr>
<td>Sides &amp; forward (side) plating, general, with adequate</td>
</tr>
<tr>
<td>for barge mooring</td>
</tr>
<tr>
<td>Sides of the rounded aft</td>
</tr>
<tr>
<td>Round corners</td>
</tr>
<tr>
<td>Spud carriage wall</td>
</tr>
<tr>
<td>Well part near spud casings</td>
</tr>
<tr>
<td>Entry houses on deck</td>
</tr>
</tbody>
</table>
### Bulkheads
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulkheads</td>
<td>8 &amp; 12 mm</td>
</tr>
<tr>
<td>Accommodation deckhouse</td>
<td>6 &amp; 7 mm (at sides in general)</td>
</tr>
<tr>
<td>Accommodation deckhouse</td>
<td>8 &amp; 10 mm (front bulkhead)</td>
</tr>
<tr>
<td>Engine room top deck</td>
<td>6 mm (top deck)</td>
</tr>
<tr>
<td>Engine room top deck</td>
<td>10 mm</td>
</tr>
</tbody>
</table>

#### 4.2.11 Tank Arrangement:
Tanks capacities and arrangements shall be in accordance with the requirements and regulations. The major tanks for fuel, lubricating oil, water ballast, potable water, and void spaces where applicable shall be integral part of the hull construction. Port and starboard fill connections for diesel fuel and potable water shall be provided on the main deck. The necessary filling, aeration, and sounding pipes, and openings, manholes and drain holes, and drip trays of sufficient dimensions shall be provided in the construction. The following tanks shall be integrated in the hull but not limited to:

- Ballast tanks (as required)
- Potable (drinking) water tanks (at least two)
- Bilge-oil-water tank
- Dirty oil tanks (at least two)
- Lubricating oil tank (as applicable)
- Waste water (at least two)
- Hydraulic Oil Tank

#### 4.3 Foundations:
The auxiliary generators sets shall be resiliently mounted. Strengthening under foundations shall be made so as to avoid disturbing vibrations. The foundations of the heavily loaded deck machinery and deck fittings shall be provided with hull integrated reinforcements and support structure of suitably steel welded construction, in accordance with the requirements.

#### 4.3.1 Crane Foundation:
The crane foundation in the bow end body of the barge shall be designed and built considering the manufacturer’s requirements (including loads, dimensions and tolerances) for installation and safe and reliable operation of the crane. Structure design and construction shall exceed the minimum requirements of the crane manufacturer, and shall consider the heavy operation of the crane and service duty. The foundation area shall be fitted with a suitable oil drip catch pan, and shall be designed in such a way to prevent those contaminants from entering in to Canal waters.

#### 4.4 Deckhouse and other Work Spaces:

##### 4.4.1 Deckhouse:
The barge shall have an accommodation deckhouse unit of normal shipbuilding steel construction, which shall contain: Fan/Air Conditioning room, offices, mess room, galley, and changing rooms. The unit shall be placed on vibration dampers. On top of the accommodation unit, the Observation House shall be installed. In general, the deckhouse shall be of welded steel construction, suitably stiffened.
4.4.1.1 **Accommodation Deckhouse Layout**: The layout of accommodations and crew facilities of the floating crane shall be designed for three shift operations. The crew of each shift shall consist of at least 25 persons. The Captain and the Chief Engineer shall each be provided with a private office with writing desk with safe and desk chair, berth, bench, bookshelf and space for a small refrigerator unit. Officers shall be provided with changing room, which contains lockers (5 units), showers, washbasins, urinal, and toilets. The crew shall be provided with two changing rooms (one for men and a small one for women), both changing rooms contain lockers (25 lockers on men’s changing room and 5 lockers on women’s changing room), showers, washbasins, urinal (only for men’s changing room), and toilets. In addition, a galley, complete outfitted shall be provided (with cooking range, ice machine, grease extractor with suction hood, filters, and exhaust fan, microwave, and wooden racks); a mess room, complete outfitted (with sideboards, refrigerator, potable water fountain dispenser, dining tables, bookshelves, coat hooks, chairs, and side boards for TV equipment) shall be provided. Sleeping accommodations are not required. Construction and outfitting of the accommodations spaces shall comply with SOLAS (fire protection) and with industry marine standards (for outfitting), as a minimum.

4.4.2 **Auxiliary Engine Room**: The auxiliary engine room shall be located in the hull or at main deck and shall accommodate the diesel generators, switch board, miscellaneous pumps, various day tanks, etc.

4.4.3 **Machine Shop**: A machine shop shall be provided either above or below deck. The machine shop shall be equipped with a drill press, work bench and a not less than 1 x 400 amp electric arc welding machine. The machine shop shall have air conditioning.

4.4.4 **Container’s Area**: A space shall be arranged for two 20’ containers, stored by means of standard container fittings welded on deck.

4.4.5 **Store Room**: At least, two store rooms shall be provided. One room for spare parts and the other room for supplies. Both rooms shall have air conditioning.

4.5 **Hull Equipment**

4.5.1 **Hatches**: Entrance hatches shall be provided where necessary. Escape hatches shall be provided as required by Class or Statutory Bodies. Small hatches shall be equipped with stainless steel mechanism including eyes for padlocks. Large hatches for the engine room shall be easily handled with crane.

4.5.2 **Manholes**: All tanks and void spaces shall be accessible through a manhole in one of the respective bulkheads or in the tank top. Manhole size shall be in accordance with ISO/DIN 83402, ASTM 1142 or as per Class requirements. For sealing the manhole covers of the water and oil tank, and other tanks, suitable and proven seals shall be used. Tanks with a length of less than 3.0 meters shall be fitted with one manhole, as a minimum. Tanks with a length in excess of 3.0 meters shall be fitted with two manholes as far as applicable. The manhole covers on main deck passageways shall be flush with the surrounded plating. All manholes shall be identified with tank numbers by
means of welding beads. Steps and/or ladders or grips shall be provided for easy access, when tank height is above 1.2 meter.

4.5.3 Exterior Steel Doors: The floating crane shall be provided with steel weather tight hinge doors on all exterior doorways. The thickness shall be according to class. The construction and lay out of the weather tight doors shall be according to Class and international and national regulation and shall ensure adequate corrosion resistance. In general all doors shall be provided with 4 or 6 toggles suitable for one-handle operation, a single cylinder lock and securing hooks. Clear width of the opening of all doors shall be at least 700mm. Each door shall open to the outside and shall have a covered roof or cove.

4.5.4 Windows and Portholes: The windows shall be designed and built to provide thermal and acoustic isolation equal to that of the walls and roof. Movable windows shall be provided for the case of air conditioning failure. Movable windows shall be able to crank down, slide sideways or swing and overlap. Movable windows shall be fitted with corrosion resistant steel frames and shall be provided with drains or other means which shall drain to the outside. Windows shall not vibrate or rattle. Means shall be provided for locking the windows from the inside. Operating hardware for the movable windows shall be corrosion resistant material. The fixed windows shall be set in rubber or neoprene self sealing weather strips. The deckhouse shall be fitted with windows. Flanges, covers and glass frames shall be made of bronze or stainless steel. Windowpanes shall be made of two ply construction using tinted security glass with sufficient thickness, as required by Class.

4.5.5 Drain Plugs: All tanks and void spaces in the hull shall be provided with drain plugs. Drain plugs to be of stainless steel with a diameter of 3 in. (75 mm). Plug heads for fuel- and lubricating oil tanks shall be different from plug heads for water tanks. Two different sized sockets and wrenches shall be provided on board. Close to the drain plugs the tank numbers shall be marked with welding beads.

4.5.6 Stairs, Ladders, Railings, Platforms, etc.:

4.5.6.1 Ladders / handrails / stairs: Tanks and exits shall be fitted with ladders of steel according to Class, and made to Contractor's Standards and Panama Canal Safety Standard. Slope, width and height between steps of the stairs shall comply with Panama Canal Safety Standard. Ladders / railings and handgrips which are fitted for safety purposes shall be made of steel and placed on locations where required by Class. Wherever possible the slope of the stairways shall be limited to 50° from the horizontal. The width between handrails shall be not less than 700 mm. Stairs giving access to the auxiliary rooms below deck shall have side rails with perforated steps and shall be provided with removable handrails of steel tube with connection pieces of “Kee clamp” type (or equal) and shall be provided with a dust-chute.

4.5.6.2 Railings and stanchions: If required by Class the installation of railing on main deck, the main deck shall be fitted with a removable railing, as far as practicable. The upper decks shall be fitted with railing. In general, all railing works on weather-exposed decks shall be galvanized.
4.5.7 **Floor Plating:** The engine room shall be provided with aluminum or steel chequered floor plates. In way of the escape routes steel plates shall be used according to the Class. Plates shall be laid in easily removable panels on an open construction of steel profile, bolted with self-tapping screws. At positions of machinery, valves, etc. located below the floor plates, removable plating shall be provided.

4.5.8 **Fendering System:** Provisions shall be made for a suitable, heavy duty, fendering system, all around the floating crane.

4.5.9 **Signal Masts:** The middle signal mast shall be made of steel and shall be located in a suitable location. The mast shall be fitted with supports and fittings for navigation lights, flag lines, antennas, etc. Access to the top of the mast shall be by means of climbing steps. The mast shall be provided with safety rings according to authorities. SB and PS masts carrying PS/SB passing/obstructed navigation lights and day signals shall be furnished and installed. The fixed side masts, made of steel, shall be installed in a suitable location. The masts shall be fitted with supports and fittings for navigation lights and day signals. Day signals shall be handled from main or upper deck. Access to the top of the masts shall be by means of climbing steps. The anchor mast shall be made of steel and located in a suitable location. Masts shall be foldable. Navigation lights shall comply with COLREG and ACP standards.

4.6 **Corrosion Protection**

4.6.1 **General:** The floating crane shall be designed and constructed using the best materials and ship industry practice to avoid metal corrosion. Metal surfaces shall be protected against corrosion using protective coatings suitable for the intended service and in accordance with the following requirements.

4.6.2 **Surface Preparation and Shop Primer:** All steel used in the construction of the floating crane shall be blasted to SA 2 1/2 (near white metal) or better and treated with a weldable, epoxy shop primer, approved for the purpose. In general, and unless otherwise approved, dry abrasive blasting shall be applied instead of shot blasting or pickling. Surface anchor profile shall be in the range of 50 to 60 microns (2-3 mils). The shop primer is in addition to the required number of layers mentioned in this specification. Should the time limitation of the weldable epoxy shop primer be exceeded, the surface shall be recoated with the same material, before the time limitation is exceeded and in any case before any rust occurs. Otherwise the entire affected area shall be prepared by blast cleaning in accordance with this specification.

4.6.3 **Protective Coatings:** In general, metals subject to atmospheric exposure shall be protected with primer and intermediate coats resistant to chemical attack and topcoats resistant to UV degradation. Metals subject to immersion duty shall be coated with coatings resistant to continuous immersion in fresh and sea water and resistant to cathodic disbonding. Exterior hull below the high water line shall be topcoated with a tin-free antifouling coating with a service life of minimum 3 years. Tank linings shall be appropriate for the liquids to be contained.

4.6.4 **Surface Preparation after Construction:** Prior to painting, surfaces shall be prepared and primed, depending on the damage and on the paint system to be applied, as specified in
the table below. Sharp edges and corners shall be rounded; weld spatter and slag shall be thoroughly
removed; and rough welds shall be smoothed, by means of power tools. De-rusting and cleaning shall

<table>
<thead>
<tr>
<th></th>
<th>Alkyd paint systems</th>
<th>Epoxy paint systems interior -Ballast tanks -Bilge</th>
<th>Epoxy paint systems interior -Void</th>
<th>Epoxy paint System Outside: hull Sides and bottom -FW tanks (1)</th>
<th>Epoxy paint system outside: others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burned spots and damaged shop primer or primer</td>
<td>St 2</td>
<td>SA 2 1/2 or St 3</td>
<td>St 2</td>
<td>SA 2 1/2 or St 3</td>
<td>St 2</td>
</tr>
<tr>
<td>Welds</td>
<td>St 2</td>
<td>SA 2 1/2</td>
<td>St 2</td>
<td>SA 2 1/2</td>
<td>St 2</td>
</tr>
<tr>
<td>Rust damage</td>
<td>St 2</td>
<td>SA 2 1/2</td>
<td>SA 2 1/2 or St 3</td>
<td>SA 2 1/2</td>
<td>SA 2 1/2</td>
</tr>
</tbody>
</table>

Table 5. Surface Preparation

4.6.5 **Primer Application.** As soon as practicable after construction, but before any
corrosion damage shows on the metal surfaces, such metal surfaces shall be prepared in accordance
with Paragraph 4.6.4 and coated with the first layer as required. After cleaning by power brushing (C St 3) or grit blasting (SA 2 1/2) the area shall be coated with the first layer as specified. Any subsequent damages shall be repaired by cleaning, as specified above for damaged primer, and coated with the specified coating system. After cleaning by power brushing (C St 2), the area shall be treated with one layer of stripe coat. Power brushing and coating shall be done before rust damage occurs.

4.6.6 **Coating System:** The coatings shall be supplied by International Paints Inc. (http://www.marine.com/), Jotun Coatings (http://www.jotun.com/), Sigma Coatings (http://www.sigmacoatings.com/marine), or approved equal. The coating system shall be selected based on long service life and minimal maintenance by the vessel’s crew. All protective coatings shall be lead and chromate free, designed to protect against heavy corrosion in tropical marine environment and with a minimum service life to first maintenance of 60 months in seawater.

4.6.7 **Painting of Shell Plating:**

Shell bottom, shell side, sea chest below waterline:
1 x 150 microns modified epoxy
1 x 100 microns modified epoxy (tie coat)
1 x 100 microns tin free anti-fouling

Shell sides above waterline:
1 x 125 microns epoxy coating
1 x 125 microns epoxy coating finish.
2 x 40 microns polyurethane finish.

4.6.8 **Painting of outside metal surfaces of barge or superstructure**
Deck house external walls, deck house tops not walked on:
1 x 100 microns modified epoxy
1 x 100 microns modified epoxy (tie coat)
2 x 40 microns polyurethane finish.

Pipes on deck:
1 x 100 microns modified epoxy
1 x 100 microns modified epoxy (tie coat)
2 x 40 microns polyurethane finish.

Winches on deck:
1 x 50 microns epoxy
1 x 200 microns modified epoxy
1 x 50 microns epoxy finish.

Exposed deck surfaces, deck house deck walked on:
1 x 175 microns epoxy coating
1 x 125 microns epoxy coating non-skid finish.

Deck fittings, bollards, capstans:
1 x 50 microns epoxy
1 x 125 microns epoxy coating
1 x 125 microns epoxy coating finish.

Railings signal masts:
1 x 50 microns epoxy
1 x 125 microns epoxy coating
1 x 125 microns epoxy coating finish.

Ventilators and other steel parts above deck:
1 x 100 microns modified epoxy
1 x 100 microns modified epoxy (tie coat)
1 x 40 microns polyurethane finish.

4.6.9 Painting of inside metal surfaces of barge or superstructure

Engine room, pump room, auxiliary engine room underneath floor, bottom of floor from underneath:
1 x 150 microns epoxy coating
1 x 50 microns epoxy finish.

Engine room, pump room, auxiliary engine room above floor:
1 x 80 microns zinc phosphate primer
1 x 35 microns alkyd undercoat
1 x 40 microns alkyd finish.
Galley, CO2 room, air conditioning unit room, changing room, galvanized steel sheet in these spaces:
1 x 80 microns zinc phosphate primer
1 x 35 microns alkyd undercoat
1 x 40 microns alkyd finish.

Steel structures behind linings and insulation:
1 x 65 microns epoxy coating.

Void tanks:
2 x 150 microns epoxy coating.

Ballast water tanks, bilge tanks:
1 x 50 microns epoxy lining primer
1 x 250 microns epoxy lining (solvent free).

Fresh water tanks:
1 x 80 microns epoxy lining primer
1 x 300 microns pure epoxy lining.

Drinking water tanks:
The tanks shall be made of stainless steel with plane type walls. Clean all markings, remove temporary welds, and passivate affected surfaces.

Oil tanks:
1 x 80 microns epoxy primer.

Sludge oil tanks, Dirty oil tanks:
1 x 80 microns epoxy primer
2 x 80 microns epoxy lining suitable for oils and water.

Sewage Tank:
2 x 200 microns coal tar epoxy

Pipes and Valves:
1x 80 microns epoxy primer
2x 125 microns polyamide epoxy.

4.6.10 Coating and Marking of Pipelines: All piping to transport gas or liquid shall be coated in the primary color scheme required by the ACP and marked with colored rings to denote the nature of liquid or gas passing through it. Pipeline identification and colors shall be in accordance with ISO 14726 and ACP marine safety standard for floating equipment piping 2600SEG-301 (http://www.pancanal.com/eng/legal/reglamentos/security/marine/).

4.6.11 Painting Machinery and Equipment: Machinery and auxiliary equipment shall be delivered and installed in painted condition. For all machinery and equipment installed under deck
and painted by various Subcontractors, it is allowed to use alternative systems. Coating material and color shades shall be the standard manufacturers system for coastal tropical marine environment. Damaged spots shall be touched up, and if necessary the entire item shall be treated with the final coat. Color scheme shall be as per ACP’s choice.

4.6.12 Painting Walls, Border Strips and Different Coating Systems:  Walls, deckhouse walls, border strips along platforms, borders of drip trays, etc. shall be provided with a painted plinth, in the same system and color as the adjacent floor or deck. In spaces where two different paint systems are specified (e. g. epoxy for deck, alkyd for walls), the epoxy paint system shall be extended to part of the alkyd areas, in such a way that alkyd paints are applied on the epoxy system, and not vice versa (this applies e. g. to the plinth area). If required, a suitable sandwich coat shall be applied on the overlapping strip of the epoxy coated surface, to avoid lifting of the alkyd paint.

4.6.13 Coating Materials: The makes suggested by the Contractor shall be listed in the drawing, “Preservation Plan” and shall be forwarded to the CO for his approval.

4.6.14 Coating Application: Coating application shall be performed so as to result in complete and uniform coverage of the metal area to be coated. A stripe coat shall be brush applied on irregular surfaces, such as welds, corners, and edges before applying the first coat. Different paint layers shall have different colors or shades.

4.6.15 Galvanizing: The following parts shall be hot dip galvanized, if not mentioned otherwise:

- Side rails of stairs (outside, and inside engine room and pump rooms)
- Railings and stanchions on open deck, handrails and stanchions for outside stairs
- Fire fighting pipes
- Pipelines of the washing arrangement on hawser pipe
- Ballast- and bilge water pipes

4.6.16 Painting Galvanized Surfaces: In preparation for top coating, galvanized surfaces shall be pretreated per coating manufacturer’s recommendations and coated with a corrosion inhibiting epoxy primer suitable for galvanized surfaces.

4.6.17 Cathodic Protection: Impressed current system or sacrificial anodes of approved type shall be provided at the underwater shell, ballast water tanks, and the sea water inlet chests. Sacrificial anodes shall have a useful life of at least 5 years in seawater and under normal conditions.

4.7 Spuds:

4.7.1 General: The floating crane shall be provided with three identical steel spuds with square cross section that have adequate strength and the necessary length for all lifting and other crane operations conditions. The spuds shall be used for anchoring and stabilizing floating crane
during crane operations and when idle. Each spud shall be lifted by the crane for maintenance, powered by rack and pinion mechanism (rack and pinion mechanism shall be preferred, other alternatives could be considered and evaluated by the Contracting Officer). Spuds shall be secured by a manually and/or powered operated pin or similar, at certain height during short movements at working place and during equipment mobilization (at least at three different height positions).

4.7.2 Design Conditions and Strength Calculations: The spud system shall be designed to meet the design requirements of paragraph 3.1 General Requirements. During the design phase and prior to commencing construction a detailed strength analysis of the complete spud system shall be carried out including as a minimum the effects of following forces:

4.7.2.1 The forces generated by waves, swell and current on the pontoon, both horizontally and vertically.

4.7.2.2 Wind loads shall be considered in the design of the floating crane, according to American Bureau of Shipping (ABS) Guide for Certification of Lifting Appliances, during operating conditions and idle.

4.7.2.3 Worst lifting conditions at different distances.

When calculating the forces on the spuds, all above mentioned forces shall be combined, taking into account the actual operational conditions that can occur. The worst combination of all various loads shall be considered to determine the maximum spud load.

The maximum calculated spud load, as described above, defines the strength of the spud, spud guiding system, spud carrier, and supporting structure in the floating crane.

The spud lifting system shall not be considered as a hoisting tool.

The strength analysis together with the drawings shall be submitted to the CO for review prior to commencing construction.

4.7.3 Spud Construction: Spuds shall have round sections. Spuds shall be of a welded steel construction; consisting of stiffened steel plates. Spuds shall have a constant section over the entire length of the spud. All three spuds shall be identical. The length of the spuds shall be considered a water depth of 25 m and 1 to 2 meters submerged at the bottom. At the bottom, each spud shall be provided with a heavily constructed steel point. The spuds shall be fitted with lifting eyes. The clearance between spuds and spud guides shall be minimal, in such a way that no secondary forces occur when withstanding wave forces. Maximum total clearance shall be 10 millimeters. The building tolerance of the spuds shall suit the clearance of the guides. Welds in the spuds shall be 100% penetration butt welds. At least 50% of welds shall be ultrasonic or radiographic examined. On each spud, a depth indication shall be provided, at least on the fore and aft faces of the spuds. Letters (or numbers) shall be welded every meter to the spud. The spuds shall be designed and built in such a way that any water intrusion will not cause an additional load to the hoisting / lowering system; in any case, water volume in excess shall be drained out.
4.7.4 Spud Guides and Spud Liners: Each spud shall be supported in a spud guide casing frame. For the two aft spuds, the spud guide casing frames shall be mounted in the aft spud wells. For the forward spud, the cantilever guide frame shall be mounted in the spud carrier. The spud guides shall be equipped with replaceable spud liners or wear blocks. These spud liners elements shall dampen shocks and vibrations. Length and stiffness of the spud liners shall be determined during detail design. The spud guide frames shall be identical. Each spud guide shall be equipped with two manually operated securing pins to fix the spud to the guide during maintenance of the hoisting system.

4.7.5 Spud Hoisting and Lowering System: A spud hoisting and lowering system shall be provided, with following functions: hoisting spuds, lowering spuds. A rack and pinion system shall be provided as the driven mechanism.

4.8 Machinery System

4.8.1 General: All machinery, equipment, instruments and installations shall be of the latest design and shall be of rugged construction executed as per best shipbuilding practice and shall be of highest quality and suitable for operation in a tropical, humid marine climate.

The generator installation shall consist of two identical main generators sets and one harbour/emergency generator set.

The design and lay out of the machinery installation shall be in accordance with the Rules and Regulations of the Class for the notation specified, and the requirements of these specifications, as a minimum. All the equipment, including auxiliaries, pumps, coolers, electric motors, piping systems, ventilation and A/C systems, shall be built in an efficient, reliable, and ease of maintenance arrangement.

The engine room installation shall be outfitted for an unmanned engine room.

All auxiliary engines shall be designed and manufactured for marine service, and shall be four stroke, turbo-charged / after cooled. All engines shall be of high efficiency with low life-cycle costs. All engines shall be part of the current production program of the manufacturer, including spare parts and services. All engines shall comply with environmental regulations of emissions control according to IMO and US EPA Tier 2 or Tier 3, or equivalent international approved equivalent emissions control regulation.

Piping systems for the different machinery installations, including engines, shall be provided with the necessary monitoring devices, such as manometers, thermometers, etc, as required by the different manufacturers and these specifications. Piping connections to diesel engines and sensors (transducers, pressostats, etc.) shall be of flexible type.

Torsional vibrations shall be avoided while within the working range of all machinery. Necessary torsional vibration calculations shall be carried out by the yard to the approval of Class.
4.8.2 Diesel Engines for Driving the Main Generators: Two (2) identical main generators sets shall be provided in the engine room. The diesel engines shall be built together with a generator on a common frame, mounted on resilient mountings. Couplings between engines and generators shall be included. Start and stop shall be in the engine room. Emergency stop shall be locally at the engine and in the observation house. The engines shall comply with the following:

- Speed, maximum: 1800 rpm
- Cooling: fresh water cooled through box type coolers

The engines shall be provided with the following in accordance with requirements and manufacturer’s guidelines:

- Control station fitted to the engine
- Mechanical/electronic governor
- Gauge board
- Oil mist detector (or other class approved system)
- Electric starting system
- Air intake filter
- Turbocharger and after cooler
- Fuel system with duplex fuel filter
- Primary fuel filter / water separator
- Lubrication oil system
- Built on cooling water pump
- One set of special tools

The engines shall be supplied with controls, monitoring, alarm, and safety system in accordance with requirements, manufacturer’s guidelines and Class:

- Monitoring / gauges: oil lubricating pressure, engine coolant temperature, operation time in hours, battery charge and RPM
- Alarms and shutdown systems for: Over-speed, low lubricating oil pressure and level, high cooling water temperature, low coolant level. The alarms shall be shown in a grouped alarm in the observation house control desk.

4.8.3 Diesel engine for Driving the Harbour / Emergency Generator: One (1) emergency generator set shall be provided in the emergency generator room. The diesel engine shall be built together with a generator on a common frame, mounted on resilient mountings, and provided with a built-in fuel tank. A coupling between engine and generator shall be included. The engine shall comply with the following:

- Speed, maximum: 1800 rpm
- Cooling: fresh water cooled via radiator (its fan driven by the engine)
Engine shall be electrically started. Start and stop shall be locally at the engine. An emergency starting system shall be provided. The diesel engine shall be supplied with a monitoring, alarm, and safety system in accordance with requirements, manufacturer’s guidelines, and Class, including but not limited to:

- Monitoring / gauges: oil lubricating pressure, engine coolant temperature, operation time in hours, battery charge and RPM

- Alarms and shutdown systems for: Over-speed, low lubricating oil pressure and level, high cooling water temperature, low coolant level. The alarms shall be shown in a grouped alarm in the observation house control desk.

Technical data for generator see subparagraph 4.12.4.2.

4.9 Auxiliary Systems

4.9.1 Compressed Air System: A working air system shall be installed. The system shall have several connections on the floating crane, like in the main engine room, in all workshops, at the workdeck area on the midship, at spud winches (or winch rooms) and in the rear of crane. All connections shall be provided with valve and quick couplings of stainless steel construction. Two electrically driven screw type compressors shall be arranged for automatic operation and shall supply air to a working air receiver via an aircooled aftercooler. The compressors shall be mounted in a sound insulated housing. System shall have two working compressors one should function at full load while the other will be for stand by.

Working Air Compressors:
Capacity : not less than 1275 m³/h free air delivery (FAD)(750 cfm)
Pressure : not less than 7 bar

4.9.2 Fixed fire fighting arrangement

4.9.2.1 CO2- Fire Extinguishing Installation: A CO2- fire fighting system shall be provided for the engine room spaces. The bottles shall be located in the CO2-room. The control box shall be located near the entrance of the Engine room, together with the S.O.S. valves. A separate CO2- system shall be provided for the galley with one cylinder according to the authorities. The systems shall be provided with required alarms and controls according to Class.

4.9.2.2 Hydraulic Pump Room Fire Extinguishing Installation: Depending on the design, suitable fixed fire fighting systems shall be provided for the hydraulic pump room of the spuds. The fire extinguishing systems shall be in accordance with all applicable codes and regulations.

4.9.2.3 Fire Pumps: See Section 4.11.5.1.

4.9.3 Diesel Fuel System: A diesel oil system shall be provided for the various consumers: For main diesel generator sets, emergency generator set, diesel for emergency fire fighting pump. Also, the system shall supply the supporting workboats and tugs. The system shall be in
accordance with these specifications, Class and equipment manufacturers. At least, two main diesel
tanks, one day tank, fuel oil transfer pumps, purifiers, deck filling stations, and connections for fuel
dispensers on deck shall be provided.

The main diesel tanks shall be connected to a diesel oil overflow system, which shall be provided with
a high level alarm. From all fuel tanks de-aerating pipes shall be lead to the main deck. Emptying of
over-flow-tank shall be via the fuel oil transfer pumps. The day tank shall be provided with an
automatic filling system. Also, the system shall be designed to transfer the fuel oil from the day-tank
in return to the tanks.

The main diesel tanks shall be filled from fuel-oil filling stations, located on main deck amidships on
SB and PS. Connections on main deck on both sides of the floating crane (port & starboard) shall be
provided for the installation after acceptance of the floating crane by the ACP of fuel dispensers for
servicing workboats and tugs. The filling lines of the diesel fuel system and the discharge lines for the
fuel dispensers on main deck shall be provided with fuel meters.

Each system shall have at least two fuel oil purifiers (centrifuges), self cleaning, fully automatic, (one
stand by) with the required capacity, controls and alarms.

Fuel transfer pumps: At least two fuel transfer pumps for diesel oil shall be installed (one as stand by
unit). The pumps shall be used to transfer the fuel between the main tanks, to and from main tanks to
the day tank, and to crane filling station.

Execution: (screw type is preferred)
Capacity: not less than 10 m³/hr
Discharge head: not less than 2.5 bars
Speed, maximum: 1800 rpm

4.9.4 Cooling water system: Box cooling water systems shall be arranged for auxiliary diesel engines, the hydraulic system oil coolers and the air conditioning system. System shall be provided with all required pumps. Separate fresh cooling water pumps shall be installed for each circuit. For the chiller installation two pumps shall be required (one stand-by). Expansion tanks and drain tank shall be arranged where necessary. Cooling systems arrangement and equipment, including the box coolers, shall be ease of maintenance.

4.9.5 Cooling water system: Box cooling water systems shall be arranged for auxiliary diesel engines, the hydraulic system oil coolers and the air conditioning system. System shall be provided with all required pumps. Separate fresh cooling water pumps shall be installed for each circuit. For the chiller installation two pumps shall be required (one stand-by). Expansion tanks and drain tank shall be arranged where necessary. Cooling systems arrangement and equipment, including the box coolers, shall be ease of maintenance.

The cooling area of box coolers shall be dimensioned for zero speed of the vessel, 25% fouling, and
genes running at 110% of power rating. Installation of the box cooling in the hull shall remain 100%
submerged under all conditions, even when the floating crane is lifted out of its floating position by the
spud system.

August 2017
Floating Crane Technical Specifications (Preliminary)
4.9.6 Drinking Water and Sanitary System

4.9.6.1 Drinking Water System: The drinking water system shall draw water from the potable water tanks and discharge it via pressure tank to the drinking water system. The potable water tanks shall be filled from filling stations on the main deck. The system shall consist of a pipe system, pressure water sets, electric heaters, and a filtering system. The system shall provide potable / drinking water to the following consumers but not limited to: heaters; accommodation space, including sinks, hand wash basins, showers, toilets, urinals; all water drinking fountains; connections in engine room, hydraulic system room, workshops; diesel oil purifiers; taps on main deck, as required.

Two pressure water sets, serving the drinking water systems shall be furnished and installed. Each pressure set shall consist of a suitable, durable, corrosion resistant, steel pressure tank with membrane, having a capacity of not less than 450 l and an electric driven self priming centrifugal pump with an average capacity of not less than 3 m$^3$/h. The pump shall start and stop automatically by means of a pressure switch, mounted on the pressure tank.

A freshwater UV sterilizing unit and a carbon filter shall be fitted in a bypass line of the main supply line, which leads to the various consumers of the drinking water system. The freshwater system shall be provided with a chlorinator, fitted in bypass.

Two (2) thermostatically controlled electric water heaters of not less than 300 liter capacity each shall be provided and serve the closed hot fresh water circuit. The hot water is circulated through the system by means of a hot water circulation pump. The hot water system shall be provided with thermal insulation, as required.

The cold drinking/potable water system and the hot water system shall be, where necessary, provided with separation valves and drain plugs. All piping material shall be suitable and approved for the application and in compliance with the authority requirements and safe use of the system.

4.9.7 Sewage System: All gray and black water discharges from toilets, washbasins, galley, etc. shall be led to a “biological” sewage treatment plant and a sewage tank. This system shall be in accordance with the regulation of USCG IMO TYPE TWO and THREE and shall be of approved marine sanitation devices, dimensioned in accordance with crew size and duty cycle requirements.

Processed liquid effluent of the treatment plant shall be either discharged overboard or via a shore connection on main deck with the sewage pump (in case the processed effluent has been stored in the sewage tank). Discharging of the sewage of tank shall be done via a shore connection on main deck with the sewage pump. A bypass for direct discharge shall be provided. If sludge is produced by the system and shall be removed from the equipment, this shall be reduced to its minimum size or treated in such a way that could be removed by a person from the floating crane after the reduction has been taken place. Sludge cannot be discharged into Panama Canal waters.

4.9.8 Sounding, Filling and De-aeration Piping
4.9.8.1 Level gauges (visual): At least the following tanks shall be provided with level gauges with content showing:

- No. 2 DIESEL OIL tanks
- Day tanks
- Overflow tank
- Lubricating oil tanks
- Hydraulic oil tanks
- Potable water tanks

4.9.8.2 Sounding and De-aerating Pipes: The following tanks shall be provided with sounding pipes:

- Ballast tanks
- Tanks, being part of the hull, containing fuel, sludge, potable water and / or oils
- Sewage tank

Furthermore sounding pipes shall be provided for the bilge wells, and cofferdams in double bottom, and void spaces that are part of the hull.

The sounding pipes shall be led from the bottom up to deck, where necessary, and have dimensions and diameters according to Class requirements. The pipes shall be provided with bronze caps, secured by stainless steel chain. Underneath each sounding pipe a stop (striking) plate shall be welded.

De-aerating pipes: De-aerating pipes and caps shall be fitted according Class requirements and Contractor’s standards. All de-aerating pipes shall be fitted with an approved type automatic closing arrangements, and shall be internally and externally hot dip galvanized except for those from oil tank, which shall be black. De-aerating caps of freshwater tanks shall be fitted with anti-insect gauze and fuel tanks with a flame arrestor. The exhaust vent of the sewage plant is to extend to the top of the funnel.

4.9.8.3 Tank Sounding System, Level Alarm Indicators: An electric tank sounding system shall be provided for each of the following tanks:

- each No. 2 DIESEL OIL tanks
- day tank
- overflow tank
- each lubricating oil tank
- each storage tanks
- each drinking water tank
- each water ballast tank
- hydraulic oil tank

Each system shall consist of:
Pressure transducer mounted in or on the respective tank
Amplifier

The amplifiers shall be connected to the alarm system for alarm purposes. The alarm data shall be transferred to the system and shall indicate the relevant tank contents and tank weights. Correction for specific gravity of the liquid shall be provided.

By proper installation of the sensor, the measurement shall be as much as possible independent of list and trim.

The following tanks shall be provided with a set point for high-level alarm:

- Each fuel oil tank
- Fuel overflow/leak oil tank
- Dirty oil tank
- Sludge tank

The fuel oil daily service tank shall be provided with a set point for low and high level alarm. The fuel oil daily service tank in the emergency generator room shall be provided with a set point for low as well as high level alarm.

4.9.9 Dirty Oil System: The used oil/recovery oil tanks for diesel engines and gearboxes shall also collect waste oil and spills from the following machinery:

- Lubricating oil circulation tank, and gearboxes (including crane)
- Diesel engines and emergency diesel engine (including crane)
- Oil drip pans

A stainless steel air powered sludge/dirty oil pump of the diaphragm type shall be installed in the engine room. The pump shall have a capacity of not less than 15 m³/h at a pressure of 2 bar. The pump shall be controlled at site and outside from main deck. The pump shall draw from:

- dirty oil tanks
- sludge tank
- waste water tanks.

And discharge to:

- deck connection
- sludge tank
- supporting vessels.

4.9.10 Sludge System: Sludge, resulting from the separation processes of the fuel / lubricating oil separators and the bilge water separator, shall be led to the sludge tank.
On the bottom level the sludge tank shall be provided with a self-closing valve with funnel for draining the separated water into the bilge water tank. Discharging of sludge tank shall be via the dirty oil / sludge pump.

4.9.11 Ventilation and Air Conditioning: The capacities and dimensions of fans, air ducts, gratings and fire dampers shall be in accordance with Class and manufacturers’ equipment requirements. Ventilation gratings shall be made of steel and shall be provided with a thermoplastic coating. Manually, or automatic (where required), operated dampers shall be provided for shutting off the passage of air in the event of a fire. Emergency stop buttons-switches shall be installed at a central location according to Class requirements. Supply grills shall be fitted with sea water resistant aluminum mist-eliminators.

Mechanical ventilation system
The air inlets of the mechanical ventilation system shall be provided with air inlet filters. The filters shall be mounted in stainless steel cassettes, which are mounted in a stainless steel frame construction. The air velocity through the filters, with all fans working, shall not exceed 2.5 m/s, taking into account the net filter surface.

In general, all start/stop switches of fans are located in the switchboard room except the following fans, which are having local switches:

- Exhaust fan workshop
- Exhaust grease extractor with suction hood, including filter and exhaust fan -galley
- Supply fan auxiliary and emergency generator room (automatically started)

Secondary ventilation ducts in the accommodation and engine room are made of galvanized thin-walled piping or/and thin-walled galvanized steel sheets.

Design Conditions
The following inside conditions shall be kept:
Inside: 22.5 °C / 50% RH,

At the following outside conditions:
- Outside: 40.0 °C / 80% RH
- Wind speed: 40.0 knots
- Min. sea water temp.: 15.0 °C
- Max. sea water temperature: 32.0 °C

The air conditioning plant shall operate with maximum 70% return air during the most extreme conditions for accommodation spaces, and with maximum 90% return air for equipment spaces. Cooling of the AC system shall be generated by a chilled water plant.

The installation shall be based on the following number of air changes per hour but not limited to:

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Supply</th>
<th>Exhaust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabins</td>
<td>not less than 8 -12 times</td>
<td>30</td>
</tr>
</tbody>
</table>

August 2017
Floating Crane Technical Specifications (Preliminary)
### Floating Crane Technical Specifications (Preliminary)

<table>
<thead>
<tr>
<th>Location</th>
<th>Minimum Ventilation</th>
<th>Maximum Ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mess</td>
<td>not less than 12 -15 times</td>
<td>not less than 15 times</td>
</tr>
<tr>
<td>Galley</td>
<td>not less than 20 times</td>
<td>not less than 40 times</td>
</tr>
<tr>
<td>Sanitary Spaces</td>
<td>not less than 20 times</td>
<td>not less than 40 times</td>
</tr>
<tr>
<td>Change room</td>
<td>not less than 15 times</td>
<td>not less than 15 times</td>
</tr>
<tr>
<td>Emergency engine room</td>
<td>not less than 20 times</td>
<td>not less than 60 times</td>
</tr>
<tr>
<td>Hydraulic room</td>
<td>not less than 20 times</td>
<td>not less than 60 times</td>
</tr>
<tr>
<td>Auxiliary Engine Room</td>
<td>not less than 60 times</td>
<td>not less than 60 times</td>
</tr>
<tr>
<td>Switchboard room</td>
<td>not less than 20 times</td>
<td>not less than 60 times</td>
</tr>
<tr>
<td>Workshops</td>
<td>not less than 15 times</td>
<td>not less than 15 times</td>
</tr>
</tbody>
</table>

The ventilation and air conditioning systems shall serve the following locations but not limited to:

**Air conditioning of the following rooms:**
- Supply of cabins, galley, mess, etc.
- Supply of changing rooms
- Supply of workshops
- Workshops
- Store rooms

**Ventilation supply of the following rooms:**
- Auxiliary engines room, Pump room, Electrical system room, Hydraulic room, Emergency generator room
- Workshops
- Store rooms

**Exhaust of the following rooms:**
- Exhaust sanitary spaces
- Exhaust galley
- Exhaust change room
- Exhaust paint store
- Exhaust deck and workshops

**4.9.12 Exhaust Piping:** The diesel engines shall be provided with exhaust gas silencers with spark arrestors, in their respective exhaust gas line. The silencers shall be of the resonance and absorption dumping type, sound reduction not less than 25 dB (A). All silencers shall be flexibly mounted to the floating crane's structure. Exhaust lines shall be floating fixed by dash points for resumption of thermal dilatations. The exhaust lines shall be connected to the engines by means of expansion bellows. Where necessary, extra expansion bellows shall be installed. Insulation of exhaust lines shall be by means of mineral wool covered with sheet steel plating according to the rules of the classification society. On the exhaust pipes water drains shall be provided.

**4.10 Deck Equipment and Outfit:**

**4.10.1 Overhead Crane:** An overhead crane shall be provided, one located in the engine room and one in the machine workshop. These cranes shall travel on overhead rail systems, and shall be capable of lifting all major equipment components within the engine room and the machine workshop. All equipment shall comply with Class, and applicable requirements of industry recognized standards, such as CMMA # 70 or equivalent.

---

August 2017

Floating Crane Technical Specifications (Preliminary)
4.10.2 **Mooring and Towing Equipment:** Mooring ports (Panama Chocks type, as per DIN 81915 or equivalent) and double bollards (SWL of each installation shall be 445 kN, as per Panama Canal regulations) shall be provided for towing the barge. At least, six polypropylene or polyamide mooring lines shall be provided with the barge, in accordance with Class and applicable requirements. Each rope shall be provided with two eyes of approximately 1.8 m.

4.10.3 **Bitts, Cleats:** All necessary deck fittings shall be delivered with the floating crane; double bollards, single bitts, cleats, chocks, horizontal sheaves and rollers, and fairleads shall be located on the main deck for efficient handling of scows, for mooring of auxiliary floating equipment (fuel barges, potable water barges, tugs, workboats, launches), and for mooring the vessel.

4.10.4 **Life Saving Equipment:** Life saving equipment as required by SOLAS, Flag State Authorities, and Panama Canal Maritime Safety Standards, and these specifications shall be furnished:

4.10.4.1 **Life Rafts:** Inflatable life rafts shall be provided as required by Class and Authorities. The rafts shall be of a type approved by class regulations and Flag State Authority. All rafts shall be stored in G.R.P. containers in cradles, complete, and shall be provided with a hydrostatic release or launching device.

4.10.4.2 **Personal Life Saving Equipment:** Personal life-saving equipment for the total crew, i.e. life jackets, life buoys etc. shall be provided as per requirements of the Statutory Bodies. Survival suits shall be provided only if required by Class and / or statutory bodies for the intended floating crane service at the Panama Canal. Final positions for storage of all equipment shall be as directed by the Contracting Officer and as required by Statutory Bodies.

4.10.4.3 **Emergency Signals:** One set of smoke- and light distress signals shall be provided.

4.10.5 **Fire Fighting Equipment:** Fixed and loose fire fighting equipment shall be Type Approved by SOLAS, Authorities, and Panama Canal Maritime Safety Standards, as applicable. Type and number shall be according Class, Authorities, and Panama Canal Maritime Safety Standards. Where required the type and number of the fire fighting equipment shall be supplemented.

4.10.5.1 **Fire extinguishers:** Fire extinguishers as required by the Statutory Bodies and Panama Canal Maritime Safety Standards shall be provided on board on accessible locations, all of them of an approved type.

4.10.5.2 **Fire hoses:** Fire hoses and nozzles shall be of an approved type and stored near the fire-main connections in wall-mounted boxes, of approved construction. Boxes on the open deck shall be of the strengthened type or shall be mounted on locations where they are protected from incoming waves. Fire hoses shall be delivered complete, with spray / jet nozzle.
4.10.5.3 Firemen's Outfit, Breathing Apparatus and Accessories: The floating crane shall be delivered with at least two firemen’s outfits stored in widely separated accessible areas. Each outfit shall include but shall not be limited to the following: one pressure-demand or positive-pressure self contained breathing apparatus (SCBA), one flashlight, one flame safety lamp or combination oxygen / combustible gas indicator (shall be intrinsically safe and UL or FM approved), one spanner wrench, an approved firefighters outfit (to include approved rigid helmet, boots, gloves, coat, trousers and coveralls), and one fire axe.

4.10.5.4 Additional Fire Fighting Installation: Fixed CO₂ Fire Extinguishing Installation shall be provided as specified for engine room and galleys. One portable fire-fighting pump shall be installed on deck.

4.11 Piping Systems

4.11.1 Materials: Materials for piping systems shall be in accordance with Class rules. Where Class rules do not specify materials, commercial marine quality piping and fittings shall be used. Hydraulic piping and tubing exposed to weather shall be seamless stainless steel in accordance with ANSI, ASME, and SAE. Pipes in oil systems shall be made of black steel; pipes in ballast- and bilge water systems shall be hot dip galvanized. All pipes shall be made of steel, if not mentioned otherwise.

4.11.2 Pipe Fittings: Unless otherwise indicated, shall be as specified below:

4.11.2.1 Pipe Joints: Pipes with an outside diameter of 25mm and smaller sizes shall be connected by means of steel pipe couplings. Pipes with an outside diameter bigger than 25mm shall be connected by means of welded steel flanges.

4.11.2.2 Pipe Fittings and Flanges: Pipe fittings and flange dimensions shall be in accordance ANSI/ASME standards (highly preferred) or with I.S.O.-standards.

4.11.2.3 Exception: Flange connections above electric cabinets shall be avoided.

4.11.3 Piping Design: Maximum velocities in pipelines in general shall be in accordance with the following values:

- Diesel oil: Suction side 2.0 m/s, pressure side 3.0 m/s
- Oil (Lubricating, TO): Suction side 1.0 m/s, pressure side 2.5 m/s
- Compressed air: 20 m/s
- Cooling water: Suction side 2m/s, pressure side 2.5 m/s
- Ballast/bilge: Suction side 2m/s, pressure side 3.0 m/s

Piping diameters and wall thickness shall be designed in accordance with rules requirements of Class, system requirements and these specifications. Each system shall be designed for full load condition and for the environmental conditions as specified. Air pockets in pipelines shall be avoided as far as possible. Where pockets occur, bosses with a cock or screwed plug for venting shall be provided.
4.11.3.1 Piping Schedule: The steel pipes shall be seamless Schedule 40 as minimum standard.

Galvanized steel pipe work shall be **hot dip galvanized**. On open decks bolts and nuts shall be in stainless steel. Under deck they shall be in galvanized execution.

4.11.4 Valves and Fittings: Each system shall be provided with the necessary valves and fittings.

4.11.4.1 Valves: In general, valves of the butterfly type shall be used. Butterfly valves, which are in contact with seawater and/or bilge water systems, shall be executed with internal rubber linings to avoid corrosion. All valves fitted to the shell shall be nodular iron or cast steel. Inner parts of cast iron, nodular cast iron, cast or forged steel fittings shall be of bronze or stainless steel (in fuel systems inner parts shall be made of steel). Valves that are smaller than 50 mm shall be manufactured of bronze or equivalent. Thermostatic valves shall be provided with a manual operated handle (emergency). All in- and outlet openings below the deep waterline shall be capable of being closed with a valve for carrying out of maintenance works. Seawater inlet valves shall be sturdy butterfly valves.

4.11.5 Bilge, Ballast, and Internal Fire Fighting System:

4.11.5.1 Pumps: The described systems shall be provided with the following pumps, as a minimum:

4.11.5.1.1 Fire Fighting Pump: One (1) each fire fighting pump (electric driven), with enough capacity according to class and regulations shall be provided on the floating crane.

4.11.5.1.2 General Service Pump: One (1) each general service pump, with enough capacity to replace the bilge pump and the fire pump shall be furnished. The General Service pump shall be connected to the deck wash system.

4.11.5.1.3 Emergency Fire Fighting Pump: One (1) each, portable emergency fire-fighting pump (diesel driven) shall be furnished.

All pumps shall be electrically driven (with the exception of the emergency fire fighting pump) and of the centrifugal type with bronze casing, bronze impeller and stainless steel shaft. The suction of the service pumps shall be connected to the main seawater cross over. This line shall be connected to two each cylindrical raw water inlet chest / filter tanks, integrated with the floating crane’s structure, one at SB side and one at PS.

Each inlet chest shall have a capacity of 100%, based on the maximum demand of seawater. The inlet chest / filter tanks shall have a low seawater inlet in the floating crane’s side. The inlets shall be provided with stainless steel gratings. Each inlet chest shall have a sieve made of perforated stainless steel plate. The filter sieves shall be hoisted and removed for cleaning purposes from the main deck.
level. The filter sieves shall be kept in position by means of stems, fixed at main deck level. The inlets can be closed with a stem for seawater inlet valve repairs.

4.11.5.2 Bilge Water Separator: In the pump room, one automatically operated bilge water separator shall be installed. The suction line shall be connected to the bilges and dirty water tanks. The unit shall be provided with an automatic oil drain system, oil content alarm type and an electric heating element in order to preheat the bilge water before separating. The separator shall be in accordance with the MARPOL regulations. All oily water shall be piped to sludge dirty water oil tank.

| Capacity | not less than: | 2.5 m³/h |
| Alarm    | not less than: | 12.5 ppm |
| Stop     | not more than: | 15.0 ppm |

4.11.5.3 Ballast System: Filling and discharging of the water ballast tanks shall be done by means of a locally controlled operating system and control of the pumps from the pump room also. Stripping of tanks shall be done via a pump in the pump room. The suction pipes in the ballast tanks shall be provided with a conical inlet piece, which shall be mounted as close as possible to the tank bottom.

4.11.5.4 Bilge System: In the pump room a bilge manifold shall be provided, and connected to the bilge lines of the pump room, and to the required spaces (including void spaces, if required by the Class). This manifold shall be connected to the bilge stripping pump in the pump room and to the general service pumps.

4.11.5.5 Deck Wash System: The deck wash system shall be designed in accordance with class and the requirements of these specifications. The connections shall be located as directed by the Contracting Officer. Two deck-wash lines shall be led at PS/SB side between the fore- and aft ship. Connections shall be provided at appropriate locations on main deck and on upper deck. Outside the accommodation deckhouse at each deck level one connection shall be provided. An international shore connection shall be placed at a proper location.

4.11.5.6 Fire Fighting System: One fire-fighting pump shall be diesel driven. The fire fighting system shall be designed in accordance with Class requirements.

4.12 Electrical Systems Installation: The electrical installation and all materials shall be suitable for marine service and the intended application, and shall be in accordance with the requirements of the Class. The electrical system shall comply with the requirements of IEEE 45 standards or IEC 60092 and IEC 60533 standards. Whenever any equipment or installation is referenced to other standards than the IEEE 45 standard or IEC 60092 and IEC 60533 standards, those shall be recognized international standards or codes, and the Contractor shall provide the cross-reference information, equipment or installation specifications and characteristics to demonstrate and prove compliance with the intended design and performance requirements.

4.12.1 Design Conditions: Unless specified otherwise:

Degree of protection of machines:
- on open decks: minimum IP56
• within pump rooms and engine rooms and other spaces with liquid spill probability: minimum IP44
• within dry accommodation spaces: minimum IP22
• Generators shall not be installed in open decks

Degree of protection of transformers, switchboards and motor starters:
• on open decks: minimum IP56
• within pump rooms and engine rooms and other spaces with liquid spill probability: minimum IP44
• within dry accommodation spaces: minimum IP22
• Transformers shall not be installed in open decks.

Degree of protection of luminaries:
• on open decks: minimum IP55
• within pump rooms and engine rooms and other spaces with liquid spill probability: minimum IP34
• within dry accommodation spaces: minimum IP22

Degree of protection of sockets outlets, switches and connection boxes:
• on open decks: minimum IP56
• within pump rooms and engine rooms and other spaces with liquid spill probability: minimum IP55
• within dry accommodation spaces: minimum IP22

Output of machines continuously 100%

Insulation / Temperature rise:
Dry Type Transformers NEMA Class F / within Class F temperature rise limits
Electric Motors NEMA Class F / within Class F temperature rise limits
Main and Harbor/Emergency Generators NEMA Class H / within Class F temp. rise limits

4.12.2 Systems: The electrical installation shall consist of the following systems:
• AC main system shall be designed at a standard voltage available at de Republic of Panama (480V, 690V or 4160V depending on the crane capacity design). Shall be supplied by two main generators (one operating and the other as stand by, for backup), feeding principally:
  - 3 x 480 V for supplying the auxiliary switchboard for the ships main, fed from the AC main System, through a step-down transformer, or fed from the harbor generator during harbor mode.
  - 120/208 V for small loads and lighting, through a step-down transformer.
  - 24 V DC loads, through a step down transformer and rectifier assembly.
  - Harbor switchboard.
  - Other loads as required.
- 3 x 480 V - 60 Hz – AC harbor switchboard interconnected with the 3 x 480 V main switchboard and disposition to be fed from the harbor/emergency generator shall be provided for feeding 480 V loads.

- 3 x 120/208 V - 60 Hz – three phase, four wire, AC system, supplied by the main and harbor/emergency switchboards through step-down transformers, for lighting, small consumers and other.

- 24 V - DC system for alarm systems, control systems, communication systems and other appliances, fed from the main and harbor/emergency switchboards through step-down transformers and rectifier assembly. The 24 V DC system shall be provided with a battery bank.

Each Motor Control System (MCS) shall include all systems and components required to meet the performance, protection, safety, testing and certification criteria of this specification. All these components shall be part of an integral Motor Control System.

The electrical distribution system shall be designed according to IEEE 45 standard or IEC 60092 and IEC 60533 standards.

Because of the frequency converters activities for reducing the harmonic currents according to the Classification Society and Authorities have to be performed (“Active Front End“, filters, min. 12-pulse converters ). Concerning the total harmonic distortion and EMC effects, the electrical distribution system shall be designed according to IEC 60092 and IEC 60533.

The Motor Control System, as defined above, shall be completely factory pre-wired, assembled and tested (with the motor) as complete package, to assure a properly coordinated and fully integrated drive system.

4.12.3 Electric Power Generating System: The arrangement of the power supply systems shall be based on the following operating conditions and shall operate so to accomplish the requirements of these specifications. The power system shall be controlled and monitored from the engine room. Additionally, the power system shall be monitored remotely from the observation house.

4.12.3.1 Main Generator Capacity: Two identical generator sets shall be installed in the engine room. The final power shall be determined by an electric load balance analysis. Each generator shall be sized to feed all consumers within 80% of its rated power with the other generator acting as stand-by. The sets are not required to be equipped for parallel operation.

4.12.3.1.1 Electric Load Requirements: The Contractor shall carry out a complete electric load analysis for the following:

- Operational lifting condition
- Harbor condition
- Emergency condition
- Electric load analysis shall take into account all loads.

- Sizing of main generators shall take in consideration electric load analysis results for operational lifting condition and electrical power back-up condition during crane’s operation. The Output Voltage for the Main Generators shall be selected from a standard voltage available at de Republic of Panama. Standard voltages available are: 480V, 690V or 4160V and shall depend on the design load.

- Sizing of harbor/emergency generator shall take in consideration electric load analysis results for harbor and emergency condition.

4.12.3.2 Harbor/Emergency Generator: One harbor/emergency generator set shall be installed in the engine room separated from the main generators. The final power shall be determined by an electric load balance analysis. The harbor/emergency generator shall be sized to feed all consumers supplied by the harbor switchboard within 80% of its rated power.

4.12.4 Power Generation

4.12.4.1 Main Generators: Two identical, self-regulated, self-excited AC main generators shall be installed in the engine room, each driven by a diesel engine.

Each generator shall be designed according the following specification:

- output: as per requirements
- duty: S1 Continuous
- continuous- power factor: 0.8 at full load
- nominal voltage: Depends on the design load
- nominal frequency: 60 Hz
- nominal speed: maximum, 1800 rpm
- insulation: Class H
- temperature rise: according to insulation Class F
- anticondensation space-heaters

4.12.4.2 Harbor/Emergency Generator: One self-regulated, self-excited AC harbor/emergency generator driven by a diesel engine shall be installed in the engine room separated from the main generators.

The generator shall be designed in accordance with the following specification:

- output: kVA, in accordance with requirements
- duty: S1 Continuous
- power factor: 0.8 at full load
- voltage: 3 x 480 V
- frequency: 60 Hz
- speed, maximum: 1800 rpm
- anticondensation space-heaters
4.12.4.3 Transformer 480 V/ 208,120 V: Two transformers 480 V/ 208, 120 V - 60 Hz – AC for supply 208 and 120 V loads shall be installed. One transformer shall be fed from the main switchboard and the other one shall be fed from the harbor switchboard. Both transformers shall feed the 3 x 120/208 V - 60 Hz – three phase, four wire, AC system. Each transformer shall be sized to feed all the 120/208 V consumers with the other transformer de-energized. The transformer shall comply with the following specification:

- voltage primary 3 x 480 V (Δ – Delta)
- voltage secondary 3 x 208 V (L-L) /120 V (L-N) (Y - Star)
- frequency 60 Hz
- Type dry, air cooled type
- output kVA, as required by design plus a 25% over capacity
- taps ± 2 x 2,5%

4.12.4.4 Shore Supply Isolating Transformer 480V/ 480V: One transformer 480 V/ 480 V - 60 Hz - AC for supplying the main switchboard trough shore supply shall be installed with the following specification:

- voltage primary 3 x 480 V
- voltage secondary 3 x 480 V
- frequency 60 Hz
- Type dry, air cooled type
- output kVA, as required by design
- taps ± 2 x 2,5%

4.12.5 24 V – DC System: A 24 V DC system shall be provided for supplying navigation and communication, alarm systems, control systems, emergency lighting and other consumers. The 24 V DC system shall be fed from the 480 V AC main switchboard and from the 480 V AC harbor switchboard through transformer/ rectifier assemblies (charger units). The system shall operate so that one charger unit shall carry the entire load while the other is de-energized. One 24 V - DC lead acid accumulator system for marine use shall be provided. The charger units shall be executed as battery charger and DC supply rectifier unit with separated circuits and shall provide uninterrupted DC power supply and voltage limitation. The charger unit shall be complete with voltmeter, ammeters, alarm and status contacts, earth fault lamp, etc. The 24 V DC system shall have the necessary outgoing groups for the 24 V consumers.

4.12.6 Electrical Cables and Wiring: All cables shall be of an approved for marine shipboard environment. Cable insulation shall be in accordance with voltage levels. All electrical cables and wiring external to equipment shall be at least of a flame-retardant type. Cable terminals shall be properly insulated. Compression type cable glands of an approved type shall be used. Cableways of the ladder type shall be used. Power cables, control cable, alarm system cable and communication cables shall be contained in separated cableways from each other and shall be
identified by labels. Undesirable inductive effect in AC installations shall be avoided. The conductors of all phases of any circuit shall be contained in a single cable or conduit to neutralize induction.

For fixing the cables: seawater, oil, sunlight resistant (for exterior) and ozone proof nylon fixing strips shall be used. Corrosion treated steel cable fixing strips shall be applied on vertical cableways, every meter. The cableways shall be secured to bulkheads, fixed structures, etc. by means of welded strips and shall be properly grounded to the floating crane structure. Cables under floor plates in the machinery spaces or workshops, or cables that shall be protected in the floating crane pump room, shall be run entirely in grounded galvanized solid drawn steel pipes.

Cables on deck and other cables, which shall be protected, shall be run in corrosion-resistant painted, galvanized steel conduits intended for the use in marine environments, provided with plastic pipe ends on the inside end of the pipe and glands on the outside ends. Where cables have to be passing decks or watertight bulkheads, watertight passages shall be applied. Before entering boxes, switchboard, junction boxes, cables shall be marked with plastic markers according to the electric diagrams. All conduits connections shall be properly sealed to avoid moisture from entering.

“Pull Wires” shall be provided to facilitate the installation by ACP of other equipment as requested by the CO.

**Socket outlets for general use:**
In each covered space a number of 120V / 15 A socket outlets with format NEMA 5-15R for general use shall be provided. On deck 120VAC / 15 A with ground-fault protection, water tight sockets shall be provided. Every outlet exposed to severe weather conditions shall have weather proof protection. Ground fault protection shall be provided where outlets are placed in exterior, in wet areas or other locations required by the corresponding regulations.

A sufficient number of 480 VAC, 30 A, three phase, three wire water tight sockets shall be installed, in compliance with Class and IEEE 45.

A local area network (LAN) with CAT5 outlets in offices, mess rooms, workshops, observation house, and engine room shall be provided for computers network connection.

**4.12.7 Electric Distribution System:**

**4.12.7.1 Main Switchboard:** Shall be of a standard voltage available at the Republic of Panama and depending on the design load of the crane. The main switchboard shall be located in the Engine Room and shall be arranged in panels. On the top and rear the panels shall be provided with steel plates and on the front with lockable doors. The main switchboard shall consist but not be limited to:

a) One generator panel shall be provided for each AC main generator and fitted with:

- Hand operated generator power circuit breakers of the draw-out type with short circuit protection, reverse power protection, thermal overload relay as well as all necessary...
devices for operation and auxiliary contacts. The breaker shall be provided with signaling, indicating the reason of a trip.

- Earth fault detection unit with indicator (if required for ungrounded system).
- Signal lamp stand-still heater within generator.
- Ammeter with selector switch.
- Voltmeter with selector switch.
- Frequency meter.
- VA, Var, Watt, power factor meter.
- All generators shall have facilities for monitoring and alarms.

b) Outgoing feeders for the following loads:

- 480 V harbor switchboard interconnection.
- One transformer for the 120/208 V system.
- 24 V DC system through one transformer/rectifier assembly
- Isolating transformer for shore supply.
- Other loads as required.

The switchboard shall be equipped completely with the necessary fuses, terminals, relays, bus bars, wiring and other equipment for proper electrical operation. Electrical heaters shall be installed for humidity control.

4.12.7.2 Harbor/Emergency Switchboard 480 V: The harbor/emergency switchboard 480 V shall be located in the Engine Room separated from the main switchboard and shall be arranged in panels. On the top and rear, the panels shall be provided with steel plates and on the front with lockable doors. The switchboard shall consist but not be limited to:

a) One incoming panel for main switchboard interconnection:
   - Main circuit breaker with overcurrent protective devices
   - Status indicator
   - Ammeter
   - Voltmeter
   - VA, Var, Watt, power factor meter

b) Panel for harbor/emergency generator connection:
   - Circuit breaker with overcurrent protective devices
   - Status indicator
   - Ammeter
   - Voltmeter
   - frequency meter
   - VA, Var, Watt, power factor meter

c) Outgoing feeders for the following loads:

   - 480 V Consumers.
• One transformer for the 120/208 V system.
• 24 V DC system through one transformer/rectifier assembly.

The switchboard shall be equipped completely with the necessary fuses, terminals, relays, bus bars, wiring and other equipment for proper electrical operation. All remote controlled equipment shall be provided with an isolating switch, fitted at site. Electrical heaters shall be provided for humidity control.

4.12.7.3 80 V Motor Starters: Motor starters shall be principally integrated in the main or harbor/emergency switchboard, unless the starter is integrated in a system control box. Each fixed type motor starter shall be executed with push buttons for start/stop for local control, indicating lamps.

All controller or starters shall have a disconnect device (tag-out safety system). If the motor is out of sight of controller or starter, a push start/stop shall be provided at motor location and locking type disconnect device shall be located at controller or starter.

4.12.7.4 Power and Lighting Distribution Load Centers: Power and lighting distribution load centers shall be provided as necessary. Load centers shall be provided with main circuit breakers, circuit breakers for outgoing groups and at least four spares for outgoing groups.

4.12.7.5 Shore Supply Connection, Shore Cable and Storage Reel: A shore supply connection facility for 480 V – 60 Hz – (Amperes determined by design), 3 wires, shall be provided and connected to the shore supply section of the main switchboard – 480 Volts through an isolation transformer. The facility shall contain:

• main switch with fuses or main circuit breaker
• phase sequence meter
• terminals for shore cable connection

A shore cable with a minimum length of 50 m with connections and a storage reel shall be provided. For the shore connection, the cable shall be fitted with a plug for connection with a “pin and sleeve” type receptacle. The contractor shall coordinate with ACP and submit technical data for the plug selection.

4.12.8 Crane’s Control Cabin: The control cabin shall be designed in accordance with ergonomic demands and shall be adapted to the specific layout and equipment of the crane. The control cabin shall be provided with but not limited to:

• control and monitoring system for the crane operation.
• control and monitoring for spuds and spud carrier.
• audio/visual alarm devices notifying the operator of an alarm condition within the floating crane (e.g. general alarm, fire alarm, etc.)
• Radios and public address system
4.12.9 **Observation House:** The observation house, located above main deck, shall be designed as the principal area for monitoring the entire floating crane. The observation house shall be constructed to provide 360° visibility. The observation house shall be provided with but not limited to:

- monitoring system for the lifting operation.
- control and monitoring for spuds and spud carrier.
- floating crane’s equipment monitoring, control and alarm system (see section 4.12.11.1).
- control and monitoring of electrical power system.
- navigation and communication equipment (see section 4.13).
- main panels for alarm systems e.g. general alarm, fire alarm, etc.
- control and monitoring of spuds hydraulic power unit.

The observation house shall be provided with an ergonomic console for mounting the control, monitoring, audio / visual alarm devices. The console shall be completely wired and ready for connection. The console shall be designed for easy access to all components. A writing space shall be provided where suitable. There shall be adequate space for placing instruments e.g. HMI monitors and keyboards for control/alarm/monitoring and other systems, printers, telephones etc. The controls and instruments on the consoles shall be arranged in groups or banks, each bank containing all controls, indicators and instruments required to operate the individual equipment. The amount of controls, instruments and indicators, when practical, shall be kept to the necessary minimum.

4.12.10 **Equipment Control:** Equipment shall have disposition for local control. Equipment automatic or remote control shall be implemented in a second priority level, where required, through the floating crane’s equipment monitoring and control system (see section 4.12.11.1). Where automatic or remote control is provided, a switching scheme shall be implemented in the floating crane’s equipment monitoring and control system that will allow the selection between local (manual) control and automatic or remote control. The selection between local (manual) and automatic or remote control shall be performed at the location of the controlled equipment. The system shall be designed so that it will warranty safety of the floating crane crew.

4.12.11 **Control, Monitoring and Alarm Systems:**

4.12.11.1 **Floating crane’s equipment control, monitoring and alarm system:**
Distributed multi-processor system for acquisition and storage of measured data and monitoring and control of the floating crane’s machinery shall be provided. The system shall be dimensioned for:

- analogue input channels
- binary input channels
- an efficient number of analogue and binary output channels and 25 % spare channels (input and output)
- with following general functions:
  - connection of binary transmitters for normally closed or open operation
  - connection of analogue transmitter of Pt 100, thermocouples, 0-20 mA, 4-10 mA, 0-10 V
  - time delay of alarm signals
- suppression of alarm signals
- HMI monitor with a background drawing of the floating crane and showing the machinery conditions e.g. status, pressure levels, voltages, etc.
- selectable measured data representation with individual measuring point, measuring value, limit value etc.
- limit value monitoring
- correspondence procedure for changing means., point parameters
- alarm recording with printer
- system self-monitoring

The floating crane’s equipment monitoring and control system shall be PLC based consisting of a master unit located in the observation house and slave units at the main deck and crane control cabin. The process modules shall be designed for the acceptance and processing of binary and analogue signals from the sensors and perform output signals.

Programmable Master Controller (PLC):

- Shall be an open type, modular type, high speed, high performance, multi-tasking controller with chasis integrated or extended I/Os modules.
- Shall be proven, state of the art, technology.
- Shall be capable to control discrete and analog variables (inputs/outputs), batch and high speed movement control.
- The Programmable Controller and all the peripherals shall incorporate an open network communication protocol (Ethernet IP) interface to enable remote troubleshooting capability, and a serial port (USB) to allow both of them to communicate with other OEM products or to be configured remotely using a laptop computer.
- The PLCs shall support calculations or derived tags. Shall be designed for operation in 0°C to 55°C temperature in dirty and dusty environment and shall be immune to electrical noise. All modules in the PLC shall be hot swappable.
- All PLC modules, by means Digital Inputs, Digital Outputs, Analog Inputs and Analog Outputs shall have 25% spare space available.
- All signals shall be wired to terminal blocks with voltage suppressors.
- The PLCs shall use standard IEC 61131 graphical compliant programming language (Ladder Logic and/or Function Block).
- The new PLC systems will be fully programmed by the contractor to provide all existing functions.
- The PLC shall be fully compatible with the Variable Frequency Drive, and shall be capable to share the parameters between them.
- Shall include one set of the required development programming software for the controller, and the Variable Frequency Drives.

- All modules along the floating crane shall be interconnected allowing communication between them. This communication scheme shall be through a robust, high performance and standard network. The user’s system data shall be stored in non-destructive EEPROM memories.

Programming:
- All required programming shall be supplied and shop tested by the contractor prior to shipment to the jobsite.
- All programming will be made using “ladder logic”. The contractor may use function blocks in case there are subroutines in which the use of this language facilitate the operation, diagnostics and maintenance of the system.
- All the rungs of ladder shall be fully supported with detailed rung comments written in English.
- The program will be laid out in sections so that each section stands on its own and can be easily found in a program library.
- An advanced troubleshooting screen will be developed such that ACP maintenance personnel can easily view system inputs and outputs to determine the source of any malfunctioning device. Contractor shall make a draft submittal of all new Operator Interface screens and ladder program for coordination and approval prior to final programming.
- The PLC software shall provide control and monitoring of all the machinery associated from a local panel mounted human machine interfaces.
- The PLC software shall include all the required programming to communicate with the Main System control through the data acquisition servers, and other PLCs in the network for interlocking purposes.

All modules along the floating crane shall be interconnected allowing communication between them. This communication scheme shall be through a robust, high performance and standard network. The user’s system data shall be stored in non-destructive EEPROM memories.

Power supply: 24 V DC

As a minimum, the system shall control, monitor and generate alarms upon programmed values for the spuds and spud carrier (locally, from observation house and from crane’s control cabin).
An engineers’ alarm system shall be integrated with the floating crane’s equipment monitoring and alarm system. Upon an alarm condition, the floating crane’s equipment monitoring and alarm system shall notify it to the crew through the engineer’s alarm system. Audio/visual notification devices shall be installed, as a minimum, in the observation house, engine room, public spaces and where required by the Class, regulatory authorities and ACP. Number and place of the reset pushbuttons shall be in accordance with the requirements of the relevant authorities and ACP.

4.12.11.2 Audio Visual Signal Alarm System: For visual and audible alarm indication, in the engine area or other areas as required by the Authorities, a combined light signal call system according to IMO shall be provided.

The activation of the light column system shall be made via potential free contacts from the following systems:

- general alarm
- fire alarm system
- engineers’ alarm system
- CO2-alarm system
- automatic telephone

The number of audio visual signal alarms devices shall be as stated by the Class, regulatory authorities and ACP.

4.12.11.3 General Alarm System: A general alarm system shall be provided according the rules with a sufficient number of alarm devices and configurations (lamp and siren). The general alarm system shall be as stated by the Class, regulatory authorities and ACP.

4.12.11.4 Fire alarm system: A fire alarm system shall be provided according the Class rules with a sufficient number of lines and detectors. The system shall be of the type approved by the relevant Authority. The fire detection system shall be installed for the following spaces, as a minimum:

- engine room
- pump room
- hydraulic room
- electrical system room
- deck store
- office rooms
- work shops
- switchboard room
- alleyways in accommodation
- mess rooms
- hand call points as required
- other location as stated by the relevant authorities
4.12.12 Lighting System:

4.12.12.1 General: mainly LED lights shall be used.

4.13 Nautical, Navigation and Communications Systems

4.13.1 Automatic Telephone/Public Address System / Talk Back: Automatic fully electronic telephone installation shall be provided, suitable for not less than 20 extensions, with two talk possibilities at the same time, 5 priority calls, 1 general call and 3 group calls. The telephone system shall support VOIP (Voice over IP). It is recommended systems from Nortel, Avaya and Audio-Code, or similar approved.

The following telephones shall be installed, as a minimum:
- One (1) ea. flush mounted telephone, with handset in observation house
- One (1) ea. flush mounted telephone, with handset in ECR
- Telephones with handset or headset and fitted in acoustic booth with siren, mounted in:
  - engine room
  - electrical system room
  - hydraulic room
  - workshops
  - main store room
  - spud winches (as applicable)
  - other locations as required
- Five (5) ea. watertight telephones in stainless steel cabinet with built-on speaker, for mounting on:
  - One (1) at fore deck
  - One (1) at aft deck
  - One (1) at each barge winch (two in total)
  - One (1) near the crane
- One (1) telephone with handset shall be provided at each of the following spaces: floating crane operator cabin, observation house, captain office, chief engineer office, galleys, and mess rooms.
- One (1) ea. connection to the WiMax E system, enabling switching of incoming calls to any telephone on board, and enabling outgoing calls on a number of extensions.
- Telephone stations in technical spaces shall be provided with an external signal. This signal shall be connected to a relays box to which the lighting columns, rotating beam lights and signal horns of engine room alarm and monitoring system shall be connected.

Power supply: 120 V - AC, 24 V – DC back-up supply

A command/public address system shall be installed as a separate system and shall consist of:
- main station, mounted in the observation house with microphone and
- pushbutton
- amplifier

August 2017
Floating Crane Technical Specifications (Preliminary)
• speakers on locations as required by the Authorities and ACP

Power supply : 24 VDC

The telephone/ public address/ talk-back system may be provided as a combined system. The telephone and public address installations shall fulfill all relevant regulations.

4.13.2 Radio Communication System: The equipment shall be mounted in the floating crane as indicated and shall comprise the following equipment:

4.13.2.1 UHF Radio Telephones: Eleven (11) each 25-Watt half duplex UHF marine band (bandwidth: 450 – 520 MHz) radio telephones, complete, shall be provided (Reference: make Motorola, type PRO5100). The radios shall be located as follows; exact location shall be coordinated with ACP:

• Three (3) radios in the operator cabin
• Three (3) radios in the Observation house
• Two (2) radios in the Officers day room
• Two (2) radios for barge mooring winches (one at winch)
• One (1) radio at Captain Office
• One (1) radio at Chief Engineer

As a minimum, each radio shall consist of the following:

• transceiver unit with integrated DSC receiver modem with channel 70 watch keeping receiver and handset in holder
• whip antenna
• remote handset in the floating crane control console
• power supply unit 24V-DC/12V-DC
• power supply unit 120V-AC/24V-DC with automatic change over- interface.

4.13.2.2 VHF Radio Telephones: Two (2) VHF radios, complete, each 25 Watts, bandwidth 136-174 MHz, shall be provided (Reference: make Motorola, type PRO5100). The radios shall be located as follows; exact location to be coordinated with ACP:

• One (1) radio in the operator cabin
• One (1) radio in the Observation house

As a minimum, each radio shall consist of the following:

• transceiver unit with integrated DSC receiver modem with channel 70 watch keeping receiver and handset in holder
• whip antenna
• remote handset in the floating crane control console
• power supply unit 24V-DC/12V-DC
• power supply unit 120V-AC/24V-DC with automatic change over-interface.

4.13.2.3 **WiMax E System:** One CPE for the WiMax E system shall be provided in the observation house comprising:

- Transceiver control unit
- Interface with the telephone exchange
- Interface with the LAN switch
- Antenna

4.13.2.4 **Echo Sounder:** One dual channel hydrographic echo sounder, consisting of:

- one VDU, one keyboard and a graphic recorder unit fitted in the observation house, with the depth range of 2m up to 650m
- one 33 kHz transducer, mounted in the floating crane’s bottom
- one 210 kHz transducer, mounted in the floating crane’s bottom
- one control box
- two active echo sounding channels with digitization
- manual and automatic gain control
- manual and automatic switch-over of measuring range
- built-in clock and calendar
- Interface to lifting monitoring system.

4.13.3 **Signaling Devices:** The signaling devices shall be in accordance with IEEE 45, Panama Canal and Class rules requirements, shall be activated by the operator (unless otherwise indicated), and shall include but shall not be limited to the following:

4.13.3.1 **Whistle:** The vessel shall be outfitted with a maneuvering whistle to be arranged on the top of the observation house and crane’s cabin. The maneuvering whistle shall be 50 mm (2”) size, 134 dB with solenoid valve. A mechanical pull shall be arranged to bypass the solenoid valve to enable the Captain to activate the whistle from the observation house.

4.13.3.2 **Warning Horn:** The warning horn shall be audible for at least 1.6 km (1 mile). A mechanical pull shall be arranged to bypass the solenoid valve to enable the Captain to activate the horn from the observation house and crane’s cabin console.

4.13.3.3 **Warning Lights:** Warning lights shall be in accordance with Autoridad del Canal and Class rules requirements.

4.13.4 **Differential Global Positioning System (DGPS):** Furnish one on board receiver of global positioning system, comprising of:

- Display unit, fitted in the observation house
- GPS antenna/receiver unit
- UHF antenna/receiver unit for DGPS signal (frequency range: 450 – 470 MHz)
- Interface to lifting monitoring system and automatic control system
- Power supply: 24 V – DC
- Furnish one Land Reference Station with GPS antenna/receiver unit, including UHF transmitter and antenna
- Power supply: 24 V – DC.

4.13.5 Automatic Vessel Identification System (AIS):

The AIS transponder shall be Class A IMO type-approved (Reference: make Kongsberg, type AIS 200).

- The AIS transponder shall comply with the following standards:
  - ITU-R M.1371-1 Technical characteristics for a universal shipborne automatic identification system using time division multiple access in the VHF maritime mobile band.
  - IEC 61993-2 Maritime navigation and radio communication equipment and systems – Automatic Identification systems (AIS) Part 2: Class A shipborne equipment of the Universal Automatic Identification system (AIS) - Operational and performance requirements, methods of test and required test results.
- Separated VHF and GPS antennas for the AIS transponder.
  - The GPS antenna for marine use shall have enough gain to deliver a good signal to the GPS receiver according to the length of the antenna cable.
  - The VHF antenna shall be the type of a flexible whip for mobile application (3 dBd gain, ¼ wavelength). The antenna base shall be flexible (spring or compound), resistant to water and UV rays. It shall be possible to cut the whip to operate at 162 MHz. It shall handle a minimum of 50 W of RF power. Reference: Antenna Specialists ASP-7455 or similar approved.
  - Mobile antenna mount that fits on a ¾ inch hole, consists of a 1-1/8 inches, 18 thread mount, the cable is connected at a 90° angle from the mount, gold plated contact pin and brass nut ring, it mounts from the top of the hole. The mount shall come with a 17’ cable, no end-connector. Reference: Antenna Specialists / Maxrad NMO58AU-NC.
  - Shall provide manuals, softwares and passwords/keys required to install, program, configure, troubleshoot, and use the AIS transponder.
- Shall provide one year warranty on the equipment.
- Power supply: 24 VDC
• Shall provide a computer with the latest Intel CPU, 2GB Ram, minimum 160GB hard disk, RS-232C Serial Port, 19” LCD Display, Ethernet port, keyboard and mouse, UPS 120VAC /60Hz

• The computer shall be installed near the AIS transponder.

• The computer display shall be installed in the observation house.

4.13.6 Gyro compass: Furnish one gyro system, consisting of:

• Master compass for mounting in the observation house room
• Connection unit
• Interface to lifting monitoring system.
• Interface unit to the Automatic Vessel Identification System (AIS) and DGPS
• Power supply 24 VDC

4.13.7 Television and Broadcast Central Antenna System: A TV-AM-FM antenna system will be installed by ACP. The Contractor shall furnish ¾-inch conduits for the antenna cables from the exterior to the interior of the different locations. The Contractor shall furnish conduits for Observation House Room, Crew and Officers Mess Rooms, Chief Engineer Office, and Captain Office. The location of the terminals shall be as indicated by the Contracting Officer. The Contractor shall install the necessary antenna, cables and signal splitters as indicated by the Contracting Officer.

4.13.8 Racks, UPS and Other Equipment: The Contractor shall furnish 19” equipment racks as required to install equipment in the observation house. The Contractor shall provide UPS for computers and other sensitive electronics equipment installed in the 19” equipment racks.

4.13.9 Final Location of Equipment: The ACP will indicate on the drawings submitted by the Contractor, the location of the radio and navigation equipment (vessel automatic identification system), handsets, station selector, antennas and speakers, etc.

4.14 Crane:

4.14.1 General: The crane shall be installed on the bow end deck with specifications and shall meet the basic lifting performance as specified. The crane shall be designed and equipped to work continuously at maximum rating under the conditions specified. The crane shall be fully electrically driven, self-contained, pedestal mounted unit; modified by crane manufacturer for lifting/marine application, including corrosion protection features. The service life expectancy of the crane shall be not less than 60,000 hours. The boom crane and all its structure shall considered loads such as dead load, live load, wind load and other forces due to swing or list.

4.14.2 Crane Position and Lifting Monitoring System: The floating crane shall be equipped with a proven and latest Lifting Monitoring System that will continuously and effectively
show the graphical (at least top and side views) and numerical position information of the floating crane, and thus will allow the operator to work safely. As a minimum, the system shall:

- Provide accurate position data of the crane main hook relative to the pontoon and to a Reference World coordinate system (it shall be linked to the floating crane DGPS, gyro compass, and tidal data systems to obtain position and heading information)
- Provide position data from the spud carrier and the spud depth
- Provide working limit envelope alarms.
- Provide overload condition, shown on screen and with audible alarm sound.

As a minimum, the system shall consist of:

- A central processing unit fitted on the crane.
- An Input/Output unit fitted in the crane control cabin with double screen operator station
- A set of standard sensors to log motions and positions of the crane and attachments. Nevertheless, all sensors shall be of proven, rugged design, readily available in the market, and non-proprietary.
- Interfaces to position and heading reference sensors.
- CPU and flat screen color monitors shall be mounted on shock absorbers.

4.14.3 Specific requirements for the crane:

4.14.3.1 Mounting: The crane shall be mounted on foundation on the bow end deck of the pontoon. The foundation shall be oversized, torque-resistant and shall be designed to absorb shocks and stresses created by actions of the crane as well as forces generated by wave action and barge movements. The foundation shall be reliable and shall have a long lasting proven service (as the life of the crane). The foundation shall consist of a steel frame. Facilities shall be provided to seafasten the crane during sea transport. The pontoon foundation shall be machined as instructed by the crane manufacturer and shall be approved by the crane manufacturer before installation of the crane.

4.14.3.2 Main Components: The crane shall be delivered with, but not limited to, the following:

- Pedestal-slew bearing unit: The pedestal shall be the interface for the crane’s slew bearing. The slew bearing connects the pedestal with the revolving crane (360°).
- Main hook: The main hook shall be capable to be lowered on the deck at bow end; shall be capable to go under water up to 5m. Block speed shall be about 4.5 meter/minute @ 100% load.
- Auxiliary hoist which capacity shall not be less than 60 ton.

4.14.3.3 Safety systems: The crane shall be equipped with the necessary provisions for emergency shutdown. An emergency stop shall be installed on the counterweight. The design of the crane shall minimize the risk of fire. The crane shall be equipped with its individual, self-contained, independent automatic fire extinguishing system, which shall be working on 24-hour protection basis, at all times and conditions, even if the crane is shutdown, without an operator. The
The fire extinguishing system shall comply with applicable standards and regulations, such as NFPA17, and manufacturer’s requirements. The fire suppression system shall be the most appropriate fire suppression agent or combination of agents and the right quantity of agent needed for a given machine, under the operating and environmental conditions specified (Reference only: A combined powder/foam system with sufficient numbers of nozzles and adequate volume of dry and wet agent). The crane shall be equipped with devices to limit the swing angle, and mechanical stops as required.

4.14.3.4 Operator’s Cabin: The crane shall be equipped with a marine type, enlarged operator’s cabin sufficiently sized to accommodate, in addition to the crane operating and monitoring systems, the additional electronic lifting monitoring system, the pontoon spuds control systems (lifting and hoisting of spuds, and moving of spud carrier). The cabin shall be provided with an air conditioning system and shall be pressurized with filtered air. It shall be resiliently mounted and provided with good thermal insulation and optimum noise insulation. The cabin shall provide optimum visibility of the attachments as well as the instrument and control panels. Windows at the side of the cabin shall be sliding type, as far as practicable. Due to the marine environment, the crane manufacturer shall suit the construction and outfitting of the cabin for corrosion control and long lasting protection. The Contractor shall submit the layout of the operator’s cabin to the Contracting Officer (CO) for approval prior to its construction. The cabin shall accommodate one operator and one apprentice.

4.14.3.5 Service, Maintenance and Access: Access to the machinery and electric system shall be possible from the front and aft side of the crane. Service ladders, platforms and steps shall be provided on both sides of the boom to facilitate maintenance and inspection. Roof extensions and suitable rain shelters for heavy tropical rains shall be provided to a practical extent to allow the operator to reach in / out of the operator’s cabin, including the access stairs. The crane shall be provided with an automatic greasing system. All bearings of the attachment shall be greased automatically. For greasing these points, contractor shall furnish a suitably placed grease pistol with hose reel. The grease lines and injectors of the system shall be of stainless steel and properly sized. The automatic system shall also lubricate the swing ring teeth. The crane shall be fitted with a service station located at the front side of the machine to enable good access with the working attachment in service position on deck. Another service station shall be fitted on the pontoon near the crane service station. These service stations shall provide connections for lubrication, fresh water, emergency power, compressed air etc. Crane drip pan shall not drain overboard; shall drain into a piping connected to a dirty oil tank on the floating crane.

4.15 Electrical System: The system shall consider an expected service life time of not less than 12,000 hours. The system shall be redundant so if a component fails the other has sufficient capacity to safely hold the load. The electrical system shall be provided to withstand the marine environment, and the following degree of protection shall be provided as a minimum:

<table>
<thead>
<tr>
<th>Type</th>
<th>Protection Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Installations outside</td>
<td>IP 56</td>
</tr>
<tr>
<td>Electrical Installation in covered spaces</td>
<td>IP 54</td>
</tr>
<tr>
<td>Electrical distributor boxes</td>
<td>IP 65</td>
</tr>
</tbody>
</table>
An additional switch / connection shall be installed to supply shore power from the pontoon to the crane. The crane shall be provided with marine type working lights, inside and outside of the crane, including the machinery spaces, top of operator’s cabin, on the boom.

The electrical system shall be designed for severe marine tropical environment. The electrical system shall be designed in accordance with these specifications, and the requirements of applicable IEEE, NMEA, NEMA, NEC Standards or equivalents. The design, construction and testing of the system shall be such that a "maintenance friendly" installation is obtained with all components easily replaceable and within easy reach.

**4.15.1 General:** The floating crane shall be fitted with an electrical system for operation of major components that include but shall not be limited to the following:

a. Windlasses (at least 4 units: two at bow & two at stern)
b. Crane at full capacity

**4.15.1.1** Electrical components shall considered the environment characteristics to increase their lifetime.

**4.15.1.2** The auxiliary system also provides emergency power when the crane system fails. The power of the auxiliary system shall be sized to provide power for the following functions, however not simultaneously:

a. To operate the windlasses
b. To operate the deck crane at full capacity

**4.15.1.3** All electrical system, including crane equipment, shall be factory tested.

**4.15.2 Control and Working Modes:** The system shall be designed and fitted with electric control; this also applies to control of pontoon's functions from the crane's cabin. The electrical functions of the Floating crane shall be controlled by means of a PLC. Programmable software and manuals as well as the actual program for the PLC’s shall be delivered as part of documentation and a full printout of the function program shall form a part of the documentation. Special care and precautions shall be taken in case of malfunction of the PLC; e.g., individual local controls must be possible for the various components / functions in case the remote control fails. The control system shall consist of one master control system, located in the observation room, one slave control in the crane cabin and local controls. The master and slave controls shall have a panel with all required indicators, controls and alarms. A take-over and accept system for the control (Observation room / Crane cabin / Local) shall be fitted. The control system shall be fed by 24 V DC from the ships batteries. All solenoids shall be 24-Volt DC operated and shall be provided with a signal lamp and emergency hand operation. The electric control system cabinet shall be fitted in the electrical room. Various working modes and safeties shall be defined and programmed with at least the following modes and safeties:

a. Working Modes:
System configured for powering by crane electric system.
System configured for powering by Auxiliary electric system.
System configured for emergency feeding of crane.

b. Safeties:

- Alarms and auto stop on overload on main and auxiliary hoist.
- Alarms and auto stops on hydraulic oil temperature.
- Alarms and stops on oil level in hydraulic tank.

5. Special Tools, Testing Equipment and Spare Parts

5.1 Spare Parts for One Year of Operation and Critical Spares (Optional): Furnish critical spares as specified; and, spare parts package for at least one year of operation (estimated 2000 hours of operation per year).

5.1.1 Optional Spare Parts for One Year: Unless otherwise specified, optional spare parts shall include manufacturers recommended maintenance kits and components for at least one (1) year of operation. It shall include but shall be not limited to:

**Crane**
- Maintenance kits (for at least three years of operations)
- Joystick

**General Parts for the Floating Crane**
- As per manufacturers’ recommendations; for one year of operation.

5.1.2 Optional Critical Spares: Critical spares are major parts that have high value and long lead times. Optional critical spares shall include as a minimum:

**Crane**
- Sheaves

**Spuds**
- Hydraulic Motor
- Hydraulic Valve Blocks

Other manufacturer’s recommended critical spares
5.2 **Spare Parts and Tools List:** The Contractor shall provide a list with all spare parts and tools recommended for the floating crane by the various original equipment manufacturers for all machinery and equipment on the floating crane that will be required to assure continuous operation of the floating crane during 36 months. The floating crane will operate not less than 2000 hours per year. In addition, the Contractor shall indicate in the list those items that have a long-term delivery (more than six (6) months). The list shall be organized by systems and major components, and shall identify parts that are recommended by the manufacturers for routine maintenance and overhauls required for a 99% availability of the floating crane. It shall contain complete ordering information, including but not limited to: manufacturer’s name and address; part description and/or specification and identification; estimated cost; and cross reference to drawings and manuals. A first spare parts list shall be submitted to the CO not later than 12 months before delivery of the floating crane. This first list shall include, but not be limited to, the long-term delivery items and those that are required for the first year of operation of the floating crane. A second revised spare parts list shall be submitted to the CO not later than six (6) months before delivery of the floating crane and a complete, final spare parts list shall be submitted to the CO upon delivery of the floating crane.

5.3 **Special Tools and Testing Equipment:** The floating crane design shall not require the use of special tools or testing equipment for maintenance, unless the Contractor can prove, that they will provide significant advantages. Written evidence of this shall be submitted to the CO for approval prior to purchasing and manufacturing. The Contractor shall provide the approved special tools and testing equipment with the delivery of the floating crane at no additional cost to the ACP.

5.4 **IMO and SOLAS Outfits and Equipment:** The Contractor shall furnish and supply all loose IMO and/or SOLAS required outfits and equipment.

6. **Contract Planning and Execution**

6.1 **Project Management Plan:** Within 45 days after receipt of award, the Contractor shall submit to the Contracting Officer for his review a Project Management Plan in accordance with these specifications and the Project Management Institute guidelines or guidelines of an equivalent international recognized organization. The Project Management Plan shall contain but shall be not limited to the following Management Plans: Project scope, Schedule, Cost, Quality, Process Improvement, Staffing, Communication, Risk and Procurement.

6.2 **Planning and Progress of Work:** Within 45 days after receipt of award, the Contractor shall submit to the Contracting Officer for his review Project Schedule and the Schedule Baseline (Progress Chart) stating key events like but not limited to:

- Design
- Purchase major items
- Start steel fabrication
- Start assembling (keel laying)
- Launching
- Start commissioning machinery systems
- Sea trials and Floating crane trials
- Delivery
6.2.1 Engineering: The engineering phase of the project is considered of great importance to ensure the correct flow of information to and from all parties involved in the project, by which procurement of equipment and materials can take place and manufacturing proceeds as scheduled. As a minimum, the Contractor shall submit to the Contracting Officer for his review, updated design data and shop drawings and manufacturing data in accordance with these specifications. The Contractor needs not to wait for the Contracting Officer’s comments to continue with work.

6.3 Monthly Reports: A monthly Progress reports shall be submitted to the Contracting Officer for his review. Reports shall include but shall not be limited to all tests witnessed, inspections witnessed, correspondence received, observations, comments and recommendations. Each report shall be submitted within 10 calendar days of the subsequent month. An updated version of the Progress Chart shall be delivered to the Contracting Officer each month.

6.4 Meetings:

6.4.1 Post-Award Orientation: The Contractor shall attend a post-award orientation conference that will be held at the ACP within 30 days after the date of the Contractor's notification of award. The Contracting Officer will notify the exact date and location for this conference to the Contractor no later than 7 days prior to the date of the conference. The purposes of this conference is to ensure that the Contractor and the ACP personnel understand the contract requirements and the rights and obligations of both parties, and to clarify the roles of the various ACP personnel who will be administering the contract and the contract administrative procedures to be used. Specific subjects that may be addressed at this conference include:

- Special contract provisions;
- Specifications or other work requirements;
- Requirements for the Project Management Plan.
- Verification of Dimensions and Requirements: The Contractor shall visit the ACP to verify details of the work, working conditions and dimensions in the field and advise the Contracting Officer of any discrepancy before performing any work. The Contractor shall be specifically responsible for the conditions and proper relation of the floating crane design, construction, testing, delivery and operation to the Panama Canal structure. The Contractor shall also verify ACP existing equipment such as dump scow barges, heavy lift floating cranes and repair shops.

6.4.2 Intermediate Sixty Percent (60%) Design Review Meeting: The Contractor shall attend a sixty percent (60%) review meeting at the ACP that may be called by the Contracting Officer within 15 days after the ACP's receipt of intermediate designs submitted by the Contractor in accordance with these specifications. The exact date and location for the meeting will be coordinated with the Contractor by the Contracting Officer at least one week in advance.

6.4.3 Final Design Review Meeting: The Contractor shall attend a review meeting at the ACP that may be called by the Contracting Officer within 15 days after the ACP's receipt of final designs submitted by the Contractor in accordance with Paragraph 7.3.2 of these specifications. The
exact date and location for the meeting will be coordinated with the Contractor by the Contracting Officer at least one week in advance.

6.4.4 Meetings at the Contractor’s Plant (if applicable): By the time ACP inspectors and Contracting Officer's representative are at Contractor’s plants or yards, weekly meetings to review the progress of work shall be scheduled. The weekly meetings between ACP representative(s) and Contractor will in principle be held at the Contractor’s office. The Contractor shall make the minutes of meetings, which shall be send to ACP for review. ACP will return it’s remarks within one week to the Contractor. The Contractor shall at its expense furnish one or more competent field engineers fluent in English who shall assist in answering any questions, related to any and all work being done.

7. DOCUMENTATION AND DRAWINGS:

7.1 General: Whenever data as required below is for the Contracting Officer's comments or approval, the results of the Contracting Officer's review will be communicated to the Contractor within 30 days after the ACP's receipt of the required data. The Contractor shall react to Contracting Officer's remarks, within 14 calendar days or 10 working days.

7.2 ACP Proprietary Data Rights: The ACP will acquire full proprietary interest and unlimited nonexclusive rights on all the data produced by the Contractor under this Contract, including all plans, drawings, calculations and technical data thereon, except data corresponding to commercial components. The Contractor agrees and grants the ACP permission to reproduce and use the data submitted and to have or permit other parties to use them in the best interest of the ACP, for maintenance or replacement purposes. Any failure by the ACP to exercise or enforce such permission, including the acceptance of data, plans, drawings or technical data with Contractor’s restrictions for use of these data, shall not constitute a waiver of ACP’s right to reproduce and use the data submitted and to have or permit other parties to use them in accordance with this contracting clause. The ACP will use, duplicate and disclose the data in whole or in part, for the acquisition, independent operation, maintenance, repairs, and modifications of the equipment only, and will not engage in the commercial reproduction and sales of assemblies, components or parts. The ACP further agrees to make such disclosure to third parties subject to prohibition against further use and disclosure by the independent Contractor; however the ACP shall not be responsible or liable by any and all acts or omissions of third parties against such prohibition.

7.3 Review of Drawings and Documents: All drawings shall be fully detailed with:

- general arrangement of parts and systems,
- detailed drawings of all parts, with all dimensions and tolerances,
- full material and manufacturing specification of all parts,
- Full details and parts list of all components, etc.

All drawings and documents shall be made in the English and/or Spanish language. The metric system shall be used in all drawings and documents. Calculations shall be submitted simultaneously with the supporting drawings and diagrams to the Contracting Officer for review.
Drawings necessary for Class approval shall be submitted to Class for review and approval in a timely manner, to comply with the proposed delivery schedule. Drawings to be submitted to Class for review and approval shall be submitted to Contracting Officer for review as well. The Contractor shall incorporate ACP's remarks in the drawings and floating crane’s design, in accordance with the specifications. Items and arrangements not defined in the specification will be designed in close operation with ACP.

In case of alteration or modification of drawings, the Contractor shall submit to the CO the revised drawings for review. Review of plans, drawings and calculations does not relieve the Contractor of its responsibility for delivering a floating crane of good quality, performance, and efficiency and in full accordance with this specification and contract requirements. The Contractor shall be specifically responsible for the dimensions and design and the satisfactory completion of the work in accordance with the provisions of this Contract.

Of each plan reviewed or approved by Class and Authorities a certified copy shall be handed over to ACP, with eventual remarks. Drawings for components or work provided by subcontractors shall be submitted to the CO for review, prior to the manufacturing and construction.

7.3.1 Intermediate Design Data (approximately 60% of final design): Within 210 calendar days after receipt of award the Contractor shall submit to the Contracting Officer for his review, five (5) sets of intermediate design data prior to final designs and manufacturing. The Contractor shall provide to the Contracting Officer after receipt of award one copy of the latest Class Rules applicable for the floating crane. The Contracting Officer may disapprove the design data that does not comply with Class rules, regulations, and the requirements of these specifications. The design data shall include, as a minimum, technical design specifications and description of the system and components, design calculations, design drawings, diagrams, equipment and machinery data and performance, and material specifications, and equipment, machinery, outfits and installation manufacturers’ names (makers). In addition, approximately 60% completion design data shall be provided but shall be not limited to the following:

- Outline Specification
- Design General Arrangement Plan
- Crane equipment
- Machinery system, including systems diagrams
- Electrical installation
- Hull and superstructure: including but not limited to the following:
  - Weight estimation and Stability Calculation
  - Principal Strength check of Hull, complete
  - Hull Construction Plan, complete
  - Welding Details
  - Superstructure Construction Plans
  - Mid ship sections
- Auxiliary systems
- Deck equipment
- Piping systems
- Hydraulic system
• Spud systems, including Principal Strength check of Spuds
• Maker’s list

7.3.2 Final Design Data: Within 300 calendar days after receipt of award and after 100% completion of the design and prior to the keel laying and start of floating crane construction phase, the Contractor shall submit to the Contracting Officer for his review, five (5) sets of final design data. The Contracting Officer may disapprove the design data that does not comply with Class rules, regulations, and the requirements of these specifications. The design data shall include, as a minimum, technical design specifications and description of the system and components, design calculations, design drawings, diagrams, equipment and machinery data and performance, and material specifications, and all equipment, machinery, outfits and installation manufacturers’ names (makers). In addition, final design data for items indicated in paragraph 7.3.1 shall be provided. Final design data shall be complete and accurate and shall include but shall not be limited to the following drawings and data:

• General arrangement
• Mid ship section
• Hull Construction Plans with cross sections
• Shell of hull plating
• Arrangement of deckhouse and accommodations, with tri-dimensional geometry
• Deckhouse structure
• Tank arrangement plan
• Revised weight estimate
• Safety plan
• Electrical One-Line Diagram
• Arrangement drawing with cross and longitudinal sections, of the engine room
• Location of hatches and hatchways
• Arrangement of winches
• Insulation plan
• HVAC One-Line Diagram
• Plan of railings
• Visibility plan (from operators cabin)
• Bilge and Fire System Schematic
• Fuel Oil Schematic
• Freshwater System Schematic
• Sanitary System Schematic
• Machinery Cooling Schematic
• Machinery Exhaust Arrangement
• Navigation Light Plan
• Design Specifications / Calculations of Hull, Outfit, and Machinery
• Design Specifications / Calculations of Lifting Equipment
• Maker’s list
• Location of major electrical equipment
• Hydraulic System Schematic
7.3.3 **Material Safety Data Sheets:** The Contractor shall provide to the Contracting Officer a material safety data sheet (MSDS) for each type of insulation material, coating material, fuel oil and lubricant, before incorporating them in the design and/or construction of the floating crane. The Contracting Officer may request the MSDS for any other material used by the Contractor under this contract. In addition to the MSDS, the Contractor shall disclose the name, formula, and approximate percentage by weight and volume of each ingredient in each product; the results of any toxicological testing of the product; its pyrolysis products; and any other information as may be needed to permit an accurate appraisal of any problem associated with the handling, storage, application, use, disposal, or combustion of the material. A copy of a MSDS sample form is available at following URL link: [http://www.osha-slc.gov/dsg/hazcom/msds-sha174/msdsform.html](http://www.osha-slc.gov/dsg/hazcom/msds-sha174/msdsform.html)

7.3.4 **Shop Drawings and Manufacturing Data:** During the construction phase of the floating crane and prior to fabrication or construction, the Contractor shall submit to the Contracting Officer for his review, five (5) sets of data produced or required for the fabrication and construction of the floating crane and its components. The data shall include: shop drawings, specifications, quality control and testing procedures.

7.3.5 **Crane Design:** Within 240 calendar days after receipt of award the Contractor shall submit to the Contracting Officer for his review, five (5) sets of crane design data prior to final designs and manufacturing. The Contracting Officer may disapprove the design data that does not comply with Class rules, regulations, and the requirements of these specifications. The design data shall include, as a minimum, technical design specifications and description of the system and components, design calculations, design drawings, diagrams, equipment and machinery data and performance, and material specifications, and equipment, machinery, outfits and installation manufacturers’ names (makers). The Contractor shall design and specify the crane system and components only; the construction, testing and delivery of these components are not required. The ACP will decide on the use and implementation of the crane design.

7.4 "As-built" Drawings: Six weeks after delivery of the complete floating crane, all as-built drawings shall be delivered to ACP. After delivery of the floating crane a revised general arrangement plan shall be handed to ACP. Construction- and detailed drawings, which normally are handed over to the Contractor by suppliers for information, shall also be submitted to the CO for review.

7.5 **Reproducible Drawings:** Reproducible drawings shall be provided upon the delivery of the floating crane. The Contractor shall furnish to the Contracting Officer one complete set of reproducible tracings on 0.005 inch (0.13 mm), standard speed, black image, double matte drafting surfaces on both sides, dry erasable polyester film. Such drawings shall have a shelf life of at least 25 years and shall contain all details, dimensions, subassembly and assembly plans of the equipment, including complete material specifications and installation information, tolerances, mechanical and electrical properties, surface finishes, etc. Where functions of equipment components are indicated, a
complete control schematic diagram with control operations sequence description shall be provided. The tracings shall be to accurate scale and shall be suitable for reproducing sharp legible prints.

7.5.1 Components: The drawings provided shall include but shall not be limited to the following components:

- Generator diesel sets
- Diesel engines
- Electric motors
- Winches
- Overhead traveling crane
- Gearboxes

If requested so, ACP will provide a statement that above-mentioned drawings and documents will only be used in relation to the floating crane.

7.5.2 List of drawings: At least following drawings completed with detailed drawings shall be furnished by the Contractor upon the delivery of the floating crane:

- General arrangement
- Mid ship section
- Construction plan with cross sections
- Shell of hull plating
- All construction drawings of steel hull, of deckhouses, etc
- Welding table
- Tank testing plan
- Tank arrangement plan
- Docking plan, with position and number of docking blocks, docking plugs.
- Removal and replacement procedures for crane support
- Removal and replacement procedures for crane slewing bearing
- Safety plan
- Arrangement drawing with cross and longitudinal sections, complete with auxiliaries, all piping, cable ways, flooring, location of panels and starters, etc....with detailed drawings of following rooms especially:
  - Engine room
  - Funnels
  - Hydraulic pumps
  - AC rooms
  - Workshops
  - Stores
  - Emergency generator room
  - Fan rooms
  - Switch board room
  - CO2 room
• hatches and hatchways
• arrangement of winches
• arrangement of life saving equipment
• arrangement drawing of accommodation, ECR, with cross sections and view on walls
• all furniture
• walls and ceilings in accommodation
• plan of doors, hatches with key-number plan
• plan of windows, portholes, window boxes
• plan of floors
• insulation plan with details
• name and number plates
• warning plates
• accommodation color scheme
• arrangement of spare parts (onboard of the floating crane)
• arrangement of stores
• arrangement winches
• ventilation and AC plan
• ventilation and AC ducts
• air intakes and outlets with details
• Fire flaps with details (for closing ventilation ducts etc.)
• loose tanks, with appendages
• steel ladders, platforms and stairways
• arrangement of floors in engine room, pump room, store, ...
• plan of manholes
• plan of railings
• plan of marks (draughts marks, freeboard marks, ...)
• plan of cathodic protections
• paint specification
• masts
• rigging plan including cranes
• visibility plan
• galley arrangement
• antennae plan
• arrangement of generator sets
• arrangement of crane electric components
• hydraulic drawings
• drawings of all pipes, with passages and all details
• sea inlet chests with details
• all foundations
• crane track
• electrical drawings
including one line diagram, drawings for switchboard (elevations and wiring), routing of cabling within the floating crane, location of equipment, lighting fixtures, electrical outlets, panel-boards, etc., for complete electrical drawings
- machinery drawings without exception
- spud system drawings
- all approved drawings by Class and Authorities

All drawings shall contain enough information to enable the ACP to procure the different parts of the items.
Where necessary or demanded, the drawings shall be documented by the relevant calculation notes.

7.5.3 Mounted Drawings: The following schemes, colored when required, shall be made of resopal or gravoply and mounted in an approved location on board the floating crane:

- General arrangement plan
- Floating crane diagram
- Safety and fire fighting plan (one for the observation house, one for the crane operator’s cabin, and one for each accommodation deck).
- Maneuvering information and pilot card (Bridge poster)
- Bilge/ballast
- Block scheme No. 2 DIESEL OIL procedure
- Block scheme Sludge discharge
- Colored block scheme of all tanks
- A synthetic white board shall be placed against one of the walls of the engine room which the No. 2 DIESEL OIL tanks with the respective tank capacities are indicated complete with index for tank soundings.

7.6 Digital Computer Drawings: The Contractor shall furnish upon delivery of the complete floating crane four complete sets of the reproducible drawings, each on a CD-ROM medium. Six weeks after delivery of the complete floating crane, the Contractor shall furnish four complete sets of the as-built drawings, each on a CD-ROM medium. All computer drawings shall be in the latest AutoCAD file format.

7.7 Three Dimensional (3D) Model: The Contractor shall furnish upon delivery of the complete floating crane a complete 3D model, on a USB flash drive. Six weeks after delivery of the complete floating crane, the Contractor shall furnish a complete model including any modification on the real floating crane, on a USB flash drive. All 3D Models shall be in the latest STEP or IGES file format.

7.8 Documents and Manuals: Instructions and maintenance books, manuals, etc. of all machinery and installations shall be delivered in fourfold on paper. Final sets of instruction books and manuals shall consist of the following: One set of documents and manuals (4 copies) in the English language, or one set of documents and manuals (2 copies in the Spanish language and 2 copies in the English language), in the original execution as normally delivered by the OEM of the relevant items; and, one set (4 copies) in the English language and one set (4 copies) in the Spanish language of the
floating crane operation manuals. Two draft copies of each manual set (2 copies in English language and 2 copies in Spanish language, as applicable) shall be submitted to the Contracting Officer for review, at least 90 days prior to delivery of the floating crane. The Contracting Officer will return one copy of each draft with comments. The Contractor shall submit, for approval of the CO, two draft copies of each set (second draft) of the corrected manuals at least 30 calendar days before start of training at the Panama Canal. The Contracting Officer will return one copy of each second draft with comments. After starting on-site testing, but before final acceptance, the Contractor shall submit to the Contracting Officer the final sets of the approved instruction books and manuals. All the approved instruction books and manuals shall also be provided in a digital form (PDF or other) on CD ROM. Included documentation to be made by Contractor:

- Trim and stability book
- Damage stability book
- Sounding tables for all tanks

7.9 Major Purchased Components List: The Contractor shall submit for review by the Contracting Officer within 30 calendar days prior to the delivery of the floating crane, a list of all major purchased components that are installed in the floating crane. Four copies of list shall be provided in the English language and two copies on CD Rom in the Microsoft Access format (latest edition). The list shall include but shall not be limited to: the equipment type, manufacturer’s name and address, model number, description of component and estimated cost at the time of delivery. The major components list shall include any navigation and communication equipment supplied with the floating crane. Prior to the date of submittal, the list content shall be coordinated with the Contracting Officer.

7.10 Tonnage Measurement Certificate: An International Tonnage Measurement Certificate and computations shall be delivered with the floating crane. The tonnage of the floating crane shall be in accordance with the International Convention on Tonnage Measurements of Ships 1969.

7.11 Statutory Documents at Delivery: All necessary certificates and official documents as required by the Class and/or Statutory Bodies shall be supplied in duplicate on delivery of the floating crane. The documents to be provided at delivery shall include but shall not be limited to the following:

Builder’s Certificate
Class Certificates for hull, machinery and equipment
Safety Construction Certificate
Safety Equipment Certificate
Safety Radio Certificate
International Tonnage Certificate
International Loadline Certificate
Panama Canal PC/UMS Documentation of Total Volume Certificate
Certificates for nautical equipment and navigation lights
Certificate for medical equipment
Potable water Certificate
International Oil Pollution Prevention Certificate
SOLAS certificate of inspection. Only if applicable and required by Class and/or Statutory Bodies
Derating Exemption Certificate
Panama Maritime Authority Register
Approved stability booklet
Certified Ullage tables for fuel tank
Manual of the Floating Crane
Safety Manual
Maintenance Manuals
Asbestos free Certificate
Certificates for mooring equipment
Certificate for Fire fighting equipment
International harmless antifouling systems certificate IASC
Approved noise and vibration measurement report
External noise measurement report
All other certificates for materials/ equipment as required by Class and/or other Authorities

If final certificates are not available on the date of the floating crane’s delivery, the Contractor shall advise the CO in writing and provide provisional certificates to the CO for approval. For those cases where the CO approved provisional certificates, the Contractor shall provide the final certificates prior to the floating crane’s Final Acceptance by the ACP.

7.12 Quality Assurance, Testing and Inspection Plans:

7.12.1 Quality Control Plan (QCP): The Contractor shall submit to the Contracting Officer for his approval a detailed Quality Control Program (QCP) with the final design of the floating crane, and shall comply with it through all phases of this contract.

7.12.2 Testing and Inspection Plan (TIP): The Contractor shall submit to the Contracting Officer for his approval a detailed Testing and Inspection Program (TIP) prior to the procurement of materials and components, which shall include testing and inspection of the individual, floating crane components and the fully assembled floating crane. The program shall cover on-site inspection and testing, and shall include the applicable standards for inspection and testing. The ACP will witness inspections and tests.

7.12.3 ACP (On-site) Inspection and Testing Procedures: The Contractor shall submit to the Contracting Officer for approval prior to the delivery of the materials and components, testing procedures, which shall cover all inspections and tests, including operation tests. Inspection and tests shall be in accordance with Class rules requirements. The Contractor shall witness all on-site inspections and tests.

7.12.4 Quality Assurance, Testing and Inspection Monthly Progress Reports: Monthly progress reports for inspections and tests shall be submitted in accordance with Paragraph 6.3.
8. TESTING AND INSPECTION:

8.1 Testing and Inspection Procedures: The Contractor shall submit to the Contracting Officer, two months prior to testing, test procedures. The test procedures shall include, but not be limited to, shop tests of major floating crane components, welding tests, tank pressure tests, inclining, trim and stability tests, shop test and quay side test, spud system test, floating crane trials, acceptance test.

8.2 Inspection of Supplies and Deliverables: The Contractor shall provide and maintain an inspection system acceptable to the ACP covering supplies and deliverables under this contract and shall tender to the ACP for acceptance only supplies and deliverables that have been inspected in accordance with the inspection system and have been found by the Contractor to be in conformity with contract requirements, Class rules and regulations. As part of the system, the Contractor shall prepare records evidencing all inspections made under the system and the outcome. These records shall be kept complete and made available to the ACP during contract performance and for as long afterwards as the contract requires. The ACP may perform reviews and evaluations as reasonably necessary to ascertain compliance with this paragraph. These reviews and evaluations will be conducted in a manner that will not unduly delay of contract work. The right of review, whether exercised or not, does not relieve the Contractor of the obligations under the Contract.

8.3 Inspection by the ACP: The ACP will reserve the rights at any time for the inspection of the contractor facilities before and during the work performance. Contractor shall give access to workshops and berths, where work is being executed for the Floating crane. The ACP has the right to inspect and test all supplies and deliverables required for the contract, to the extent practicable, at all phases and times, including the period of manufacture, and in any event before acceptance. The ACP will perform inspections and tests in a manner that will not unduly delay the work. The ACP assumes no contractual obligation to perform any inspection and test for the benefit of the Contractor unless specifically set forth elsewhere in this Contract. The ACP has the right either to reject or to require correction of nonconforming supplies and deliverables. Supplies and deliverables are nonconforming when they are defective in material or workmanship or are otherwise not in conformity with contract requirements. The ACP may require the Contractor to remove supplies rejected or required to be corrected or to perform the work or service again in conformity with contract requirements, Class rules and regulations, at no increase in contract amount. If the Contractor fails either to promptly remove, replace, or corrected rejected supplies that are required to be removed or to be replaced or corrected, within a reasonable time after receipt by the Contractor of notice of defects or nonconformance, or when the defects in deliverables cannot be corrected by re-performance, the ACP may apply any of the applicable contract clauses related to contract nonconformance.

8.4 Non-destructive Examination: Non-destructive testing and X-ray photographs of welds shall be taken at locations indicated by Class.

8.5 Facilities to be furnished by the Contractor: If the ACP performs inspection or test on the premises of the Contractor or a subcontractor, the Contractor shall furnish, and shall require subcontractors to furnish, all reasonable facilities and assistance for the safe and convenient performance of these duties. As a minimum, a reasonable facility shall consist of a field office for at
least two people complete accommodated with telephone service, fax, photocopier, 2.0 GHz computer with Microsoft Office (latest edition), and E-mail connection (internet service), and climate controls (A/C and Heating), at the building and outfitting yard(s). The office shall be properly cleaned, lighted as appropriate, and shall be furnished with desks, chairs, letter and plan files, closet with clothes hooks. The office shall be located conveniently to toilet and shower facilities.

8.6 Testing and Inspection Reports: The Contractor shall furnish to the Contracting Officer for his review a report on all tests and inspections, showing in detail each test procedure and inspection results. Five copies of the certified test reports shall be submitted to the Contracting Officer in booklet form. Testing and inspection reports shall be in accordance with Class rules and regulations requirements, manufacturers’ recommendations, applicable recognized lifting and industry guidelines, and these specifications. The Contractor shall submit an Inclining Experiment Report to the Contracting Officer. In addition, the Contractor shall submit monthly reports in accordance with Paragraph 6.3.

9. TRAINING PROGRAM AND SERVICES: The Contractor shall provide training services in accordance with the training program proposed by the Contractor and accepted by ACP prior to award. The training shall include but is not limited to all the items contained in the operation and maintenance manuals.

9.1 Training Services: Training services shall start after the systems are functionally complete but prior to final acceptance tests. Instructors fluent in the English or Spanish languages shall conduct the training sessions for ACP personnel.

9.2 Training Program: The program shall emphasize the training of ACP personnel, including but not limited to operational crew, maintenance and technical support personnel and engineers. The program shall give ACP personnel a thorough understanding of the floating crane construction and the operation and maintenance procedures. The program shall be designed and integrated to ensure the development of skilled ACP personnel in the safe and efficient operation and maintenance of the floating crane. The ACP operational crew and maintenance support personnel and engineers will consist of personnel that have experience on this type of barges. The training program shall consist but shall be not limited to the following areas:

9.2.1 Equipment Training: This part of the program shall aim at but shall be not limited to the development of the theoretical and practical knowledge and skills related to the floating crane plant, including but not limited to: construction and functions of the components and systems, and interrelation of parts; operation, control and monitoring of all systems and safety procedures; flow of lubricants, hydraulic fluids, cooling fluids, fuel, compressed air, etc.; troubleshooting, maintenance, repair, and overhaul procedures. Part of the program (not less than 60%) shall be conducted at the plant of the crane manufacturer and/or at the construction yard where the crane will be mounted on the pontoon, and shall take place at the final phase of construction, during start up and commissioning stages as required by the approved training program. The program shall consist of at least 15 workdays, 8 hours per day, for each target group. The Contractor shall cover the expenses for lodging (hotel) and all transportation at the place of training for not less than 250 man-days.
9.2.2 **Practical Onboard Training:** This part of the program shall relate to but shall be not limited to the development and improvement of the operation and maintenance skills of the ACP personnel while working onboard the new floating crane under the supervision of different Contractor specialists, including but not limited to: floating crane master, automation/control engineer, and electrical and mechanical service engineers. This part of the program shall be conducted at ACP’s Dredging Division in Gamboa and onboard the floating crane during actual lifting in the Panama Canal. The training shall consist of at least 15 workdays, 8 hours per day, for each target group.

10. **Tests and Trials:**

10.1 **General:** The tests and trials shall be at the Contractor’s expense and shall be made in the presence of the Class, CO and/or COR (Contracting Officer Representative). All testing and trials shall be completed to the satisfaction of the CO. All materials, supplies and parts of assemblies or systems under this Contract shall be tested in the presence of the class, CO and/or COR. Where the CO waives his or the COR’s presence at such tests, the test reports and certified copies of the tests shall be furnished to the CO. Except as otherwise indicated in the Contract, the cost of all tests and trials, exclusive of the expense incident to the presence of the CO or COR, shall be borne by the Contractor. The Contractor shall provide all parts required for the floating crane trials. Any damage or failure of any parts, equipment or systems during test trials shall be promptly repaired by the Contractor at the Contractor’s expense.

10.2 **Test Program:** The Contractor shall prepare a detailed test program. Within one week, after completion and testing of all systems, test reports shall be submitted in booklet form showing all field tests (readable and comprehensible) performed to prove compliance with the performance criteria of each system. Each test report shall indicate the final performance, compliance of each system and shall be handed to ACP in four copies.

10.3 **Factory Tests, Dock Trials:**

10.3.1 **General:** The Contractor shall submit to the Contracting Officer for his review all instruction books, drawings and specifications at least eight weeks before testing or trials commence. The Contractor shall submit a testing plan to the Contracting Officer for his approval, at least eight weeks prior to the commencement of the tests. Authorities and ACP’s representatives shall be invited to attend the tests. The plan shall include the following tests:

- Shop tests of all major floating crane components.
- Complete program of floating cranes trials.
- Complete program of quay testing.
- Complete program of floating cranes sea trials

As much as possible, shop tests shall be arranged at subcontractor premises. During sea trials the Floating crane shall be manned by a master and crew nominated and paid by the Contractor. The costs of trials shall be for account of the Contractor.

10.3.2 **Launching:** The Contractor shall be responsible for the satisfactory launching of the floating crane at such time as mutually agreed upon by the parties, based on the
production schedule. Launching shall be at risk of the Contractor. If damage of any kind including but not limited to damage to hull, appurtenances or paint, occurs the Contractor shall promptly repair such damage.

10.3.3 Inclining Test: With the Floating crane's ballast tanks empty, other tanks as far as possible empty and the floating crane in a state as complete as practicable an inclining test shall be held in the presence of an ACP's representative and a surveyor of the Class. The test shall be held with the floating crane in sailing condition.

10.3.4 Responsibility: Contractor shall be responsible for any damage during testing.

10.4 Lifting Test and Inspection: The test shall be performed by the Contractor under ACP's Inspector guidance. During this test the floating crane shall make at least three steps using its spuds. It shall lift different weights, at different distances. The ACP shall issue a Final Acceptance Certificate after the satisfactory completion of this test and inspection.

11. Delivery, Onsite Installation, and Acceptance:

11.1 Delivery: The floating crane shall be delivered DAP Republic of Panama at the Contractor's expense to the Port of Balboa (Pacific Ocean) or the Port of Cristobal (Atlantic Ocean), within 24 months after award of the Contract complete and ready for operation. The Contractor shall deliver the floating crane fully assembled, and in a seaworthy condition in accordance with Class and applicable regulations. It shall be delivered in a semi-submersible vessel from the building site to the place of delivery. The floating crane shall not be delivered by towing from the Contractor’s site to the place of delivery. The Floating crane shall be delivered with almost empty storage tanks, complete with equipment, tools and other items, which are described in this specification. Spare parts, tools and inventory as being delivered by the Contractor in accordance with this specification and as far normally delivered by the various manufacturers shall be transported and placed or fitted on board and securely stowed, where possible, in a position adjacent to their use in case of heavy items; small items and parts are stowed in standard plastic container boxes, suitably labeled, complete with list of components. The boxes are stored in steel racks. Suitable racks (as described in the relevant sections) are provided for stowage of spare parts that cannot be conveniently boxed. The entire floating crane shall be properly cleared cleaned and fixed up. The ACP will tow the floating crane from the port of arrival to the Dredging Division in Gamboa, Republic of Panama for the lifting inspections, tests and final acceptance.

11.2 On-site Installation: After arrival of the floating crane at ACP’s Dredging Division, the Contractor shall conduct within eight (8) calendar days any required re-assembly; preliminary testing and support prior to the start of ACP field-testing of floating crane capabilities. The Contractor shall be responsible for all ACP equipment furnished after delivery to the Contractor.

11.3 Acceptance: Following the delivery and on-site installation of the floating crane, and after the completion of the Equipment Training (paragraph 9.2.1), the completed floating crane will be field tested for 30 calendar days minimum in the Panama Canal waterway. The Contractor shall provide the required expert personnel and all parts required for field tests. Field-testing outages caused by the Contractor or its equipment failure shall not be considered as part of the 30-day field testing.
An outage that exceeds 48 hours shall require the restarting of the 30-day field-testing period. The Contractor shall be responsible for all cost incurred due to restarting the 30-day field-testing. In the event of any damage or failure of any parts that includes but is not limited to systems, engines, pumps etc, during field-testing, Contractor shall promptly repair such damage at the expense of the Contractor. The Contractor shall provide the service of engineers and technicians as required during this period of time, for support and repairs. Upon successful completion of field testing and when the floating crane performance is deemed satisfactory, the Contracting Officer will issue to the Contractor a Certificate of Final Acceptance.

11.3.1 Damages Prior to Final Acceptance: If at any time prior to final acceptance of the floating crane, the Contracting Officer (CO) or Contracting Officer’s Representative has reason to believe the floating crane has been strained, grounded or in any manner damaged or that the underwater portion has been seriously impaired, the floating crane shall be dry-docked and repaired at the Contractor’s expense. If no damages or other impairments are found, the dry-docking will be at the expense of ACP.

12. Warranties and Technical Support

12.1 Warranties: The Contractor shall give warranties for the design, materials, workmanship of the floating crane and equipment supplied.

12.1.1 Initial Warranty: Notwithstanding inspection and final acceptance by the Contracting Officer of the floating crane and equipment furnished under the contract or any provision of this contract concerning the conclusiveness thereof, a warranty shall be given by the Contractor for a period of 365 calendar days, beginning from date of final acceptance of the floating crane that the floating crane assembly and equipment shall be free from any defects in design, materials, and workmanship, and shall conform to the specifications and all other requirements of this contract. The warranty set forth in this paragraph shall be referred to as the "initial" warranty period.

12.1.2 Manufacturer's Warranty: Warranties issued by other manufacturers of equipment supplied under this contract, which exceed the Contractor's warranty referenced in the paragraph above, shall be transferred to the ACP by the Contractor to continue with full force and effect until the end of the manufacturer's warranty period. Such warranties shall be submitted to the Contracting Officer’s prior to on-site inspection and testing of the floating crane assembly.

12.1.3 Extended Warranty: Repairs or replacements made in accordance with paragraphs 12.1.1 and 12.1.2 of this warranty clause shall also be warranted by the Contractor to free from any defects in design, materials, and workmanship for an additional period of 365 calendar days following the date of completion of such repairs or replacements. The warranty set forth in this paragraph shall be referred to as the "extended" warranty period.

12.1.4 Contractor's Liability: In the event of a breach of warranty, in the Contracting Officer's notice to the Contractor directing it to take corrective action, the Contracting Officer will establish a reasonable period of time for the Contractor to correct the breach. If within five (5) working days after the notification of the Contracting Officer's directions for correction, the Contractor fails to initiate positive action to correct the breach, the ACP may correct it by any means the Contracting
Officer deems appropriate, and the Contractor shall be liable to the ACP for the costs of correcting such a breach. Latent defects shall be covered by the Contractor, even do, the warranty period expired.

12.2 Technical Support (After Warranty Expiration): The Contractor shall provide technical support services in accordance with the Technical Support Plan proposed by the Contractor and accepted by the ACP prior to award. The technical support services shall be available after the date of expiration of the warranty period for the floating crane, and for the period indicated by the Contractor in its plan. The plan shall be developed to provide continuous and prompt response to the ACP in case of malfunctioning, doubts on operation, spare parts or maintenance, or any other consultation of technical nature related to the floating crane. The Contractor shall guarantee a minimum of five years of service support on all equipment.

13. PROGRESS PAYMENTS AND TRANSFER OF PROPERTY

13.1 Payment Schedule: The ACP will make seven progress payments to the Contractor as follows:

13.1.1 First Payment: The first payment for the floating crane shall become processed after receipt of award by the Contractor, and after the order for the crane and major equipment with longer delivery times has been placed by the Contractor, as certified by the CO, and shall be 10% of the Contract price.

13.1.2 Second Payment: The second payment for the floating crane shall be 5% of the Contract price; provided, however that the Contractor has been paid the first 10% of the contract price (the first payment). It shall become due after 80% of steel for the hull construction have been delivered and received at the building yard, and relevant basic design drawings have been approved / reviewed by the CO; and after actual construction of the vessel has started (keel laying); and after the order for major machinery and equipment (diesel engines, generators, winches, electrical installation) has been placed, as certified by the CO.

13.1.3 Third Payment: The third payment for the floating crane shall be 10% of the Contract price; provided, however that the Contractor has been paid the maximum of the contract price under the first and second payments and further provided the Contractor has completed the construction and installation of 50% of the total calculated weight in tons of all hull and superstructure steel, as certified by the CO, and that the main generator sets are fitted in the hull. Hull in this case includes all structures along with spud casings and spud carrier.

13.1.4 Fourth Payment: The fourth payment shall be 10% of the Contract price; provided, however that the Contractor has been paid the maximum of the contract price under the first, second, and third payments and further provided that the Contractor has completed satisfactorily the testing of the crane at the factory and has received the crane complete, with all the attachments, at the building yard, as certified by the CO.

13.1.5 Fifth Payment: The fifth payment for the floating crane shall be 15% of the Contract price; provided, however that the Contractor has been paid the maximum of the contract price under the first through the fourth payments and further completed satisfactorily the launching
of the vessel, 100% Construction and Assembly, Factory Testing, Inspection, and Successful Trials (basin and sea trials) at the building yard, as certified by the CO.

**13.1.6 Sixth Payment:** The sixth payment shall be 20% of the Contract price; provided, however that the Contractor has been paid the maximum of the contract price under the first payment through the fifth payments and further provided that 100% of the Delivery required under the Contract—as determined in accordance with the prorating schedule shown in paragraph 13.3 of this clause—has been accomplished by the Contractor and accepted by the CO.

**13.1.7 Seventh and Final Payment:** The final payment for the floating crane shall be 30% of the Contract price; provided, however that the Contractor has been paid the maximum of the 70% of the contract price authorized through the previous six payments, and further provided that the final testing and inspections in Panama—as determined in accordance with the prorating schedule shown in paragraph 13.3 of this clause—has been accomplished by the Contractor and accepted by the Contracting Officer. The final payment shall become due within 30 calendar days after the following conditions are met:

a) Delivery, testing and final acceptance in the Republic of Panama of the floating crane.

b) Training services as specified has been delivered to the ACP

c) Delivery of all certificates, reports, drawings and instruction manuals, if applicable, to the Contracting Officer.

d) Final payment for this contract shall be withheld, until all certificates, drawings and instruction manuals are in the possession of the ACP.

**13.2 Transfer of Property:** All material and work covered by the progress payments, including all drawings or tracings furnished or those of modifications made or required by these specifications, shall thereupon become the sole property of the ACP, but this provision shall not be construed as relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work, or as a waiver of the right of the ACP to require the fulfillment of all the terms of the Contract.

**13.3 Prorating Schedule:** The following prorating schedule shall be used for the purpose of determining the percentage of construction work as stipulated in the paragraphs of this clause:

<table>
<thead>
<tr>
<th>Table 6. Payment Prorating Schedule</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Submittal of documentary and written official evidence of procurement of fabrication reservation slots of major components, including but not limited to the complete crane, and any major equipment with long delivery times, as required under the Contract.</td>
<td>10</td>
</tr>
<tr>
<td>2 After the following has been satisfactorily accomplished as required under the Contract: a) Eighty (80%) of steel for the hull construction have been delivered and receipt at the building yard, and</td>
<td>5</td>
</tr>
</tbody>
</table>

August 2017
Floating Crane Technical Specifications (Preliminary)
b) Hull design drawings and data have been submitted and approved / reviewed by the CO; and

c) Actual construction of the vessel had took place with the placement of modular hull components at the slipway or drydock (keel laying); and

d) After submittal of documentary and written official evidence of procurement for major machinery and equipment (diesel engines, generators, winches, electrical installation).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>a) After 50% of construction of hull and superstructure *(Shall be considered as the construction and installation of at least 50% of total calculated weight in tons of all hull and superstructure steels as determined and verified by the CO )</td>
</tr>
<tr>
<td></td>
<td>b) Procurement and Installation of Main Generators Sets on board</td>
</tr>
<tr>
<td>4</td>
<td>a) After satisfactorily completion of factory testing of the crane, as required under this Contract, and</td>
</tr>
<tr>
<td></td>
<td>b) After receipt of the complete crane, with all attachments, at the building yard, as required under this Contract</td>
</tr>
<tr>
<td>5</td>
<td>After Launching and 100% Construction and Assembly, Factory Testing, Inspection, and Successful Trials (at the Contractor’s building yard)</td>
</tr>
<tr>
<td>6</td>
<td>Delivery in Panama, DAP Port of Balboa or Cristobal</td>
</tr>
<tr>
<td>7</td>
<td>Final Inspection, Testing and Acceptance – at Gamboa, Rep. Panama; After training, delivery of reproducible as-built drawings; operation and maintenance manuals. After final acceptance.</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
</tr>
</tbody>
</table>

14. ATTACHMENTS
The documents in the following list are part of the specifications:
- Attachment No. 4 Neopanamax Cross Section
- Attachment No. 5 Lower Trackway Maintenance