Part VII – Technical Specifications

Contents

Chapter 1 General Provisions

1.1 Introduction

1.1.1 This document (or "Technical Specifications" or "TS" or "Part VII") sets out the requirements of the Government in relation to one (1) unit aluminium alloy catamaran vessel (viz., "Vessel") for use by the Environmental Protection Department ("EPD" or the "user department").

1.1.2 Unless otherwise specified in the Technical Specifications, all the specifications stated in this Part VII of the Tender Documents are classified and labelled as follows:

a) Essential Requirements **[E]**;

b) Desirable Specifications **[D]**; and

c) Those specifications which are without any label (viz., **[E]** or **[D]** shall equally form part of the Contract like the specifications labelled as **[E]** ("specifications without label")

1.1.3 All Essential Requirements and Specifications without Label shall form part of the Contract. For Desirable Specifications, to the extent the Contractor has committed to comply with them in its tender, they shall also form part of the Contract. As part of the tender evaluation during the tendering stage (viz. Stage 1 of the evaluation – completeness check), the Tenderer shall submit all the information sufficiently detailed to substantiate that the product and the services offered meet the Essential Requirements as stipulated in this Part VII (viz., specifications with **[E]** label) and repeated in Annex C to Part II - Conditions of Tender, failing which its tender will not be considered further. For those Specifications without Label, where there is any proposal or evidence to show that the tender does not comply with these specifications, the Tenderer's tender will not be considered further. Commitment to comply with the Desirable Specifications will equally form part of the Contract.

1.1.4 Neither the Essential Requirements nor the Specifications without any Label may be counter-proposed by the Tenderer. Any contravening counter-proposal shall be dealt with in accordance with Clause 17 of Part II – Conditions of Tender.

1.1.5 All specifications forming part of the Contract in the aforesaid manner shall be of equal materiality and importance upon the award of the Contract. The non-compliance with any specifications set out in these Technical Specifications shall have the same consequences as specified in the Contract. Save during the tendering stage in the manner as mentioned above, no differentiation shall be made based on the classification unless otherwise expressly specified.

1.1.6 The Vessel shall be Ready for Use before the Delivery Date and delivered by the Delivery Date as per the schedule stipulated under Schedule 2 – Delivery Schedule of Part V - Schedules.

1.1.7 Unless otherwise expressly defined in the Contract, all technical terms and expressions used in this Part VII shall be interpreted in accordance with the professional or common usage in naval architecture, marine engineering, nautical navigation and the shipbuilding industry. Where design specifications of the Vessel or any Equipment are required to be approved by the specified Recognised Organisation ("RO"), they must be approved by the RO as well as by the Government New Construction Section ("GNC") of the Marine Department ("MD") prior to the construction of the Vessel or installation of that Equipment on the Vessel.

1.1.8 Where design specifications of the Vessel or Equipment are not required to be approved by the RO, they must be approved by GNC prior to the construction of the Vessel and installation of the Equipment on the Vessel. This applies regardless of whether this is stated to be the case in the relevant individual provisions.

1.1.9 For the avoidance of doubt, references to "tests" throughout the Tender Documents and the Contract shall include all inspections, surveys, assessments, trials and experiments.

1.1.10 Without prejudice and in addition to the interpretation principles set out in Clause 1.2 of Part IV - Conditions of Contract, the following interpretation principles shall apply when interpreting the Tender Documents and the Contract including this Part VII:

a) references to "Chapter" or "Paragraph" or "Annex" refer to the chapter of or the paragraph of or the Annex to this Part VII;

b) quotation marks may or may not be added for each defined term whether with or without brackets; a defined term may be identified with quotation marks and brackets, or just quotation marks, or just brackets;

c) the use of article "the" may or may not appear before a defined term or an abbreviated term; there shall be no difference whether the term is preceded with or without the article;

d) a defined term may have two or more versions (typically a longer version and an abbreviated version) (e.g. "Factory Acceptance Tests" or "FAT"); or may still be referred to by the original description of the subject matter based on which the term is defined; the original description, or the longer version of the defined term, or the shorter version of the defined term may be used interchangeably. For clarity's sake, the original description, or the longer version may be used for more self-explanatory purpose; however, there shall be no difference;

e) where a subject matter has been defined with two or more alternative terms of reference, any one of these terms of reference may be used interchangeably;

f) a defined term may appear earlier than the provision in which it is defined; a term defined will have the same meaning throughout the document;

g) there shall be no difference between a term with a hyphen and the same term without a hyphen (e.g. "sub-system" or "subsystem");

h) titles and headings may appear in lower case or upper case throughout or only in upper case with the first word at the beginning; there shall be no difference in meaning;

i) headings and titles do not affect the construction of the Tender Documents and the Contract;

j) a sub-Section of this Part (at whichever sub-level and regardless of the numbering system adopted) may begin in upper or lower case and may be ended with semi- colon or full stop; these differences do not have any interpretation significance on their own;

k) figures may be expressed in Arabic numerals or in words; or both; there shall be no difference; three zeros in a figure may or may not be separated by any space or comma; there shall be no difference;

l) Where more than one unit of a subject matter is to be supplied as part of the Work, all requirements stated to be applicable to that subject matter shall apply to each such unit of that subject matter. This is regardless of whether the term "each of" or other cognate expression is used preceding that subject matter. This principle shall apply including without limitation where the subject matter is the Vessel and the Equipment on each Vessel.

1.2 Statement of Purpose of the Vessel

1.2.1 The Vessel is primarily to be used by EPD for monitoring water quality, surveillance purpose including collection of water, sediment, planktonic and benthic samples, the handling of emergency incidents, special surveys or investigations on an as-needed basis, conducting public relationship and educational purpose within Hong Kong waters.

1.2.2 In addition, the vessel will also be equipped with scientific equipment on board to monitor air quality whilst at sea.

1.2.3 The Contractor acknowledges and agrees that the Government relies on the professional judgment and skill of the Contractor to ensure that the Vessel is compliant with all of the aforementioned requirements and warrants that it will alter, modify or otherwise change aspects of the Vessel's fittings, fixtures, user interface as required by the Government in order to ensure the ultimate fitness for purpose of the Vessel before the Acceptance Certificate is issued.

1.3 Authorities

1.3.1 The Government New Construction Section (GNC) of the Marine Department (MD) is the section responsible for the procurement of the Vessel for the Government of the Hong Kong Special Administrative Region (HKSAR) of the People's Republic of China (hereinafter referred to as the Government).

1.3.2 GNC may delegate the supervision work including plan reviewing work during the construction stage to private consultancy firms to act on behalf of the Government.

1.3.3 The Electrical and Mechanical Services Department (EMSD) is the Department which will oversee the Communication Equipment and Electronic Navigation Equipment ("ENE") technical acceptance.

1.4 Shipyard

1.4.1 The Contractor's nominated shipyard building the Vessel must have the essential shipbuilding and workshop facilities such as lifting gear, hull construction and calibration equipment, machinery installation and calibration equipment and vessel launching or slipping facilities.

1.4.2 The Contractor shall employ a team of professional staff with experience in designing aluminium catamaran vessels and in carrying out supervision and quality control work in the course of Vessel construction.

1.5 Design and Construction Responsibility

1.5.1 The Vessel shall be designed and constructed for a service life of at least 15 years under reasonable maintenance.

1.5.2 It is the SOLE responsibility of the Contractor to supply the Vessel which is safe, fit and suitable for the operation of the user department and which meets all the relevant regulations and the specifications in this Part VII including the desirable specifications (if and to the extent the Contractor has indicated compliance in its tender), which include without limitation requirements for safety, health, environmental protection, hull form design features, structure, method and materials for construction and fitting out, stability, sub- division and operational efficiency.

1.5.3 Unless otherwise expressly specified in this Part VII, references to "RO" in this Part VII shall mean, in the case of the Vessel, the Recognised Organisation as specified in Schedule of Part V - Schedules for the Vessel. References to "RO Requirements" (in upper or lower case) shall mean, in the case of the Vessel, the requirements of the rules and regulations of the aforesaid RO as specified in Schedule 9 of Part V. References to the International Maritime Organization requirements ("IMO requirements") shall mean the latest and as amended requirements published by the International Maritime Organization ("IMO") and available on its website and applicable to the relevant subject matter in the relevant paragraph where it is required that IMO requirements shall be complied with provided that where the IMO requirements are of any convention or resolution or other multilateral treaty of the IMO (including any amendment thereto), Hong Kong has joined in as a party to such IMO requirements.

1.5.4 The vessel shall be issued with a Certificate of Classification with notations by the RO specified in Paragraph 2.3.2 of this Part VII.

1.5.5 Notwithstanding the submission of the preliminary plans and drawings by the Contractor then as part of its tender for the Contract, all plans, and drawings of the Vessel except the design stresses and scantling, shall be submitted to GNC for approval before completion of the Vessel design. The design stresses and scantling including internal structural members shall be approved by the RO.

1.5.6 The Contractor shall design, build and supply the Vessel in full compliance with the requirements given in this Part VII which, to that extent, may be over and above what is normally required by any statutory and RO's rules and regulations. Should there be any contradiction between the rules and regulations of the RO and this Part VII, the more onerous shall prevail unless GNC stipulates or agrees otherwise.

1.5.7 Even if the Contractor may appoint a Sub-contractor to design the Vessel with the prior written consent of the Government, the Contractor shall not be relieved of its obligations under the Contract through such appointment, and the Contractor shall be responsible for all acts, defaults, and omissions of the sub-contractor as if they were its own.

1.6 Survey and Inspection

1.6.1 Tenderers shall note that the unit price per Vessel quoted in Schedule 1 – Price Schedule in Part V - Schedules shall be deemed to have included the cost of surveys to be carried out by the relevant RO in respect of that Vessel (if required to be arranged by the Contractor under the Contract).

1.6.2 All electronic items and their installations shall be approved and inspected by EMSD representatives as part of the Technical Acceptance.

1.6.3 Subject to Paragraph 1.6.7 of this Part VII, an advance written notice of not less than five (5) working days (if the Vessel is located in Asia), and ten (10) working days (if the Vessel is located other than Asia) must be given to GNC before the representatives of GNC and other Government officers are invited to conduct a survey visit of the Vessel. The Contractor shall be fully responsible for any delay if the Contractor fails to give adequate notice as aforesaid.

1.6.4 The Contactor shall provide:

a) an Implementation Timetable, in the form set out in Annex 2 to this Part VII, setting out the major milestones and their scheduled completion dates and incorporating the Delivery Dates specified in Schedule 2 of Part V.

b) the Drawing Submissions Timetable in the form set out in Annex 3 to this Part VII; and

c) the Main Items Inspection Timetable in the form set out in Annex 4 to this Part VII.

Each one of the above shall be submitted to GNC for approval by the respective deadlines specified in Clause 11 of Part IV - Conditions of Contract.

The Delivery Date for the Vessel as stated in the Implementation Timetable shall be no later than those set out in Schedule 2 of Part V - Schedules. Notwithstanding anything in the Contract to the contrary, the Government may suspend payment of any of the instalment specified in Schedule 3 of Part V - Schedules if any of the timetables required herein has not been submitted for GNC's approval or GNC does not approve any of them or if the progress of work does not comply with any of them as approved by GNC.

1.6.5 A weekly work progress report with photos evidencing the progress and material/equipment procurement status shall be submitted to GNC during the construction of the Vessel. The weekly report shall be submitted before noon of every Monday.

1.6.6 GNC may designate consultant(s) from private sector who will be authorised to represent the GNC in all technical matters including site supervision and plan approval related to the construction of the Vessel ("GNC consultant"). The Contractor shall cooperate with the GNC consultant and afford it unhindered access to the Vessel at all times during working hours, and shall furnish it with current copies of all approved drawings, sketches, correspondence, change notices, change orders, test agendas, schedules etc. For the Main Items Inspection Timetable set out in Annex 4 to this Part (even in the version approved by the Government), the GNC consultant will further elaborate such timetable by including and expanding on these items into an on-site supervision programme ("Programme"), and which Programme shall be deemed to form part of the Contract and superseding Annex 4 (even in the aforesaid approved version) in the event of any inconsistency where the Programme is more detailed than Annex 4 to this Part. All these inspections, tests and trials must have been performed to the satisfaction of the Government before the Vessel may be shipped to Hong Kong (unless it is expressly stated in Annex 4 to this Part that certain items shall be performed in Hong Kong as part of the Delivery Acceptance).

1.6.7 After arriving at the site for a survey visit, if MD officer(s) consider it is unsafe to carry out the test or inspection, the test/inspection will not be carried out. The Contractor shall arrange another additional survey visit at the Contractor's expenses. The Government shall not be responsible for any delay arising from any postponement in conducting the survey visit due to any safety issue as specified in this paragraph.

1.6.8 Where any fee charge and associated expense are payable for the services of an RO which are necessary in order to fulfil any obligation of the Contractor under the Contract, the Contractor is responsible to pay the RO all such fees, charges and associated expenses. Such fees shall include charges for drawing approval, surveys (if deemed necessary), issue of certificates, and any other expenses payable to the RO.

1.6.9 The Contractor shall provide office space for MD officer(s) and EPD officers during their survey visits and construction progress visits to the Vessel at the shipyard where the Vessel is constructed. The office space shall include, but not be limited to, two (2) desks, six (6) chairs, one (1) telephone, one (1) conference table for 10 persons, drinking facilities, power supply and one (1) cupboard for storage of documents and working clothes. The space provided by the Contractor shall also be fitted with air conditioning, have Internet access, a copying and a printer machine. Cleaning of the space shall be carried out in each working day.

1.6.10 The hours of work of MD officer(s) or EPD officers will be arranged to coincide with those of the shipyard, in so far as it is practicable to do so. It is intended that all reasonable steps be taken so that the duties of the MD officer(s) and consultants can be carried out with a maximum of efficiency and a minimum of interference with the Contractor's work.

1.7 Acceptance and Delivery

Acceptance of the Vessel (including all Equipment) shall be carried out in two (2) parts:

a) Technical Acceptance

b) Delivery Acceptance

1.7.1 Technical Acceptance

Technical Acceptance comprising all of the following tests and trials specified in three stages as further specified below:

a) Stage 1: This Stage 1 includes two (2) parts. The first part requires the satisfactory inspection, test and trials by the GNC consultant of all items covering the hull and superstructure of the Vessel including Items H-1 to H-21 as listed in Annex 4 to this Part VII. In addition to and without prejudice to the foregoing, the second part is as follows: If and after the GNC consultant's confirming acceptance of all of the aforesaid items (or such other timing as considered appropriate by the Government), the officers of GNC and the users of EPD will make visit to the shipyard to make inspection of the hull and the superstructures of the Vessel. The Contractor may not proceed to the next stage until both parts of this Stage 1 are satisfactorily completed as confirmed by GNC.

b) Stage 2: This Stage 2 includes two (2) parts. The first part requires the satisfactory inspection, test and trials by or in the presence of the GNC consultant of all items covering the remaining parts of the hull and superstructure of the Vessel including from Item H-22 of Annex 4 to this Part VII onwards as well as all items set out under the heading of "Machinery and Electrical Installation" in Annex 4 to this Part VII. They notably include the inclining experiment mentioned in Paragraph 3.5.4 of this Part VII and the sea trial to be performed in the nearby waters of the shipyard. The tests to be performed as part of the sea trial of Stage 2 shall include all such tests and trials as specified in Paragraphs 2.13.5 and 2.13.6 of this Part VII except that they shall be performed in the nearby waters of the shipyard. Separately and in addition to the first part, the second part covers the following: if and after the GNC consultant's confirming acceptance of the items up to such stage of EM-2 (viz the main engines), the officers of GNC and the user department will make visit to the shipyard to make inspection of the machinery and electrical installation of the Vessel including participating the inspection and function test of the main engines, as well as other major equipment on a random basis. The Contractor may not proceed to the next stage until this Stage 2 is satisfactorily completed including the aforesaid visit as confirmed by GNC consultant.

c) Stage 3: This includes all the tests and trials to be conducted in Hong Kong Waters after shipment of the Vessel to Hong Kong. The Contractor shall be responsible for all costs in keeping the Vessel in Hong Kong whilst this stage of the Technical Acceptance is conducted. These tests and trials shall include without limitation equipment tests, the Official Speed Trial as mentioned in Paragraph 2.13.5 of this Part VII, all of those tests and trials as specified Paragraph 2.13.6 of this Part VII, the acceptance test for ENE as mentioned in Chapter 13 of this Part VII, the Functional Test in Hong Kong, and all other tests whether as specified in this Part VII or otherwise necessary to determine

whether or not the Vessel including the Equipment has been supplied in accordance with all the specifications set out in these Technical Specifications

d) As mentioned above as part of Stage 2 or Stage 3 (where applicable), all units of all ENE items and their installations shall be approved and inspected by EMSD as part of the Technical Acceptance including the Functional Test in Hong Kong as mentioned in Chapter 13 of this Part VII.

e) The Contractor shall supply all necessary equipment and labour at its own cost for carrying out the tests and trials comprised in the Technical Acceptance.

f) If the Vessel cannot pass each of the tests, inspections and trials comprised in the Technical Acceptance by the applicable date specified in the Implementation Plan, the options available to the Government are set out in Clause 12 of Part IV - Conditions of Contract and other applicable provisions of the Contract.

1.7.2 Delivery Acceptance

a) The Vessel, after its successful completion of Technical Acceptance, and the Spare Parts as specified in Schedule 1 of Part V, shall be delivered at the Contractor's expense to the Government Dockyard. In accordance with the applicable Delivery Date as specified in Schedule 2 of Part V. If the delivery of the Vessel in Ready to Use condition is 120 days later than the Delivery Date specified in Schedule 2 of Part V, at the discretion of Government, the Contract may be terminated according to the applicable terms stipulated in the Contract.

b) Certificate of classification for the Vessel with notations as specified in Schedule 9 of Part V shall have to be issued by the RO as specified in Schedule 9 of Part V before the Acceptance Certificate can be issued by the Government.

c) The Delivery Acceptance of the Vessel shall be carried out by GNC in accordance with the terms stipulated in the Contract. The Delivery Acceptance is only completed when the Acceptance Certificate is issued by the Director of Marine.

d) The Contractor must demonstrate to MD/GNC that all hull construction, outfitting, Vessel stability, machinery, electrical and electronic equipment are in good working order; and must hand over the Vessel, its fixtures and Equipment to GNC in good and complete condition.

e) Not later than six (6) weeks before the Delivery Acceptance of the Vessel, the Contractor is required to submit to GNC four (4) copies of the Inventory List covering all items of or relating to the Vessel including all engines, on board equipment, manuals, documentation, spares, stores, and equipment for testing in respect of the entire Vessel. The Inventory List shall be approved by GNC seven (7) days before the day of Delivery Acceptance and covers everything which the Contractor is required to deliver under the Contract. At the Delivery Acceptance of the Vessel, the approved Inventory List will be used to check that all the items have been delivered to GNC in a satisfactory state. Details of each inventory item shall include: item name, description, type, quantity, manufacturer’s name and contact details, part reference number and/or serial number, and the items’ locations in the Vessel.

f) The items specified in Paragraph 16.2 of this Part VII, all items listed in Annex 7 to this Part VII, all items set out in the Inventory List in the form as approved or stipulated by the Government, and all other items which are required to be delivered under this Part as part of the Delivery Acceptance shall be delivered to GNC as part the Delivery Acceptance of the Vessel. The Contractor must provide fourteen (14) days advance notice in writing for Vessel delivery when the Vessel is considered to be completed in

accordance with the Contract and Ready for Use and to be delivered for the Delivery Acceptance. The Government will not accept delivery if after undergoing the tests and trials in the Technical Acceptance, the Government does not consider that the Vessel is in Ready to Use condition.

g) On delivery, the Vessel must be in a clean, tidy and fully fitted and operational condition.

1.8 Warranty Services During the Warranty Period

1.8.1 Notwithstanding and without prejudice to the Contractor's obligation to provide the Warranty Services for the Vessel under the Conditions of Contract, the original copy of the manufacturer's warranty certificates and all related manuals and documents in respect of all the Equipment valid for 12 months from the date of unqualified Acceptance Certificate of the Vessel, shall be delivered to MD upon Delivery Acceptance.

1.8.2 The full scope of the Warranty Services is set out in Annex 1 to this Part VII.

1.8.3 The Contractor is responsible for arranging the Vessel for Guarantee Slipping at the end of the Warranty Period (and if there is any extension of the Warranty Period for the entire Vessel, GNC has to right to decide whether the Guarantee Slipping shall be done at the end of the original Warranty Period before any extension, or at the end of the extended Warranty Period.). In addition to any defects which the Contractor may be required to fix as part of the Warranty Services as stated in Annex 1 to this Part VII, the Contractor shall also be responsible for the rectification of any defects found in the course of Guarantee Slipping. The full scope of the Services to be provided as part of the Guarantee Slipping is set out in Annex 1 to this Part.

1.9 Support Services

1.9.1 The Vessel must be designed for through life support and easy maintenance in the HKSAR based on an operation profile and minimum life expectancy as mentioned in this Part VII.

1.9.2 The above applies not only to main engines but also to all other equipment installed in the Vessel. Support and maintenance services must be available (i.e., serviceable) in Hong Kong in respect of all equipment installed in the Vessel and return of the whole or part of the Equipment to the original place of manufacturer or supplier shall not be necessary in order to carry out any repair work.

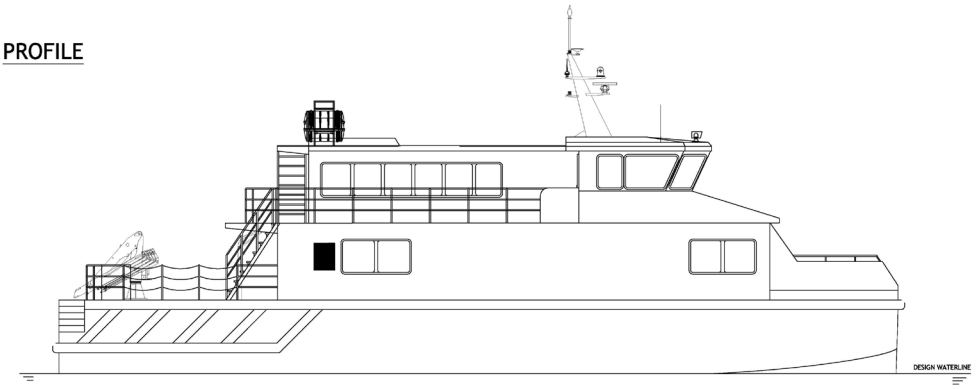
1.10 Asbestos Free

1.10.1 The Vessel must not contain any asbestos or asbestos containing materials. The Contractor must comply with the Hong Kong Air Pollution Control Ordinance (Cap. 311), Part X. The Contractor shall engage a service supplier approved by one of the RO or other entities acceptable by MD to verify that there is no asbestos on the Vessel. An asbestos free certificate or a statement of compliance issued by the service supplier to this effect shall be provided upon delivery of the Vessel.

Chapter 2 General Technical Requirements

2.1 Conceptual General Arrangement Plan

PROFILE



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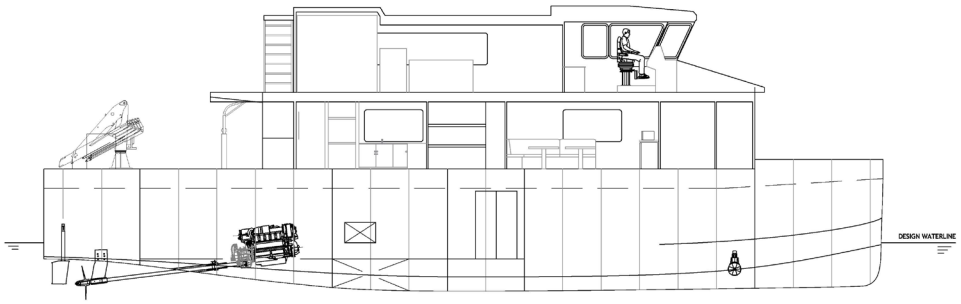

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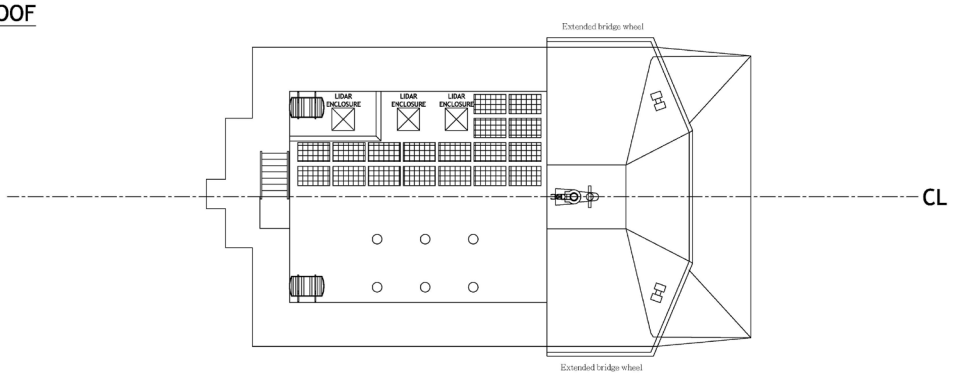
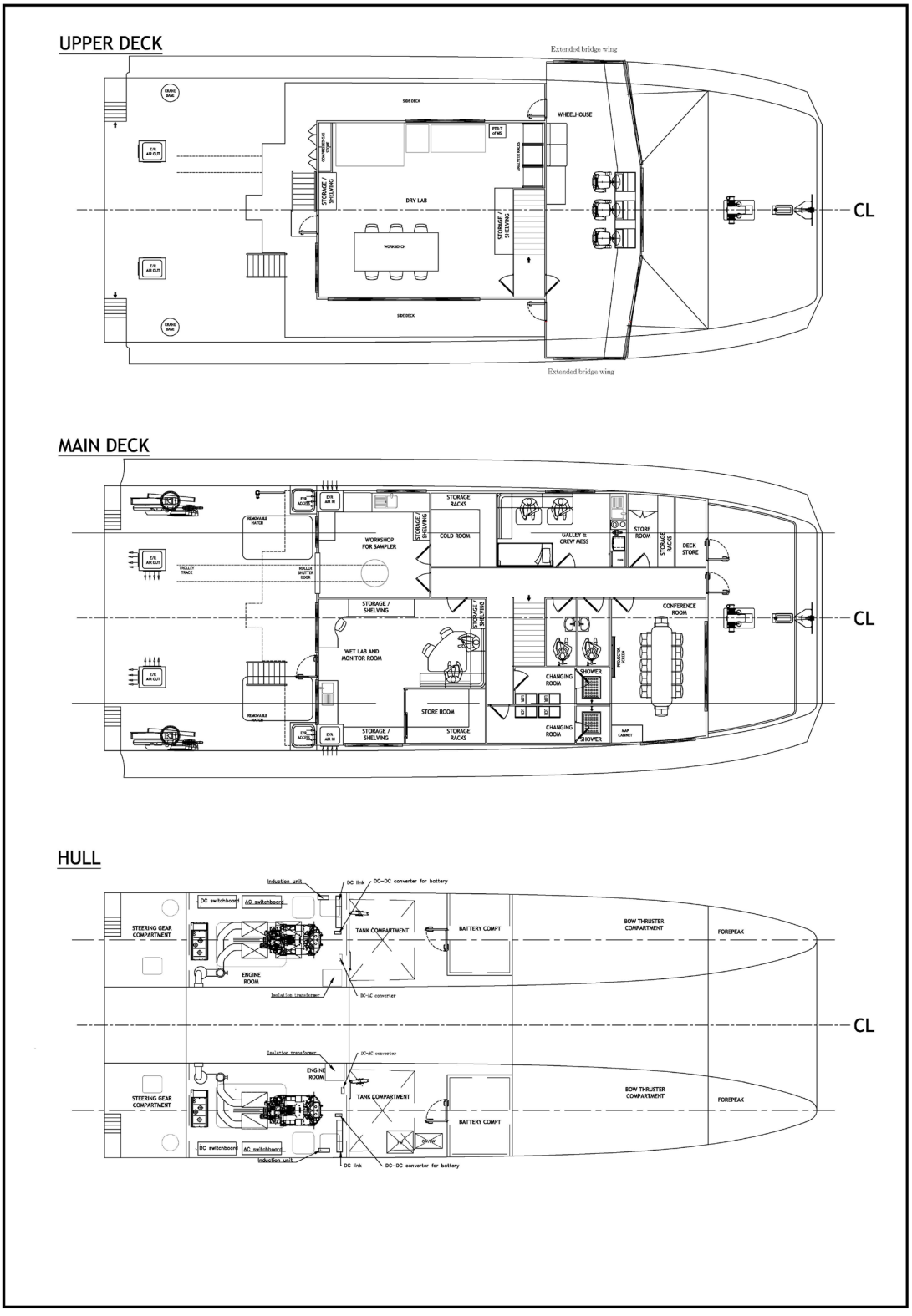



UPPER DECK
Extended bridge wing
WHEELHOUSE
DRY LAB
STORAGE / SHELVING
WORKBENCH
CL
Extended bridge wing
MAIN DECK
WORKSHOP FOR SAMPLER
COLD ROOM
STORAGE RACKS
GALLEY & CREW MESS
STORE ROOM
DECK STORE
CONFERENCE ROOM
WET LAB AND MONITOR ROOM
CHANGING ROOM
SHOWER
STORE ROOM
CL
HULL
Induction unit
DC link
DC-DC converter for battery
DC switchboard
AC switchboard
STEERING GEAR COMPARTMENT
TANK COMPARTMENT
BATTERY COMPT
BOW THRUSTER COMPARTMENT
FOREPEAK
ENGINE ROOM
Isolation transformer
DC-AC converter
CL

2.2 General Provisions

2.2.1 Without prejudice to the generality of Chapter 1, this Chapter contains the more particular technical specifications for the Vessel. The significance of Essential Requirements is explained in Paragraph 1.1 of Chapter 1 of this Part VII above.

2.2.2 The work to be done under this contract consists of the design, construction, outfit, testing and delivery of one (1) Aluminium Vessel for the EPD. Workmanship, functions, characteristics, and performance shall be in accordance with this Part VII, best marine construction practices, and the regulatory standards herein specified or otherwise applicable.

2.2.3 The Contractor shall exercise its professional expertise and knowledge to come up with an appropriate design for the Vessel which can comply with all requirements of the Contract. The Conceptual General Arrangement Plan shown above ("Conceptual General Arrangement Plan") is a reference drawing to help to explain the tender requirements. The Contractor shall submit its own design in details for MD's approval.

2.2.4 During the design and construction of the Vessel, the Contractor shall submit a detailed General Arrangement Plan ("GA Plan") and all relevant construction drawings for GNC's approval and acceptance. As for the preliminary General Arrangement Plan which has to be submitted during the tendering stage in Schedule 7 ("Preliminary General Arrangement Plan"), unless the Government otherwise directs, the GA Plan to be submitted after the Contract award shall incorporate those features set out in the Preliminary General Arrangement Plan. Requirements in these Technical Specifications that the General Arrangement Plan shall follow the "Conceptual General Arrangement Plan" in this Part VII shall be changed to follow the Preliminary General Arrangement Plan instead if in the opinion of the Government, the relevant aspect of the Preliminary General Arrangement Plan submitted by the Contractor is better than the Conceptual General Arrangement Plan, but not otherwise.

2.2.5 All the machinery, equipment and facilities, furniture, fixtures, and fittings, including outfitting of the Vessel that are described in this Part VII, together with their requirements for design and installation standards that are stipulated in this Chapter and in any other parts of this Part VII, are the items that must be included in the complete "As-built" Vessel delivered to the Government.

2.2.6 It is desirable that the Preliminary General Arrangement Plan to be submitted by the Tenderer shows improvements over the Conceptual General Arrangement Plan over such functional aspects in Assessment Criterion in Part (A)(I)(a) of Annex D - Marking Scheme to Part II – Conditions of Tender.

2.3 Rules and Regulations

2.3.1 The Vessel shall be designed and constructed in accordance with the latest edition of the rules and regulations of the Recognised Organisation as specified in Schedule 9 of Part V. By latest edition, it is meant the latest edition as at the keel laying date of the Vessel. The Tenderer shall state in Schedule 9 of Part V - Schedules which RO (to be selected from the definition of "Recognised Organisation" in Clause 1.1 of Part IV - Conditions of Contract) and its rules and regulations that shall be used in the design and construction of the Vessel.

2.3.2 The Vessel is required to be issued with certificate of classification (without conditions) as in Schedule 9 of Part V - Schedules by the RO. All plans, particulars and documentations which are required for the classification of the Vessel, in addition to those listed in Annex 3 to this

Part VII shall be approved by the RO before submission to GNC for endorsement and final approval prior to commencement of work. Any subsequent modifications or additions are to be treated in the same manner.

2.3.3 Without prejudice to the general requirements that the Contractor shall perform all Work in full compliance with all applicable laws and regulations, and in full compliance with the requirements of the Contract including this Part VII, the construction of the Vessel must comply with the rules, regulations, standards, and recommendations of the entities as specified below:

a) International Electro-technical Commission ("IEC") Regulations for the Electrical and Electronic Equipment.

b) International Telecommunications Union recommendations in the International Radio Regulations ("ITU-R").

c) Quality and standards of the welding shall comply with the rules of an RO or American Welding Society ("AWS") or other applicable international standards or rules acceptable by MD.

d) International Regulations for Preventing Collisions at Sea 1972, as amended by IMO.

All equipment/fittings shall be designed and manufactured to at least the standards as specified in these Technical Specifications. When none of the rules and regulations in this Part VII are applicable, then the applicable standards specified by the applicable organizations below shall be complied with:

- BSI British Standards Institute
- GB Standardization Administration of the People's Republic of China
- IEEE Institute of Electrical and Electronic Engineers
- ISO International Organization for Standardization
- JIS Japanese Industrial Standards

The Contractor shall design, build and supply the Vessel in full compliance with the requirements given in this Part VII which, to that extent, may be over and above what is normally required by any statutory and RO's rules and regulations. Should there be any contradiction between the rules and regulations of the RO and this Part VII, Part VII shall prevail unless GNC stipulates or agrees otherwise.

2.4 Certifications

The Vessel shall be issued with following certificates:

a) Certificate of Classification with notations by the RO;

b) An ASBESTOS FREE Certificate or compliance statement in accordance with the Hong Kong Air Pollution Control Ordinance (Cap. 311), Part X;

c) Trim and stability booklet (approved);

d) Damage stability booklet (approved); and

e) Builder's Certificate.

2.5 Principal Dimensions

The Principal Dimensions of the Vessel shall be:

Length Overall (maximum):	26.4m	**[E]**
Breadth (maximum):	10.5m	**[E]**
Draft (maximum):	1.6 m	**[E]**

The air-draught of the vessel shall not exceed 14 m.

"Length Overall" means the distance between the foreside of the foremost fixed permanent structure (included fender) and the aft side of the aftermost fixed permanent structure of the Vessel, outboard motors, and motor brackets, handles and other fittings, attachment and extensions are not included in the measurement.

The Tenderer shall indicate the length overall of the Vessel in Dimension scale in General Arrangement Plan submitted according to Schedule 7 of Part V.

2.6 Structural Materials

Material of Hull Structure: Marine grade aluminium alloy **[E]**

Material of Superstructure: Marine grade aluminium alloy **[E]**

2.7 Propulsion System

2.7.1 The Vessel shall be propelled by parallel hybrid drivetrain system, with a battery system onboard to allow for zero emissions operation and boost up the Vessel speed if necessary. **[E]**

2.7.2 The Vessel shall have one (1) hybrid drivetrain in each hull. Each drivetrain shall comprise fixed pitch propeller driven, via reduction gearbox, by marine diesel engine and also Electric motor-generator (E-motor) powered by the Energy Storage System with Batteries.

2.7.3 The port and starboard propulsion systems shall be identical from the same manufacturer, and of the same model and deliver the same horsepower and have all the other specifications identical with each other.

2.7.4 The detail of hybrid system is as specified in Chapter 14.

2.8 Vessel Operating Profile and Environment

The Vessel shall be designed and built to operate in Hong Kong Waters with the below said operational profile.

2.8.1 Summary of Operational Hours / Range: **[E]**

Number of hours/day: 8 hours/day

Number of days/year: 225 days/year

2.8.2 Total carrying capacity of the Vessel is 15 persons including 4 crew members and 11 operating staff.

2.8.3 Endurance: **[E]**

Diesel fuel capacity: 18 hours at 20 knots without the need for refuelling.

Energy Storage System with Battery ("ESS") for Zero emissions capacity (see Paragraph 2.10) shall be sufficient to provide power to meet the demand requirement for the following operation modes without any need for charging:

(i) 6.0 hours at 0.0 knot (drifting); or

(ii) 2.5 hours at 5.0 knots; whichever is the greatest.

2.8.4 The vessel shall undertake air sampling surveys whilst operating in this Zero Emission mode.

2.8.5 The vessel shall be kept in position whilst undertaking seabed and water sampling surveys.

2.8.6 The vessel shall run at between 2 and 5 knots under Nearshore Survey Mode and whilst towing various equipment under Towing Survey Mode (see Section Annex 9 for equipment details).

2.8.7 The vessel shall be able to run/operate utilizing main engine / generator and electrical motors/batteries (Low Emission Mode). The power management system shall determine automatically the minimum emission for safe operation of the vessel.

2.8.8 Ambient Conditions - All machinery, equipment, systems shall be capable of operating at their full design performance under the following environmental conditions:

Ambient air temperature +40°C

Internal air +20°C

Sea water temperature +30°C

Temperature in engine room +45°C

2.9 Contract Speed

2.9.1 The Contract Speed of the Vessel shall be not less than 20 knots at Beaufort Wind Force Scale Number 2 with both marine diesel engines running at 100% maximum continuous rating ("MCR") under Official Speed Trial Conditions. (please refer Annex 5 of Part VII) **[E]**

2.9.2 Not less than 5 knots at Beaufort Wind Force Scale Number 2 with the two (2) E-motors operating for propulsion with power supplied by the Energy Storage System only (marine diesel engines and generators are to be shut down) under Official Speed Trial Conditions. **[E]**

2.9.3 The Contract Speed prescribed above shall be achieved in following conditions:

Beaufort 2

Deep water (>15m deep)

The Vessel equipped with all material in this specification.

Loading Condition as per Annex 5 to this Part VII

Other cargo of weight of inventory and spare part that normally to be carried during vessel in operation.

The Contract Speeds prescribed above shall be achieved without any dynamic instabilities and with good tracking. The propeller propulsion system selected shall match the marine diesel engine profile and avoid cavitation.

2.10 Zero Emissions Mode Requirements [E]

The Vessel shall meet the following endurance conditions criteria whilst operating safely in Zero Emissions Mode under weather conditions equivalent to WMO Sea State 5:

(i) 6.0 hours at 0.0 knot (vessel drifting)

This operation profile shall require main diesel engines and generators engine all to be stopped. And the power supply is fed from the Energy Storage System ("ESS") only which shall be sufficient to provide power supply to run and operate the following equipment and system normally for the duration of 6 hours.

a) All navigation and communication equipment in normal running condition.

b) Normal hotel load and all on-board system and equipment including HVAC System, fresh and sea-water system shall run and operate as normal excluding the usage of bow thruster.

c) The E-motor shall be kept stand-by and ready to be put into for operation if necessary.

d) All scientific instrumentation as required.

(ii) 2.5 hours at 5.0 knots

This operation profile shall require main diesel engine and generator engine all to be stopped. The Vessel shall be propelled by the two E-motors with power supply fed from the ESS only. The ESS shall simultaneously provide power supply to run and operate the following equipment and system with sufficient capacity for the full duration of 2.5 hours:

a) All navigation and communication equipment in normal running condition.

b) Normal hotel load and all on-board system and equipment including HVAC System, fresh and sea-water system etc. excluding the usage of bow thruster.

c) Vessel navigation and manoeuvring system (e.g. steering system) in normal running condition.

d) All scientific instrumentation required.

Both of the two conditions (i) and (ii) are to be met with. And the capacity of the ESS shall not be less than the greatest demand amongst the two conditions.

2.11 Position Keeping Mode

2.11.1 A position keeping system shall be provided on board which is capable to hold the Vessel in a predetermined position and heading. **[E]**

2.11.2 The system is also capable to drive the Vessel by using joystick for manual control or by selecting the position (longitude & latitude) and required heading for automatic position keeping, via a navigation display/control panel located at the Wheelhouse Control Station. **[E]**

2.12 Nearshore Survey Mode (Zero emission) and Towing Survey Mode

2.12.1 The vessel is required to carry out nearshore survey at the speed between 2-5 knots for up to 2.5 hours. Under this Nearshore Survey mode, all diesel machinery (including main engine and generator) has to be stopped (i.e. zero emission) and deck arrangement shall also accommodate the operation. The vessel is also required to carry out towing survey at steady speed between 2-5 knots where there is no zero emission requirement. Under the towing survey mode, the vessel shall be capable to make use of main engine trolling clutch together with other necessary fittings or electric hybrid motor to achieve the low speed propulsion.

2.13 Sea Trials

2.13.1 The Contractor shall submit for MD approval, an Official Sea Trial programme 14 working days in advance of the Official Sea Trial, which shall include details of proposed procedures for carrying out the Official Speed Trial, endurance test, manoeuvring test, crash stop test, astern running test, emergency steering test, starting tests for main engine and electric generator engine/hybrid system, anchoring tests, bottom survey on the slipway and all other tests as stated in this Part VII, all of which shall be required to be performed as part of the Official Seal Trial and therefore part of the Technical Acceptance (if not earlier). The notification for Official Sea Trial shall be included evidence that the Vessel is safe to go to sea for the intended tests and trials specified in the Contract (including the inclining experiment report as mentioned in Paragraph 3.5.4 of this Part VII and approved by the RO).

2.13.2 Like all other tests and trials to be conducted as part of the Technical Acceptance, the Contractor shall carry out the full Official Sea Trial in Hong Kong at its own expense (including the expense of fuel, lubrication oil, crew, and other necessary expenses), in the presence of MD officer(s), user department officers and the consultants. The Contractor shall observe the local requirements on navigation before the sea trial, including the third-party insurance in accordance with the laws of Hong Kong.

2.13.3 The Contractor shall provide to MD officer(s), the name, post, duty, and experience of each one of the Contractor's staff on board the Vessel during the Official Sea Trial to ensure the safe operation of the trial. The number of persons on board during a particular test or trial has to be agreed by the MD officer(s). The location of each person on board, which can affect the centre of gravity of the Vessel under trial, shall be firstly agreed by GNC.

2.13.4 The Contractor shall provide a trial report in an agreed format to GNC after completion of the above tests. The report shall contain information regarding the methods of tests, engine(s) running condition, sea condition, weather condition and wind condition, loading condition of the Vessel, the heeling angles (steady or varying as the case may be) during each forward turning manoeuvre, and any other relevant information as required by GNC or the consultants during the tests.

2.13.5 Official Speed Trial

a) The Official Speed Trial shall be carried out in Hong Kong Waters under the loading conditions as specified in Paragraph 1 of Annex 5 to this Part VII.

b) As part of the Technical Acceptance as specified in Paragraph 1.7.1 of this Part VII, the Contractor shall carry out the Official Speed Trial in the presence of GNC officers or their appointed agents.

c) The actual mean speed of the Vessel (i.e., NOT theoretical) shall be measured during the Official Speed Trial runs to determine if the Contract Speed can be achieved. The speed calculations must NOT be corrected by wind, wave, tidal current, shallow water effects, and weather condition.

d) The actual mean speed shall be calculated as the arithmetic mean of not less than FOUR (4) continuous runs, i.e., TWO (2) runs in each direction. The speed for each run shall be taken by measuring the time of the Vessel running for one nautical mile between two (2) poles or other measuring method acceptable to MD.

e) The Contract Speed is considered not achieved if the Contract Speed cannot be attained once during the Official Speed Trial after a total of two (2) attempts each attempt to be measured in the manner specified above.

f) The Contract Speed to be achieved by the Vessel in the Official Speed Trial shall be:

(i) The minimum highest achievable speed of 20 knots as specified in Paragraph 2.9.1 of this Part VII, with the marine diesel engine power at 100% of declared maximum (rated) power and the Vessel under Official Speed Trial Conditions as stated in Annex 5 of this Part VII; and

(ii) The minimum highest achievable speed of 5 knots as specified in Paragraph 2.9.2 of this Part VII, with the full output of the two (2) E-motors and the Vessel under Official Speed Trial Conditions as stated in Annex 5 of this Part VII.

The power rating of the propulsion engine can also be ascertained by using torque meter. The torque meter used shall be calibrated and certified by an independent third party. The power measurement shall be taken at intermediate position from main output shaft. If this is not feasible due to engine configuration, the proposed position and correction factor shall be with prior approval from GNC.

g) If the Vessel fails to achieve the minimum highest achievable speed(s) under the aforesaid conditions, the Government will deem that the Vessel has failed to pass the Official Speed Trial and therefore Technical Acceptance.

h) The instruments used in measuring the Contract Speed for the Official Speed Trial shall be provided either by:

(i) The Contractor provided that the speed measuring device has been calibrated by a certified body in Hong Kong acceptable to GNC; or

(ii) Global Positioning System ("GPS") supplied by the Government.

i) The GPS or Differential Global Positioning System ("DGPS"), which is properly calibrated (with supporting calibration documents) and installed on board the Vessel, is acceptable to GNC; or other speed measuring methods that are acceptable to GNC.

j) The Vessel must be in the trial conditions (see Paragraph 1 of Annex 5 to this Part VII for the conditions of the trials) during the Official Speed Trial. All equipment shall also have passed the Technical Acceptance and which operation shall not be affected during the Official Sea Trial.

k) The speed, time of the day, engine running conditions, sea condition, etc., shall be properly recorded by the Contractor, and signed as witnessed by GNC surveyor (or GNC representatives) during the Official Sea Trial. A copy of the Official Sea Trial Report as required in Paragraph 2.13.6 of this Part VII shall be given to GNC before Delivery Acceptance.

l) Upon successful completion of the Official Speed Trial in Hong Kong, the Contractor shall arrange GNC officers to carry out hull bottom inspection on the Vessel to check for any hull damage before delivery.

2.13.6 The following tests shall be conducted by the Contractor as part of the Technical Acceptance and the testing results shall be recorded and form part of the Official Sea Trial Report. The applicable conditions under which each of the tests specified below shall be conducted are further set out in the relevant paragraph of Annex 5 to this Part VII:

a) Endurance Test - Diesel

The Endurance Test shall be carried out for different marine diesel engine loading and speeds to obtain the speed/fuel consumption curves (or data) for the Vessel, with the engine(s) operating within the manufacturer recommended engine operating conditions. The test results shall be recorded in accordance with the requirements stipulated in Annex 5 to this Part VII. The report submitted shall include a curve or curves showing ship speed versus propulsion engine(s) rpm and power, with particulars of the vessel loading and displacement in the test(s).

b) Endurance Test – Zero Emissions

The vessel shall be run in both profiles, as stated in paragraph 2.10, with the ESS battery bank at 100% capacity when each test is started.

The battery consumption rate & remaining charge shall be noted at 30mins intervals during each test, along with the ambient conditions.

c) Manoeuvrability Test

Forward turning circle tests to port and starboard sides shall be carried out with: both main propulsion engines running; and single main propulsion engine running.

The minimum time for turning to both sides at 15°, 90°, 180°, 270° and 360°shall be recorded. The permitted speed and rudder angle shall be measured and recorded when the heeling angle due to high speed turning is less than 12 degrees.

d) Crash Stop Test

The minimum time and distance achievable by the Vessel when running from full ahead to stop, and then to full astern shall be determined at the Crash Stop Test.

e) Astern Running Test

The maximum astern running speed achievable by the Vessel shall be determined by the test.

f) Emergency Steering Test

An emergency steering test shall be carried out to ascertain that the Vessel shall be steered satisfactorily when the electrical power supply to the steering system has been disabled.

2.14 Failure Mode and Effect Analysis – FMEA

2.14.1 A comprehensive, systematic and documented investigation (Failure Mode and Effect Analysis – FMEA) shall be carried out to establish the important failure conditions of the craft and assesses their significant effect with regard to the safety of the vessel, its occupants and the environment as required. The effect of any likely failure in handling and control devices, services or components shall be assessed to maintain a safe level of craft operation. Failure Mode and Effects Analysis shall include but not limit to:

a) machinery system and their associated control; and

b) directional control system.

The Contractor shall work in the submitted FMEA report in carrying out: evaluation, identification, analysis, verification trial and test, recording the test results and submission of relevant document in various stages for the critical system. The FMEA report shall be in accordance with updated HSC code and submit to GNC section and the RO for approval. FMEA conclusion trial shall be conducted and verified in the presence of GNC officers and the RO.

2.15 Vibration and Noise

2.15.1 Special attention shall be paid in the design and construction of the Vessel including the installation of the propulsion and other machinery. The shafting system and associated systems of the Vessel shall be free from excessive vibration.

2.15.2 The vibration levels in all relevant speed conditions shall be assessed against the ISO No.6954:2000(E) Standard.

2.15.3 Vibrations observed in machinery shall be below the level acceptable by the machinery maker recommendations or the Standards of Evaluation for Mechanical Vibrations of Machines (“VDI 2056”) criteria for assessment of mechanical vibrations in machines, whichever is lower.

2.15.4 Torsional vibrations of the shafting shall be within the limits prescribed by the classification society rules. Margin against whirling vibration of shaft line shall meet the rule’s requirement.

2.15.5 Noise levels in any compartment within the deck house shall not be more than 75 dB(A) when vessel at cruising speed.

2.15.6 Sound insulation and isolation treatment shall be provided as necessary to meet the noise level requirements.

2.15.7 Noise level shall be measured and reported in accordance with the Code on noise levels on board ships by the builder during the sea trial at MCR. Any exhibited excessive noise shall be investigated and rectified.

2.16 Material, Workmanship and Standard

2.16.1 All materials used shall be of high quality certified in accordance with the RO requirements, and shall comply with, where applicable, the appropriate Standards and Code of Practice, together with any amendments made thereto, suitable for installation in the Vessel.

2.16.2 All workmanship shall be in accordance with the recognized shipbuilding standard and practice as well as the rules and regulations of the RO and where applicable the regulatory authorities.

2.16.3 Damaged material during installation shall be replaced or repaired with MD's approval.

2.16.4 Construction arrangement and details shall be developed with due consideration for easy access and future maintenance.

2.16.5 Design and layout of machinery, equipment, piping, electrical cables and ventilation trunks shall be able to ensure that the ship and entire engine room are functional and convenient for routing inspection, maintenance, dismantling, and repair as required in normal service without unnecessary restrictions according to the recognised shipbuilding standard and practice.

2.17 Inspection and Supervision

2.17.1 The Contractor shall submit to the GNC and/or their appointed representative the construction schedule prior to construction of the Vessel. The following schedules and programs shall be submitted:

a) design schedule, updated monthly;

b) procurement schedule, updated monthly;

c) construction schedule, updated monthly;

d) other builder's standard plan schedules; and

e) inspection and test programs.

The Vessel shall be constructed and fitted out in all respects according to the RO requirements and this Part VII.

2.17.2 Inspections shall be so arranged as to enable the owner and/or their appointed representative to spend sufficient time in careful inspection. Drawings and information that maybe required for the inspections shall be made available

2.17.3 The items listed below (but not limited to) are required to be recorded by the Contractor and submitted to GNC or the delegated consultant firm in accordance with Paragraph 1.3.2 before fabrication:

a) Inventory of the incoming materials, consumables components and machinery;

b) Traceability procedures for the use of the materials, traceable identification codes which shall be serial and indexed to the controlled manufacturing procedures;

c) Lofting, cutting, fitting, welding, forming and dimensions control of all the major structural components, measures shall be taken to avoid deformation of structure during fabrication and welding;

d) Welding and inspection procedures for identifying the type and extent of Non-Destructive Test ("NDT") inspections carried out on the Vessel structures. GNC may extend the NDT where deemed to be necessary subject to the quality of the welding. A NDT inspection plan shall be submitted to GNC for approval before inspection;

e) All NDT reports;

f) Welding and inspection qualification and certification of each person;

g) Records of maintenance and calibration of the welding, machining, measuring and inspection equipment;

h) Records of machining, finish surfaces, and bolting;

i) Procedures for work quality non-conformance reporting and records of rectification of defects; and

j) The design and manufacturing drawing control procedures, including any of its revisions and updates, and records for any re-issue of drawings.

2.18 Other Design Features

2.18.1 Berthing requirement of the Vessel shall match with the designated point of berth at Government Dockyard.

2.18.2 Permanent list of the Vessel is not allowed, and where it is not practical to achieve this requirement, the maximum permanent list of the Vessel in its lightship condition must not be greater than 0.5 degree.

2.18.3 Permanent ballast can only be used as agreed by GNC. The Contractor shall note that it shall be under a very exceptional case that GNC would agree for the Vessel to have ballast installed.

2.18.4 The Contractor shall request the RO to carry out the measurement of the Vessel's Gross Tonnage ("GT") and Net Tonnage ("NT"). A statement of compliance for the Vessel stating the measured GT and NT together with the calculation details shall be issued by the RO and submitted by the Contractor to GNC for records.

Chapter 3 General Arrangement

3.1 General Provisions

3.1.1 The Vessel shall be designed and built as a catamaran vessel. The hull and superstructure are constructed of all welded marine grade aluminium alloy plates and specially designed extrusions.

3.1.2 Unless otherwise specified in this Part VII, the Conceptual General Arrangement Plan given in this Part VII only serves as a reference. It is a reference drawing to help to explain the Tender requirements and in no way a suggested or preferred layout of the Vessel. The Contractor is encouraged to produce their own design which meets the requirements of Technical Specifications in this Part VII. This Conceptual General Arrangement Plan shows a reference layout of the accommodation and compartment arrangement of the Vessel with the following maximum/minimum dimensional guidance considered:

a)	clear headroom for internal accommodation compartments, internal and external working spaces (if under fixed cover):	Minimum 2.0 m
b)	Upper Deck side walkway width:	Minimum 1.0 m
c)	Number of crew and technicians:	Maximum 15

3.1.3 During the design and construction of the Vessel, the Contractor is required to submit a detailed General Arrangement Plan for GNC's written approval and acceptance.

3.1.4 It is a contractual requirement that all furniture, equipment and facilities, fixture and fittings, including outfitting of the Vessel that are described in the TS, together with their requirements for design and installation standards that are stipulated in this Chapter and in any other parts of the TS are the items that must be included in the complete "As-built" Vessel delivered to the Government.

3.1.5 It shall be noted that the requirements given in the TS are in addition to the RO Requirements and IMO requirements and shall be met by the design and construction of the Vessel.

3.2 Hull and Deckhouse Structural Requirements

General Workmanship:

3.2.1 Trunks, coamings, and openings where applicable shall have corners radius as large as possible;

3.2.2 Fittings and openings through decks and bulkheads for pipes and cables shall be properly designed using approved fittings to maintain watertight integrity, reduce transmission of heat, and to minimise transfer of machinery vibration and noise to the hull structure;

3.2.3 Limber and vent holes shall be cut as necessary to ensure proper venting and drainage of all tanks, compartments, pockets, and voids. All tanks shall have limber holes and vent holes of adequate size for full capacity flow to suction and vent lines. There shall be no pockets where water can be trapped at any normal list or trim to be encountered in service; and

3.2.4 Sharp corners shall be avoided.

Water Tightness:

3.2.5 Tanks shall be tested by a water head one (1) metre above the top of air pipe subject to RO requirements.

3.2.6 The weathertightness of any fittings on the weather deck and deckhouse shall be demonstrated by directing a water stream from a 12 mm diameter nozzle at an output pressure of 2 bar, from a distance not exceeding 1.5m from the fitting, at all parts of the exterior including all windows, doors and hatches. Any leakage detected shall constitute a failure of the test and corrective action(s) followed by re-test(s) shall be performed;

3.2.7 All structures and fittings shall withstand the tests described above and any weakness shall be made good, and at the expense of the Contractor.

Fairness:

3.2.8 The hull, decks, and deckhouse side wall shall be fair, and shall be free from objectionable buckles or uneven sight edges. Special care shall be used in aligning and fairing surfaces which are to be joined.

Decks, Platforms, Flats and Stiffness:

3.2.9 All decks, platforms and walking flats shall be sufficiently reinforced to prevent deflection that might be caused by service load, an individual walking or standing on the deck and/or by structural flexion of the hull and/or deckhouse. Structures under or behind fittings shall be adequately strengthened to withstand the load exerted by or on the fittings;

3.2.10 The main deck shall be fitted with watertight flush deck hatch covers for removal of main diesel engines, as well as other equipment, such as the diesel generators, without moving the main diesel engines;

3.2.11 The deck area shall have proper camber and sheer to avoid water accumulation.

3.2.12 Adequately secured gratings shall be provided as required and to GNC's satisfaction. Removable gratings shall be provided where required for access to valves, equipment, bilge pickups, and to other systems below the gratings.

Hull penetration fittings:

3.2.13 Penetration of hull fittings, which are required for equipment in this Part VII, shall be located in convenient locations for maintenance purposes. The number of penetration fittings shall be kept to a minimum;

3.2.14 All penetration of hull fittings located below the waterline shall be fitted with shut-off valves fabricated of metal and having suitable corrosion protection, such as cathodic protection. All shut-off valves shall be of a type approved by the RO; and

3.2.15 Where penetrations of hull fittings are located below the waterline, the hull external surface shall be fitted with fairings/screens to minimize the drag.

Hull structural closures

3.2.16 Access to underdeck compartments from the main deck shall be provided by watertight deck hatches with coaming;

3.2.17 All hinged hatch covers shall be provided with a means to hold them in the fully opened position. A protective measure shall be provided to prevent the crew from accidentally falling into an open hatchway; and all access closings shall be able to be opened and closed from both sides.

Below Main Deck Watertight Bulkhead Closures

3.2.18 Watertight doors shall be provided for access into below deck compartments through watertight bulkheads. The watertight doors shall be RO approved and maintain the fire protection integrity of the bulkhead. The watertight doors are to provide a minimum clear opening to the satisfaction of GNC;

3.2.19 Watertight doors giving access to compartments shall have a coaming as per the RO requirements above the tank top or sole level as appropriate;

3.2.20 Watertight doors must be capable of being opened and closed from both sides. The arrangement of watertight doors including method of opening and closing shall be designed, installed and approved in accordance with the RO's requirements; and

3.2.21 The warning "Door shall be kept closed when underway" shall be marked on both sides of the watertight door.

Deckhouse Closures

3.2.22 Weathertight doors shall be provided for access into the deckhouse. Entrances shall be made from the front and rear sides with a minimum clear opening to the satisfaction of GNC and EPD. The weathertight doors shall be RO approved;

3.2.23 All doors (excluding the workshop access door on the aft deck) giving access to the deckhouse shall have a coaming above the finished main deck surface as per the RO's requirement;

3.2.24 Appropriate locking mechanisms/methods shall be provided for all access doors;

3.2.25 The deckhouse shall be designed to facilitate the removal of engines from the Engine Room to the shore for maintenance and repair. Openings in the deck and closing hatches shall not affect the structural strength of the deck structure when opened; and

3.2.26 All doors in the deckhouse shall have clear, toughened and laminated safety glass fitted. All windows in the deckhouse shall be toughened and laminated safety glass.

Wheelhouse Closures

3.2.27 Weathertight doors shall be provided for access into the Wheelhouse from the port and starboard sides with a minimum clear opening to the satisfaction of GNC. The weathertight doors shall be RO approved;

3.2.28 Doors giving access to the Wheelhouse shall have a coaming as per the RO's requirements above the finished upper deck surface;

3.2.29 Appropriate locking mechanisms / methods shall be provided for all access doors; and

3.2.30 All doors in the wheelhouse shall have clear, toughened and laminated safety glass fitted. All windows in the wheelhouse shall be of toughened and laminated safety glass.

3.3 Windows and Visibility

3.3.1 Throughout the vessel tinted windows shall be fitted, excluding the wheelhouse. Instead of adopting ordinary tinted windows to reduce thermal loading, photovoltaic film shall be used for windows as extensively as possible to maximise solar power capturing.

3.3.2 All windows shall be manufactured from clear toughened safety glass, secured to the structure and shall be issued with the type approval certificate by the RO and is suitable and safe for marine use. Details of the all windows shall be submitted to GNC for approval and window glass thickness shall be verified in accordance with the submitted information before installation.

3.3.3 Windows shall be strong and suitable for the worst intended operating conditions. Window glass and the frame shall be made of materials which will not break into dangerous fragments when fractured/shattered.

3.3.4 Retractable transparent solar UV roller blinds shall be installed on all side windows throughout the Vessel. The blinds shall be capable of being retained in position either partially lowered or fully lowered, without swinging due to vessel motions at sea.

3.3.5 All windows of the accommodation space shall be fitted with solar blinds.

3.3.6 A basic layout of the windows is shown in the Guidance General Arrangement Plan. Details of all windows shall be submitted to GNC for approval. Weather-tight test shall be carried out after windows installation.

3.3.7 Where practical, depending on the design of the bridge configuration, more windows are preferred to provide a wider clear view.

3.3.8 Retractable transparent solar blinds shall be installed inside of all wheelhouse front windows. All forward facing windows of wheelhouse shall be inclined forward and provide visibility free of any glare under all operating condition. The wheelhouse front windows shall be inclined from a vertical plane topside out to reduce unwanted reflection, at an angle of not less than 10° and not more than 25°.

3.3.9 A minimum of one (1) large window shall be fitted at port and starboard side of the wheelhouse to facilitate direct downward viewing to the side of the Vessel. These windows also provide ventilation while the air-conditioning system is not operating excluding the forward section of the side windows fitted with heavy duty wipers.

3.3.10 Frames at the wheelhouse window separations shall be kept to a minimum, and they shall be of adequate structural strength and stiffness. They shall not be installed immediately in front of any navigation seats. The positions of window frames shall be agreed by GNC before installation.

3.3.11 An all-round de-misting system shall be provided for all wheelhouse windows.

3.3.12 As a minimum requirement, the visibility to outside from inside the cabins and wheelhouse shall be in-compliance with the requirements set out in IMO.

3.3.13 Side mirrors / CCTV shall be provided at locations to allow the coxswain to safely manoeuvre the craft to a berth and to view the operation being carried out at aft deck.

3.3.14 At all times regardless of the weather and sea conditions at least two third of the wheelhouse front width in front of the coxswain shall have a clear view. The visibility check shall also be carried out during the bridge mock up inspection.

3.4 Windshield wipers

3.4.1 Contractor shall provided windshield wiper with spare wipers sufficient for the wheelhouse front windows.

3.4.2 The windshield wipers shall be marine type wide span and large area wipers with electrically operated fresh water.

3.4.3 The windshield wipers shall be Heavy-duty wipers (preferable of straight-line type).

3.4.4 They shall have an interval operating function with electrical fresh water window/wiper washing systems.

3.4.5 These wipers shall be capable of operating independently of each other.

3.4.6 All the sprinkler pipe used in the wiper system shall be made of copper.

3.5 Stability Requirements

3.5.1 The preliminary lines plan (“Preliminary Lines Plan”) as well as an offset table (“Offset Table”) for the Vessel and the preliminary stability information, including the intact and damage stability calculations for all the loading conditions stated in Paragraph 3.5.5, shall be carried out using a proven computer system, with evidence (viz. recognised by a government authority or any one RO listed in Paragraph 1.1 of Part IV) and shall be submitted with the tender in accordance with Schedule 7 of Part V. All calculations and drawings must be in metric units.

3.5.2 The Vessel shall comply with the intact and damage stability requirements stated in Paragraphs 3.6 and 3.7 of this Part VII as well as any applicable RO requirements.

3.5.3 A final stability assessment of the sea trial loading condition using final lightship data shall be approved by the RO before being delivered to GNC prior to the Official Speed Trial mentioned in Paragraph 3.5.5.6 of this Part VII.

3.5.4 Inclining Experiment

(a) An inclining experiment shall be carried out to determine the lightship displacement and position of the centre of gravity of the Vessel, in accordance with Part B Chapter 8 and Annex 1 of the International Code on Intact Stability, 2008 (2008 IS Code) adopted by IMO resolution MSC.267(85), as from time to time revised or amended by any revision or amendment that applies to Hong Kong.

(b) At least fifteen (15) working days in advance of the inclining experiment, The Contractor shall submit a "Scheme of Inclining Experiment" which includes:

(1) The proposed date, time, and place for the inclining experiment;

(2) The anticipated water depth at the time of the inclining experiment;

(3) A recent photograph of the site of the inclining experiment;

(4) A recent photograph of the Vessel to be inclined. That includes its external view and hull superstructures and main deck situation;

(5) The name of the RO representative and the name of the Contractor’s representative who will attend and be responsible for the inclining experiment;

(6) The Vessel's intended loading condition with a comprehensive list covering all items with the corresponding weight and centre of gravity locations, which may affect the Vessel's recorded lightship including items stipulated in paragraph 3.5.4 (b) (7) and (8);

(7) Items which are not fitted onboard, on the date of the experiment, but shall be included in the Vessel's lightship;

(8) Items which are fitted onboard, on the date of the experiment, but shall not be included in the Vessel's lightship;

(9) The proposed initial locations and the subsequent movements of the inclining weights;

(10) The calculation of the estimated heel of the Vessel before and during the inclining experiment;

(11) The proposed number, location and lengths of pendulum used; or other methods of measuring heel angles (that must be of a type acceptable to GNC);

(12) Hydrostatic table and tank capacity tables. The increment of draft shall be every 100 mm in the hydrostatic table and the increment of sounding shall be every 5 mm in the tank capacity tables;

(13) The list of data to be measured (i.e. drafts, specific gravity of floating water, etc.) in accordance with IMO requirements;

(14) The lightship weight, centers of gravity, the draft, trim and the metacentric heights of the Vessel after each and every shift of inclining weight shall be determined in accordance with IMO requirements applicable to the Vessel; and

(15) The Contractor shall demonstrate the condition for the inclining experiment is stable and safe.

(c) The inclining experiment shall only be conducted:

(1) After the "Scheme of Inclining Experiment" has been approved by the RO and GNC; and

(2) In the presence of the RO and GNC and/or appointed consultant. A request for attendance shall be made at least five (5) working days in advance. The

lightship weight and centre of gravity shall be calculated and presented in the inclining experiment report.

(3) All spaces and tanks should be kept dry, or tanks being pressed up with the intended liquid. The free surface of liquids remaining onboard shall be minimised and taken into account.

(d) For the avoidance of doubt, if there is any liquid on board, the worst possible free surface effects of all liquids on board shall be taken into account in all calculations;

(e) The PRELIMINARY Inclining Experiment Report which shall be submitted to the RO and GNC not later than fourteen (14) working days before the Official Sea Trials. This shall include a statement from the Contractor stating that the Vessel is safe to go to sea for the intended tests and trials specified in the Contract;

(f) The FINAL Inclining Experiment Report shall be approved by the RO before submitting to GNC for further comments and acceptance; and

(g) In addition to the above the requirements for conducting and reporting the Inclining Experiment, the Stability Information Booklet shall also follow any specific requirements given in this Part VII.

3.5.5 Stability Information Booklet

3.5.5.1 The Vessel shall comply with stability criteria mentioned in this Part VII and other applicable IMO regulations, including but not limited to the International Code of Safety for High Speed Craft, 2000 (2000 HSC Code) adopted by the IMO resolution MSC.97(73), as from time to time revised or amended by any revision or amendment that applied to Hong Kong and the (2008 IS Code). Furthermore, stability due to wind and ship rolling for the required service environment of the Vessel shall be calculated.

In addition to the requirements stated above, the booklet in its final version shall include:

(a) The Vessel's particulars, general arrangement drawing showing all compartments and tank positions, hydrostatic curves (or in table from) and cross curves (or in table from);

(b) Tank calibration / sounding tables including but not limited to fuel oil tank, freshwater tank and oily bilge water tank. These tables shall consist of the locations of tanks (in terms of frame numbers), levels from tank bottom, capacity, VCG/LCG/TCG, free surface moments and the location of the sounding points. The trim and heel of the Vessel for which these tables are applicable shall be stated clearly;

(c) Stability calculations for each loading condition shall include but not be limited to a profile drawing of the Vessel and items of deadweight, lightship, displacement, draughts, trim, VCG, GM (solid and fluid), TCG, LCG, down-flooding angle, GZ curves and values of the stability criteria according to the (2008 IS Code) and (2000 HSC Code);

(d) Any other information as reasonably required by the RO and/or GNC; and the Inclining Experiment Report approved by the RO; and

(e) In the preliminary and final stability calculations, the estimated and final (obtained after conducting the inclining experiment) lightship data of the Vessel shall be used respectively. Both the preliminary and final stability information booklets shall include the following loading conditions under different scenarios as mentioned in the table below for the intact and damage stability calculations and any other loading conditions as may be required by GNC for the purpose of such operation:

	Loading Conditions	Fuel Oil (%)	Fresh Water (%)	Black Water (%)	Oily Water (%)	Crew (No.)	Technician (No.)	Stores/ Utilities (Kg)	Beaufort Scale
1	Lightship	0	0	0	0	0	0	0	5
2	Full Load Departure	98	98	10	10	4	11	500	5
3	Full Load Arrival	10	10	98	98	4	11	500	5
4	Crew only Departure	98	98	10	10	4	0	500	5
5	Crew only Arrival	10	10	98	98	4	0	500	5
6	Cranes Operation	50	50	50	50	4	11	500	5

3.5.5.2 The following notes from (1) to (7) shall be applied to the appropriate loading conditions in the intact and/or damage stability calculations (if applicable):

(1) The maximum free surface moment shall be used for calculating the stability of the Vessel in all the above conditions;

(2) The weight of each crew and each Technician is assumed to be 82.5kg with each carrying personal effects of 20kg (for 4 Crew and 11 Technicians in total);

(3) The VCG of each person, while standing, shall be assumed to be 1000 mm above the deck where they are likely to be situated. The LCG of each person shall be in their most likely position onboard. The likely positions of these persons shall also be agreed by GNC;

(4) Heeling due to high speed turning in various loading conditions shall also be considered in the stability calculations with reference to the (2000 HSC Code);

(5) Heeling due to personnel crowding in various loading conditions shall also be considered in stability calculations with reference to the (2000 HSC Code);

(6) Heeling moments and change of centre of gravity due to the movement of the deck crane with maximum moment applied to port and starboard in the Crane Operation condition shall also be considered in the stability calculations with reference to the (2008 IS Code); and

(7) An exceptional stability case is to be assessed assuming that the Vessel is to perform

towing similar vessel shall also be considered in the stability calculations with reference to the (2008 IS Code).

3.5.5.3 The final stability information booklet (i.e. either presented separately in two (2) booklets for the intact stability calculation and damage stability calculation or combined in one (1) booklet) shall be approved by the RO before submission to GNC for acceptance. The Contractor shall supply four (4) copies of the final stability information booklet (as built) to GNC at Delivery Acceptance.

GNC is the ultimate body to give the final acceptance of the Stability Information Booklet and the Inclining Experiment Report.

3.5.5.4 The PRELIMINARY Stability Information Booklet (i.e. either presented separately in two booklets for the intact stability calculation and damage stability calculation or combined in one booklet) based on the estimated centre of gravity ("CG") positions of the Vessel shall be submitted to GNC during the design stage and within two (2) months after the Contract Date, to show that the Vessel can fulfil the required vessel stability specified in this Part VII as well as any other stability requirements required by GNC to be considered, during the design and construction stage.

3.5.5.5 The Vessel shall not carry any operational limitations with respect to its stability capability within the operational requirements stipulated in this Part VII.

3.5.5.6 The Official Sea Trial shall only be carried out after the results of the inclining experiment show the position of the Vessel's actual centre of gravity is consistent with the information given in the PRELIMINARY Stability Information Booklet, and that the Vessel is safe to proceed with the sea trials.

3.6 Intact Stability Criteria [E]

The intact stability of the Vessel shall show its compliance with the applicable requirements in the 2008 IS Code as well as Chapter 2 and Annex 7 of the 2000 HSC Code and the calculations shall be with reference to each set of the loading conditions specified in Paragraph 3.5.5.1 of Part VII and Paragraph 3.5.5.2(7) of Part VII in full load departure condition only.

3.7 Damage Stability Criteria

3.7.1 Transverse bulkheads shall be arranged to maintain the stability of the Vessel even there is flooding of any one underdeck compartment occurred. The corresponding residual stability after damage shall meet the applicable requirements in Chapter 2 and Annex 7 of the 2000 HSC Code as well as taking into consideration of the exemptible clause (i.e. 2.6.12.1) in accordance with the 2000 HSC Code applicable to Local High Speed Craft as stipulated in Annex AB of the Code of Practice, Safety Standards for Class I Vessels (January 2025 Edition) published by the Local Vessels Safety Section, Marine Department HKSAR, with reference to each set of the loading conditions specified in Paragraph 3.5.5.1 of Part VII. **[E]**

3.7.2 As regards the one (1) compartment subdivision standard specified in Paragraph 3.7.1 of Part VII, the extent and character of damage shall be assumed with the relevant longitudinal extent specified in Chapter 2 paragraph 2.6.7 of the (2000 HSC Code) only and including the following spaces:

(i) fore peak space;

(ii) space between aft end of the Vessel and adjacent transverse bulkhead;

(iii) anywhere in the Vessel's length between adjacent watertight transverse bulkheads;

Where the damage envisaged would involve transverse watertight bulkheads including collision bulkhead, such bulkheads shall not be considered effective unless they are spaced at a distance at least equal to the longitudinal extent of the assumed damage specified in Chapter 2 paragraph 2.6.7 only of the (2000 HSC Code). Where such bulkheads are spaced at a lesser distance, one or more of these bulkheads within such extent of damage shall be assumed to be non-existent for the purpose of determining which compartments are flooded.

3.7.3 The opening(s) to be used to determine the down-flooding angle(s) shall first be agreed by the RO and GNC before carrying out the calculations;

3.7.4 An inlet opening is an opening through which progressive flooding may take place if immersed. This shall not be an opening closed by a watertight cover or vent fitted with automatic closure;

3.7.5 Transverse bulkheads shall be arranged to maintain the stability of the Vessel even there is flooding (i.e. total flooding, partial flooding and progressive flooding) of any one of the underdeck compartments occurred, and when there is asymmetric flooding to any one of the underdeck compartments. For this calculation, the extent of partial and total flooding shall be decided by GNC; and

3.7.6 It is OF THE ESSENCE that the residual stability of the Vessel in the above-mentioned damage condition shall be sufficient to maintain adequate stability for her to return to the base/deport.

3.8 Freeboard Assignment

The freeboard assignment shall comply with the relevant requirements as specified in the Code of Practice – Safety Standard for Class II Vessels in the version as amended and issued by the Local Vessels Safety Section of Hong Kong Marine Department. A Statement of Compliance for Load Line for the Vessel shall be issued by the RO and submitted by the Contractor to GNC.

Chapter 4 Hull Arrangement

4.1 General Provisions

4.1.1 All details within Chapter 4 are relevant for both the port and starboard hulls of the vessel.

4.1.2 The compartments within this section shall be arranged to maintain the Intact Stability Criteria and the Damaged Stability Criteria specified in this Part VII and shall be accepted by GNC and the RO. Suitable ventilation shall be provided for the compartments which shall meet the requirements of the RO.

4.2 General Arrangement

4.2.1 Subject to full compliance with the requirements of stability and subdivision, each hull shall be divided by transverse watertight bulkheads into compartments as follows (to be identical in size and location in the port and starboard hulls):

a) Fore peak;

b) Bow Thruster Compartment;

c) Tank Compartment;

d) Battery compartment;

e) Engine room; and

f) Aft peak and Steering gear room.

On the main deck there shall be a deckhouse comprised of the following compartments:

a) Deck Store

b) Conference Room

c) Store Rooms(s)

d) Galley and Crew Mess

e) Changing Room & Showers

f) Cold Store

g) Workshop for Sampler

h) Wet lab & Monitoring Room

On the upper deck there shall be a deckhouse comprised of the following compartments

a) Wheelhouse

b) Dry Laboratory

All cabins shall be designed and arranged so as to protect the occupants from weather and sea conditions and aims to minimise risk of injury.

There shall be a public address system covering all open areas and spaces of the Vessel, and where crew shall have access, including the escape routes.

4.3 Fore peak

4.3.1 The fore peak space shall be watertight and located at the foremost end of the hull, with a watertight collision bulkhead. IMO requirements for collision bulkhead shall be complied with.

4.3.2 A hinged flush type watertight hatch cover shall be provided on the main deck for access to the Fore Peak. Access ladder shall be provided.

4.4 Bow Thruster compartment

4.4.1 The Bow Thruster Rooms (Port and Starboard) shall be located under the main deck and aft of the fore peak of each hull. Suitable ventilation shall be provided for the rooms and shall meet the requirements of the RO.

4.4.2 A flush watertight hatch cover shall be provided on the main deck for provide access to each bow thruster room. An access ladder shall be provided for each compartment.

4.4.3 Each room shall be sufficient to accommodate the following equipment:

a) Bow thruster tunnel, propeller and electrical power pack;

b) Racking and support structure for fitting of the local operating panel(s), cabling, junction boxes and any other supporting equipment; and

c) Any other equipment as required by GNC and EPD.

4.4.4 Noise and vibration transfer to the Superstructure and living spaces shall be minimised.

4.5 Tank compartment (Port and Starboard)

4.5.1 The tank spaces shall be located in front of the engine room.

4.5.2 The tank spaces shall be designed to accommodate:

a) Two (2) Fuel oil tanks (one per hull);

b) One (1) ndependent stainless steel fresh water tank with manhole cover; and

c) One (1) grey/black water tank.

4.6 Battery Compartment

4.6.1 Dedicated battery space(s) shall be provided for storage of Lithium Ion (Li-ion) batteries. The requirements of the space shall be determined by the applicable RO to the satisfaction of GNC.

4.6.2 The batteries shall be situated in a space which can be accessed from the main deck for servicing and replacement.

4.6.3 The designated battery space(s) shall be:

a) Designed and built to be weathertight within the compartment they are fitted unless the RO/ GNC stipulates a higher requirement;

b) Designed and built in accordance with RO structural fire protection requirements;

c) RO type approved heat and smoke fire detection shall be installed to the satisfaction of the RO & GNC;

d) Suitable ventilation shall be provided in accordance with RO/ GNC/ Battery supplier minimum requirements;

e) Designed and built taking consideration of the need for pipe and cabling routing from Battery Space to Engine Room.

f) RO type approved automatic fire damper to be fitted to ventilation in accordance with RO/ GNC requirements;

g) Fire suppression system shall be fitted in accordance with RO requirements and to the satisfaction of GNC.

h) It shall be required that other hybrid electrical equipment be fitted within the space. This shall be designed and installed in accordance with the battery/ hybrid supplier appointed by the Contractor to the satisfaction of RO and GNC.

4.7 Engine room

4.7.1 The layout of the engine room shall be in accordance with IMO Requirements and the RO Requirements and to the satisfaction of GNC.

4.7.2 Special attention shall be paid to the layout of the engine room for the maintenance and repair of main engines, generators and other machinery. The specific requirements given in the TS shall be complied with.

4.7.3 Access shall be from the external deck above via a watertight hatch mounted on a coaming of a suitable height to allow access whilst at sea. A second access, from the Tank compartment, via a watertight door shall be provided.

4.7.4 The engine room shall be designed as an unattended engine room.

4.7.5 All boundary bars, handrails, gratings, ladders, platforms, stanchions and vertical supports, etc. in the engine room and steering gear compartment shall be of lightweight construction.

4.8 Steering Gear Compartment

4.8.1 The layout of the steering gear compartment shall be arranged for easy and convenient installing, operating and access for maintenance/repairs to the steering gear system. Flush access manhole with hinged cover shall be provided for easy access to this compartment.

4.8.2 Readily accessible space shall be provided for the operation of an emergency manual hydraulic pump with independent piping.

Chapter 5 Main Deck & Deckhouse Arrangement

5.1 Foredeck

5.1.1 The geometry and arrangement of foredeck shall be carefully designed to facilitate safe mooring and anchoring operations to GNC's satisfaction.

5.1.2 The foredeck shall be accessed via a weather tight door from the superstructure.

5.1.3 The deck locker provided shall have access direct from the foredeck.

5.1.4 A hinged flush type watertight hatch cover shall be provided on the main deck for access to each forepeak. Access ladder shall be provided.

5.2 Deck Locker

5.2.1 The deck locker shall be accessible from the foredeck.

5.2.2 The compartment shall contain the following equipment and fixtures:

a) racking suitable for the storage of fenders, mooring lines and deck cleaning equipment.

b) racking suitable for the storage of windlass and anchor control equipment and spare parts.

5.3 Conference Room

5.3.1 The compartment shall comprise the following equipment and furniture:

a) Conference table and chairs to seat 12 persons, with 220V, 13A power sockets mounted within a covered recess in the middle of the table;

b) TV projector with a retractable powered projector screen, with the ability to connect laptops via HDMI or USB-C to screen share;

c) Wall mounted speakers for the projector sound system;

d) Powered blinds on all windows to allow use of the projector facilities;

e) Map cabinet for printed maps and other documents; and

f) Minimum of two (2) LAN ports mounted such that laptop computers sat on the conference table can be plugged into the LAN without wires trailing off the table.

5.4 Wet Laboratory & Monitoring room

5.4.1 There shall be fixed seatings with storage beneath for up to six (6) technicians.

5.4.2 The room shall also be equipped with a suitable sized work table. And recessed power sockets shall also be provided in the centre of the table for computers/equipment. The number and arrangement shall also need to be agreed by GNC and user department.

5.4.3 The compartment shall be provided with sink and fresh water supply. A small workbench area shall be fitted alongside the sink.

5.4.4 Storage cupboards/shelves shall be provided on the perimeter of the compartment. The arrangement of which is to be agreed by the GNC and user department.

5.4.5 The monitoring station shall be situated at the after end of the compartment close to centreline and with an unobstructed view of the aft deck and deck cranes, shall be equipped with:

a) A desk/shelving unit with chair, suitably sized to accommodate the followings:
   (i) Laptop computer;
   (ii) Chart repeater, minimum screen size 19";
   (iii) Echo sounder repeater, minimum screen size 15.6"; and
   (iv) Deck unit (for power supply and controlling the rosette sample) – See Annex 9 of Part VII for details.

b) Opening window (sliding type).

c) A suitable cable gland system mounted beneath the window to allow for the rosette control cable to be led from the deck unit through the aft bulkhead to the rosette.

5.4.6 There shall be direct access to the aft deck and the workshop from the compartment.

5.5 Workshop for sampler

5.5.1 The compartment shall contain the following equipment and furniture:

a) Ice maker

b) Sink with cold fresh water

c) Small workbench area alongside the sink

d) Secured storage for the following equipment (see Annex 9 of Part VII for details), which ensures safe storage in the expected operating sea states of the vessel:
   (i) Sampling Rosette;
   (ii) Van Veen Sediment Sampler;
   (iii) Small sediment grab;
   (iv) Manta tow net; and
   (v) Sample bottles & holders.

And all of the above equipment would be supplied by EPD.

5.5.2 The FerryBox system analyser equipment shall be mounted in this compartment (see Paragraph 15.3 of Part VII).

5.5.3 Manual or powered roller shutter door with a flush, direct access onto the aft deck shall be provided. Minimum opening dimensions of the door shall be 1500 mm width x 1800 mm height. The door shall be designed such that it can be opened safely in a seaway by a single person, Also the door shall be able to be locked in open position. For easy transportation of the sampler rosette (see Annex 9 of Part VII), an Aft deck rosette transportation system (see paragraph 15.4) proposed by contractor and agreed by GNC shall be provided.

5.5.4 The windows opening on to the aft deck shall be of the opening type (sliding).

5.5.5 There shall be direct access to the Cold store from the Workshop.

5.5.6 There shall be access to the Wet Laboratory & Monitoring room from the Workshop.

5.6 Cold Store

5.6.1 The Cold Store shall maintain a non-freezing temperature of no greater than 4ºC irrespective of the ambient conditions.

5.6.2 The compartment shall contain the following equipment and furniture:

a) Shelving suitable for Sample bottles & holders shall be provided. The storage racks shall be of 510 mm depth and a clear minimum height dimension of 630 mm between shelves. The shelves shall have fiddles/retainment system to ensure items stored on the shelves do not move during vessel operations;

b) The shelves shall make most efficient use of the internal space within the compartment, to maximise the storage volume. The arrangement shall be approved by the GNC;

c) One (1) 220V, 13A power socket, fitted, in a suitable outdoor specific housing; and

d) There shall be direct access from the Cold Store to the Workshop.

5.7 Galley & Crew Mess

5.7.1 The Crew Mess & Galley space shall be located on the main deck of the vessel. This compartment is for both the crew and the technicians to rest and prepare/eat meals.

5.7.2 The compartment shall contain the following equipment and furniture:

a) Comfortable seating for six (6) persons with tables; and

b) Two (2) Sofa/bed units(with storage beneath) with a pullman style berth above to allow for up to two persons to sleep at the same time.

5.7.3 A galley unit shall contain the following:

a) Refrigerator;

b) Microwave oven;

c) Induction Hob units (two (2) hobs minimum);

d) Ventilation hood above the induction hob unit;

e) Sink with hot/cold running fresh water; and

f) Rubbish bin of a suitable size, with cover.

5.8 Store Rooms

The vessel shall have two (2) storerooms on the main deck. One (1) shall be situated forward, close to the conference room and one (1) shall be situated aft, as part of the wet laboratory & monitoring room.

5.8.1 The forward storeroom shall be outfitted with:

a) Hinged door, with access to the main corridor.

b) Storage cupboard, minimum dimensions 1300 mm (H) x 1080 mm (W) x 500 mm (D)

c) Storage racks equipped with a suitable retention system to ensure the stored items shall not shift due to the vessel motions in a seaway.

d) The storage racks shall be of a minimum 590 mm depth and the following minimum height dimensions (from the deck upwards):

Level 1 – 680 mm between the deck and first shelf;

Level 2 – 640 mm between the first shelf and second shelf; and

Level 3 – 380 mm from the second shelf to the deckhead.

e) Two (2) 220V, 13A power sockets.

5.8.2 The wet laboratory & monitoring room store shall be outfitted with:

a) Sliding door access from the wet laboratory.

b) Storage racks equipped with a suitable retention system to ensure the stored items shall not shift due to the vessel motions in a seaway.

c) The storage racks shall be of a minimum 590 mm depth and the following minimum height dimensions (from the deck upwards):

Level 1 – 680 mm between the deck and first shelf;

Level 2 – 640 mm between the first shelf and second shelf; and

Level 3 – 380 mm from the second shelf to the deckhead.

d) Two (2) 220V, 13A power sockets.

5.9 Toilets

5.9.1 The vessel shall be equipped with two (2) separate toilet compartments on the Main Deck.

5.9.2 Each toilet compartment shall contain the following installations and fittings:

a) One (1) stainless steel wash basin with a spring loaded hot/cold freshwater supply tap;

b) One (1) water delivery point under basin with a plastic hose for toilet cleaning;

c) One (1) cabinet with mirror with vanity lights;

d) One (1) toilet paper holder;

e) Sufficient lighting;

f) Appropriate number of electric sockets shall be provided;

g) One (1) liquid soap dispenser;

h) Floor Drain(s) to be provided to avoid water accumulation on the toilet floor and floor covering shall pitch to a floor drain piped to the black water collection tank;

i) One (1) deep bowl water closet (not of a "vacuum" type) of suitable mode to be determined with the GNC either in the kick-off meeting after the Contract is awarded or during the design phase of the Vessel;

j) Stainless steel handrails as appropriate to allow safe use of the facilities while at sea;

k) Three (3) coat hooks;

l) One (1) paper towel waste bin; and

m) One (1) electric exhaust fan, the exhaust air shall be routed outside.

5.10 Changing Room with Showers

5.10.1 The vessel shall be equipped with two (2) changing room with changing facilities and separate shower cubicles.

5.10.2 Each Changing Room shall contain the following installations and fittings:

a) Non-slip flooring;

b) Floor Drain(s) shall be provided to avoid water accumulation on the changing room floor and floor covering. The drainage piping shall be led to the black/grey water collection tank;

c) Lockable door; and

d) One (1) electric exhaust fan led to open deck.

5.10.3 The Shower Cubicle shall contain the following installations and fittings:

a) Hot/cold water spray;

b) Minimum 50 litres electrical hot water tank;

c) Self draining shower tray, with non-slip flooring material, with a minimum of 100 mm upstand to the surrounding changing cubicle area;

d) Two (2) towel hooks;

e) Door or equivalent to prevent water spray from the shower entering the changing room; and

f) Lockers, number and size to be determined in conjunction with the GNC.

5.11 Aft Deck

5.11.1 The aft deck shall be a clear, unobstructed working area so far as practicable. Any required fittings/vents/access shall to be positioned to maximise the working space for crane operation.

5.11.2 Access to the lower deck superstructure shall be via a hinged weather tight door into the Wet Lab and Monitoring room. Access shall also be via a sliding door with no external sill into the Workshop.

5.11.3 All hatches shall be flush apart from access to the engine room, these shall be mounted on a coamings of a RO approved height to allow access into the Engine Room whilst at sea.

5.11.4 24 mm threaded boltdown sockets shall be installed at 500 mm spacing over the main storage area of the aft deck. Final location and arrangement shall be confirmed with the GNC.

5.11.5 A minimum of one (1) water clarity sampling station, minimum dimensions 1m x 1m, is to be provided. The working deck of the station shall be at 1.3m above the designed waterline, as shown on the concept general arrangement. Access to the sampling station shall be via steps, not a ladder.

5.11.6 Fresh and salt water supply points with hose facilities shall be provided. The supplied hose shall be of a length suitable to access all of the aft deck.

5.11.7 The following equipment shall be fitted (see Chapter 7 of Part VII for details):

a) Two (2) Deck Cranes

b) Aft deck rosette transportation system (paragraph 15.4 of Part VII for details)

5.11.8 Access to the Upper Deck, via an external staircase, shall be provided. Minimum width of the staircase shall be 1.0 m between handrails.

Chapter 6 Upper Deck arrangement

6.1 Wheelhouse

6.1.1 The outside configuration of the deckhouse shall be of a design that deflect rain and seawater during heavy weather. Pillars are not allowed to be fitted inside the bridge area.

6.1.2 The wheelhouse shall be located on the upper deck. One (1) access door to be provided at the aft of the wheelhouse connecting to the upper deck passageway and two (2) weathertight access doors shall be provided on to the two (2) aft deck sides. All doors, external and internal, shall be capable of being locked from inside the wheelhouse.

6.1.3 Extended bridge wing shall be provided to facilitate the berthing and mooring operation. And the design shall also enable the ship crew to monitor the aft deck operation as far as practicable. The actual arrangement shall be discussed in the kick-off meeting.

6.1.4 Seating and Settees:

a) Three (3) helmsman seats with damping capability shall be provided at the wheelhouse control console for the crew. Requirements of the seats shall be:

(i) Seats shall be of hydraulically dampened, shock absorbing type;

(ii) Adjustable seat height with foot rest;

(iii) Backrest angle, fore and aft adjustable;

(iv) Adjustable armrests and lumbar support; and

(v) Turntable/Mounting pedestal 0° - 180°.

b) One (1) settee with lockers/storage beneath shall be provided in the Wheelhouse as indicated in conceptual GA plan.

c) All seats and the attachment system shall be acceptable by GNC and user department.

d) Seat materials of upholstery shall be of fire-retardant foam and fabrics suitable for marine use.

6.1.5 The bridge shall be designed with a bridge control station for one-man operation comprising controls and instruments for navigation, manoeuvring, communication and machinery operation. Instruments, instrument panels and controls shall be permanently mounted in the consoles, taking into account operational, maintenance and environmental needs.

6.1.6 Controls for the manoeuvring of the vessel shall be easily reachable by a person of normal Asian stature in the seated position without needing to extend his arms, and without obstructing the coxswain and the patrolling officer all-round field of view.

6.1.7 The wheelhouse shall incorporate ‘P’ & ‘S” extended bridge wing section in order to give a clear view down the side of the vessel for manoeuvring and docking.

6.1.8 The wheelhouse shall not be designed for used purposes other than navigation, communications, monitoring the performance of the machinery and other functions essential to the safe operation of the Vessel.

6.1.9 The following controls, displays and equipment shall be incorporated into the wheelhouse steering control station so that all relevant controls can be reached from a fixed working position (e.g., sitting, standing or both):

a) Steering wheel and remote-control handle (joystick) for centralised and individual control;

b) Independent control handle (joystick) shall be provided for individual bow thruster;

c) Independent control for individual E-motors;

d) Engine throttle and clutch controls;

e) Rudder or steering angle indicators;

f) Steering gear indicator control panel;;

g) Main engine monitoring indicator;

h) Hybrid system selector and monitoring indicators

i) Generator engine monitoring indicator;

j) Bilge control display panel and alarm;

k) Fire alarm for engine spaces and other relevant compartments (e.g. battery room);

l) Navigation lights, search light and flood light switch panel;

m) CCTV monitors

n) Meter / gauge indicating the quantity of fuel remained in the fuel tank;

o) Emergency stop for main engine, generator, engine room fan and air conditioner;

p) Electronic Navigational Equipment and displays including:

q) Automatic Identification System (“AIS”);

r) Echo sounder;

s) Public address system/loudhailer;

t) VHF;

u) Electric horn, siren, and flashing beacon control panel;

v) Magnetic compass;

w) DGPS;

x) Radar/Electronic Chart System;

y) Watertight doors indication and alarm; and

z) Any others as required by the RO and GNC.

6.1.10 The arrangement of equipment and means for navigation, manoeuvre, control, communication and other essential instruments shall be located sufficiently close together to enable the coxswain and the assisting officer to read/receive all the necessary information, and shall be able to use the equipment and controls while they are seated.

6.1.11 All instruments shall be logically grouped according to their functions. In order to minimise the risk of confusion, instruments shall not be rationalised by sharing functions or by inter-switching.

6.1.12 Instruments required for use by any member of the operating crew shall be plainly visible and easily read with minimum practicable disposition from his normal seating position and deviation from line of vision; i.e. they will cause minimum risk of confusion under all likely operating conditions.

6.1.13 The instruments and controls shall be provided with screen and dimming facilities to minimise glare and reflections and prevent them from being obscured by strong light.

6.1.14 The surfaces of console tops and instruments shall have dark glare-free colours.

6.1.15 The Contractor shall build a preliminary mock-up and a final mock-up of the bridge including all the navigation equipment arrangement, seats and other fittings as required under this Part VII. The mock up shall be of FULL SIZE dimensions and agreed by GNC. The bridge mock up inspection shall also include the visibility requirements in Paragraph 3.3 of Part VII.

6.1.16 The following additional fittings and equipment shall be provided in the wheelhouse:

a) Two (2) wall mounted fans of dia. 300 mm;

b) One (1) display board for posting plans, maps, notices, etc.;

c) One (1) set of pigeon holes for stowage of international code flags;

d) One (1) set of international code flags suitable for the mast;

e) One (1) set of open shelves for the stowage of log books and files;

f) One (1) chart table with lamp and dimmer over, a drawer shall be provided under the table top for the stowage of charts;

g) One (1) dial type inclinometer and one thermometer for marine use;

h) One (1) metal rubbish bin with cover shall be stored inside a cabinet/locker;

i) One (1) metal box for keys shall be provided and fitted inside the wheelhouse;

j) One (1) magnetic compass with independent illuminated dimmer switch;

k) One (1) wooden box with locks for the storage of binoculars, and it shall be fitted within the vicinity of the forward helmsman seats. One waterproof and fog proof 7x50 Marine binoculars for day time use shall be provided;

l) One (1) electric powered marine wall-mounted master clock;

m) Four (4) cup holders;

n) One (1) framed safety plan of appropriate size;

o) Four (4) coat-hooks;

p) A number of storage lockers; and

q) One (1) approved type first aid box.

6.2 Air Laboratory

6.2.1 The Air Laboratory on the Upper Deck shall contain the following equipment:

a) Three (3) Sapphire window openings (with size not smaller than 680 mm x 680 mm square), with detachable cover, shall be provided. One for each light emitting from light detection and ranging (LiDAR) system.

b) Dedicated air inlets from the roof (to be capped, for future vessel operations).

c) Direct access to the external aft upper deck via a hinged weather tight door.

d) The following equipment shall be provided by EPD. And the storage/mounting racks/work areas shall be provided/reserved by the contractor and the arrangement shall be discussed in kick-off meeting (see Annex 9 of Part VII for details):

(i) Ozone LiDAR
(ii) Wind LiDAR
(iii) Aerosol LiDAR
(iv) NOx analyzer
(v) O2 analyser
(vi) CO analyser
(vii) SO2 analyser
(viii) Chemically resistant, compact and oil-free diaphragm vacuum pump
(ix) Toxic Air Sampler
(x) PTR-Tof-MS
(xi) VOC's sampling
(xii) OVOCs sampling pump
(xiii) Formaldehyde analyzer

e) A suitably sized work bench with seating for six (6) persons. There shall be recessed power sockets provided in the centre of the table for computers/equipment, number and arrangement to be approved by the GNC.

6.3 Compressed Gas Storage Lockers

6.3.1 The aft upper deck shall be equipped with two (2) compressed gas lockers, opening on to the aft face of the upper deck external deck with weathertight doors. This locker is NOT for the carriage of other Dangerous Goods.

6.3.2 Minimum internal dimension for each locker is to be 900 mm wide, 450 mm deep and 1900 mm in height.

6.3.3 The locker shall be suitably vented to the external atmosphere.

6.3.4 The final location and arrangement of the compressed gas storage shall be agreed with the GNC.

6.4 Upper external aft & side decks

6.4.1 The upper external aft and side decks shall provide walkway between the lower external deck, air laboratory, wheelhouse and the wheelhouse roof. Stairway or ladder as agreed by GNC shall be provided for access from upper deck to roof deck.

6.4.2 All staircases shall have minimum clear width (between handrails) of 1.0m.

6.5 Wheelhouse roof arrangement

6.5.1 The wheelhouse roof shall be accessible via external staircase/ladder as agreed by GNC from the upper external aft deck.

6.5.2 Railings shall be provided which are capable of supporting 2 x 15 kg air sensor packs (see Annex 9 of Part VII - Sensor-based monitoring station (Gas and PM2.5) for details).

6.5.3 A minimum of six (6) mushroom air vents shall be fitted to the deck, with a minimum clearance of 1.5m horizontally from any vertical obstruction. The layout is to be approved by the GNC. The vents shall:

a) have a minimum internal diameter of 100 mm.

b) to be weathertight for the expected weather conditions expected in Hong Kong.

c) to be capped once installed.

6.5.4 The solar panels system for the vessel shall be installed on the wheelhouse roof. The size of the system shall maximise the use of available space on the wheelhouse roof.

6.5.5 The layout of the solar panels shall allow for regular cleaning/inspection and be approved by the GNC.

6.5.6 The output from the solar panels shall be incorporated into the electrical system of the vessel.

6.5.7 Fresh water hosing facilities are to be provided, with a supplied hose of a length suitable to access all of the wheelhouse roof solar panel arrays for cleaning purposes.

6.6 Mast arrangement

6.6.1 One (1) mast shall be fitted on the wheelhouse top with all navigation lights, sound signals, radar scanner and other electronic navigational equipment as required by GNC. The mast shall be constructed such that no vibration is experienced in any operating condition. The mast design shall be of appropriate size/strength to suit its purpose.

6.6.2 All equipment and their cables, conduits, connectors, junction boxes, glands, and fittings etc., shall be waterproof and be able to function in all weather conditions at sea.

Chapter 7 Deck Equipment

7.1 Anchor & Windlass

7.1.1 Anchor

7.1.1.1 At least one (1) high holding power type anchor approved by the RO for this type of vessel and acceptable to GNC shall be provided with its associated swivel, shackles, stowage cable or cable and warp and means of recovery.

7.1.1.2 The Vessel shall be provided with adequate and safe means for releasing the anchor and its cable and warp.

7.1.1.3 The means of release shall be capable of safe operation even when the anchor cable or warp is under load.

7.1.2 Windlass & Chain Locker

7.1.2.1 The vessel shall be fitted with an electric/hydraulic windlass mounted on/beneath the foredeck of the vessel.

7.1.2.2 The electric/hydraulic windlass with its associated gypsy and warping drum, cable stopper, and hawse pipe shall be of a size, type, height and power suitable for an easy run of the anchor chain and lines.

7.1.2.3 The windlass shall be capable of lifting one anchor with sufficient length of chain, at a speed acceptable to the RO and in accordance with IMO requirements.

7.1.2.4 Control of the windlass shall be located in the vicinity of the windlass through a control unit enclosed in the watertight cabinet. There shall be another control unit in the wheelhouse, that it can be controlled in rough weather.

7.1.2.5 Emergency stop button for windlass shall be provided in local control station and wheelhouse at the coxswain station.

7.1.2.6 A canvas/tarpaulin windlass cover shall be provided if the windlass is exposed on the forecastle deck.

7.1.2.7 The Vessel shall be protected so as to minimise the possibility of the anchor and cable damaging the hull structure during operation (including in bad weather and sea conditions).

7.1.2.8 The size of chain locker shall be suitable for self-stowing of cable by gravity in all sea conditions. The chain locker shall be fitted with bilge pumping if not self-draining and a hard wood grating not less than 50 mm thick on the bottom.

7.2 Mooring and towing equipment

7.2.1 Suitable fairleads, bitts and mooring ropes shall be provided and fitted at the appropriate position for the safe mooring operation.

7.2.2 A minimum eight (8) bollards on deck shall be provided. All the bollards shall be double bitts and suitable for towing vessels of similar dimensions from side and rear. The structure associated with these bollards shall be strengthened as per the RO requirements.

7.2.3 Quantity and dimension of mooring ropes shall comply with the RO requirements.

7.2.4 Berthing arrangement of the Vessel shall match with the designated berthing point positions and arrangement to the GNC's satisfaction.

7.2.5 Enclosed lockers or bins for storing mooring lines shall be provided on deck such that they are readily available and are secured against the high wind and ship motion accelerations.

7.2.6 Two (2) stainless steel boat hooks with 3-metre staves and stowage arrangement shall be provided.

7.3 Deck Cranes

7.3.1 Two (2) hydraulic foldable knuckle boom cranes shall be provided on the aft deck, mounted close the port and starboard deck edges. These cranes shall be used for water and seabed sampling operations.

7.3.2 Each crane shall be powered via its own power pack installed under main deck.

7.3.3 One of the deck crane shall be with lifting capacity not less than 1,500 kg with 6 m outreach. The lifting capacity of the other deck crane shall not be less than the range of 600-800 kg with 3 m outreach.

7.3.4 Both the two (2) cranes shall be properly certified for full compliance with the applicable Lifting Appliances and Lifting Gear regulations of Hong Kong. The whole system shall also be approved by the RO.

7.3.5 These two (2) cranes shall be capable to be operated by two operators simultaneously.

7.3.6 Control consoles shall be provided for local control for each crane. They shall be installed under the upper deck canopy. A handheld remote control shall also be provided for each crane.

7.4 Fenders

7.4.1 Fixed hollow D shape rubber fenders of a suitable size acceptable to GNC shall be fitted continuously along the ship sides and stern at the main deck level. The arrangement of the fenders shall also provide protection between the waterline and main deck.

7.4,2 The hull structures shall be suitably strengthened for the proposed fendering arrangement.

7.4.3 Proper size and sufficient number of rubber tyre fenders shall be provided on each side of the Vessel at the weather deck level, with stainless steel securing devices. The arrangement shall also be submitted to GNC for approval prior to installation.

7.4.4 At least twelve (12) units of portable air filled fenders at diameter not smaller than 450 mm shall be provided.

7.5 Open Deck Drainage System

7.5.1 The Vessel shall be fitted with an open deck drainage system to the RO's Requirements.

7.5.2 Scupper piping shall be constructed of marine grade stainless steel. Means shall be provided to avoid any possible galvanic corrosion.

Chapter 8 Painting, Marking and Colour Scheme

8.1 Painting and Ultrasonic Antifouling System

8.1.1 The Contractor after contract award shall propose a list of the paint to be used for the hull, deck, superstructures structural materials (including anti fouling paint) with detailed specifications of the paint. Thickness of each coating shall be specified. Property compatibility of different paint layers shall be maintained.

8.1.2 Paints shall be of a fire-retardant marine quality and applied to the appropriate areas in accordance with the manufacturer's specification.

8.1.3 The Contractor shall propose a suitable paint specification for GNC's approval.

8.1.4 Surfaces that require painting shall be fully prepared to meet with paint maker's requirement prior to painting.

8.1.5 Volatile Organic Compounds (VOC) content limits of the paints shall comply with the Controls and Requirements of the VOC Regulation (VOC content limits for regulating paints used on vessels and pleasure craft) of the Regulation of Hong Kong Air Pollution Control Ordinance.

8.1.6 A Tributyltin (TBT) free fouling-release/anti-fouling paint complies with actual operating profiles of this vessel shall be applied on the following areas below the water line to provide at least two-years protection against the marine growth.

8.1.7 A TBT free certificate issued by the paint manufacturer shall be submitted before the Delivery Acceptance.

8.1.8 The fluoropolymer foul release coating/antifouling paint (e.g. Intersleek 1100SR or equivalent) shall comply with the International Convention on the Control of Harmful Anti-fouling Systems on Ships as adopted by the IMO.

8.1.9 The Contractor shall adopt an Ultrasonic Antifouling System ("UAS") for protection for ship hull areas in particular those (e.g. sea chest, stern areas etc.,) vulnerable for marine growth.

8.1.10 All deck areas shall be covered with hard wearing and anti-slip epoxy paint.

8.1.11 All paint work shall carry a one-year guarantee provided by the Contractor against defects in material and workmanship.

8.1.12 Painting schedule proposed by the Contractor in consultation with the paint suppliers/manufacturers shall be submitted for GNC approval before painting.

8.1.13 A painting report shall be submitted to MD upon the completion of painting work for the Vessel.

8.1.14 The Contractor shall provide GNC at Delivery Acceptance a letter of certification from the paint manufacturer to certify the application of the paint is under the paint manufacturer's quality control, and that it is in accordance with the manufacturer's requirements for surface preparation, metal surfaces temperature and atmospheric conditions, paint thickness and method of application.

8.1.15 The colour of the paints shall refer Markings and Colour Scheme.

8.2 Markings and Colour Scheme

8.2.1 The marking and colour scheme for the Vessel shall be in accordance with the requirements given in this Part VII.

8.2.2 The Contractor shall provide the markings and colour scheme for the Vessel, which shall be in accordance with the requirements given in this Part VII. The colour scheme shall be approved by GNC before application. All painting colour schemes for fittings shall be agreed by GNC.

8.2.3 All labelling shall be in both Traditional Chinese and English and as per applicable rules and regulations. The user department logo shall also be displayed on both sides of the deckhouse or elsewhere as directed by GNC.

8.2.4 The Vessel's name shall be marked permanently and painted on both sides of the deck house and bow and at the transom centre to the GNC satisfaction. Draught marks shall also be marked on both sides of the bow and stern in the same manner as the Vessel name. The full load design draught mark shall be marked port and starboard amidships to the satisfaction of the RO and GNC. Vessel's identification shall be marked as large as possible at the deckhouse top for helicopter viewing.

8.2.5 All labelling, stencilling and marking (not limited to the hull but including all aspects of the Vessel) shall be made on separate plaques, boards, or labels attached to the structure. By default, all displays, control actuators, electric switches, valves, and other equipment shall be labelled to indicate their type and function as appropriate.

8.2.6 Exits shall be identified, labelled and supplemented by reflective direction signs. In addition, emergency escape lights shall be installed in cabins/ compartments. Stowage locations for Life Saving Appliances ("LSA") including but not limited to life jackets and quantities of life jackets shall be identified as per the requirements specified under the Safety of Life at Sea ("SOLAS") regulations.

8.2.7 Fire-fighting equipment shall be identified and labelled as per the requirements specified under the SOLAS regulations.

8.2.8 Trip hazards shall be avoided aboard the Vessel as much as possible and, otherwise, shall be appropriately marked.

8.3 Tally Plates

8.3.1 The following information shall be displayed on the builder's plate:

a) Builder's name;

b) Vessel's name;

c) Year of build; and

d) Maximum number of persons including the crew that the Vessel is designed to carry.

8.3.2 Tally plates in both English and Traditional Chinese characters shall be fitted for all spaces and all equipment as required by GNC including but not limited to:

a) Equipment contained within consoles;

b) Electrical and communications equipment;

c) Air vents and filling pipes for fuel oil tanks;

d) All valves and equipment on deck;

e) Control panels, switchboards, distribution boxes and electrical circuits; and

f) Any other equipment/fitting as required.

Information engraved on the tally plates shall include: service, function, mode of operation, s source of power, fuse rating, voltage, warning and other information as required by GNC.

8.3.3 All cable terminations shall be identified clearly for disconnection and reconnection purposes.

8.3.4 Tally plates exposed to the weather shall be made of durable and weatherproof material and be securely fastened.

8.3.5 List of tally plates shall be provided to GNC for approval.

Chapter 9 Machinery

9.1 General Provisions

9.1.1 The Tenderer shall note that the Vessel is for use in Hong Kong and it shall that the main engines, gearboxes, electric generator sets and any other machinery offered by the Tenderer are those at present commonly used by ships operating in Hong Kong Waters, and that they have good support for spare parts and after sale services locally in Hong Kong.

9.1.2 It is desirable that the support of local agents shall include supplying brand new proposed main engines, gearboxes, electric generator sets, propulsion batteries and other machinery for five (5) years after vessel delivery.

9.1.3 The Vessel shall be equipped and fitted with all machineries described in this Chapter each complying with the specifications set out in this Chapter for such machinery. The Spare Parts to be provided shall be of the same model as supplied for the Vessel and shall equally comply with all specifications set out in this Chapter.

9.1.4 The engine room shall be an unmanned machinery space ("UMS"), designed for unmanned operation. Under normal operation, all controls are directed from the wheelhouse where the control consoles shall be fitted with a full set of monitoring instrumentation and alarm indications. However, essential local manual controls shall also be provided for the main propulsion engines and steering gear for emergency operation.

9.1.5 Two (2) accesses with reasonable separation shall be provided for the engine room. The design of the engine room layout shall be approved by the RO and agreed by GNC. The machinery, associated piping systems and fittings relating to the main engines and electric generator sets shall be of a design and construction adequate for the service for which they are intended and shall be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards. The design shall have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board. Cushion/protection on the overhead cable trunk for preventing head injury of crew shall be provided.

9.1.6 Easy access and ample headroom around all machinery shall be provided for local operation, routine checking and 'in-situ' maintenance. Well-planned removal routes shall be provided for the major items such as the main propulsion engines, gearboxes, and the generator set, etc.

9.1.7 Sufficient space and headroom in the vicinity of the machinery for local operation, inspection and routine maintenance for all the machinery shall be provided. Procedures and sequences for complete removal of the major items such as the main engines, gearboxes, generator set, fuel oil tanks etc. shall be carefully designed to enable their removal from ships for maintenance in a practicable manner so to avoid the need for the deck or shell plate to be cut.

9.1.8 All parts of machinery, hydraulic, control and other systems and their associated fittings which are under internal pressure shall be subjected to appropriate tests including a pressure test before being put into service for the first time.

9.1.9 Provision shall be made to facilitate cleaning, inspection and maintenance of main engines, electric generator sets, fire pumps etc. and their associated piping and equipment.

9.1.10 Lifting brackets for moving heavy equipment shall be mounted underneath the deck head of the engine room, the engine room entrance and other appropriate locations. The lifting capacity shall be marked on every of these lifting brackets after a load test to the RO Requirements. All lifting appliances shall be properly certified and a Registry of Lifting Appliances and Lifting Gear shall be provided in accordance with the applicable regulations.

9.1.11 All emergency stops shall be fitted with protective guards to prevent inadvertent use.

9.1.12 The machinery installation shall be suitable for operation as in an unmanned machinery space. The monitoring and control, including automatic fire detection system, bilge alarm system, remote machinery instrumentation and alarm system shall be centralised in the control station of the wheelhouse.

9.2 Main Propulsion System

9.2.1 Parallel Hybrid System shall be adopted for main propulsion of the vessel. Details of Hybrid System shall refer to Chapter 14 of Part VII for detail information

9.2.2 Two (2) fixed pitch propellers shall be driven by the following main propulsion system.

9.2.3 The system shall comprise two (2) independent drivetrains. Each drivetrain, consisting of one (1) marine diesel engine, one (1) reduction gearbox, one (1) electric motor and one (1) fixed pitch propeller which shall be fitted in each hull. The drivetrains shall be identical in each hull. **[E]**

9.2.4 Two (2) electrically started, fresh water-cooled marine diesel engines dedicated for driving the two (2) fixed pitch propellers are directly capable to be further assisted by two (2) electric motors ("E-Motor"). Both the marine diesel engines and the E-Motors shall be driving the fixed pitch propellers via the same reduction gearboxes. **[E]**

9.3 Marine Diesel Engine Propulsion System

9.3.1 The emission level of the two (2) marine diesel engines shall meet IMO Tier III emission requirements. The EIAPP Certificate and technical file shall be supplied by the engine manufacturer in the in the ship delivery. The appropriate test cycle to suit the proposed diesel engine's application, in accordance with the NOx Technical Code 2008, as amended shall be stated in EIAPP.

9.3.2 Certificate of Product for Engine and Type-approved certificates issued by the RO or another classification society listed in the definition of "Recognised Organisations" in Clause 1.1 of Part IV certifying compliance with the emission level as specified in paragraph 9.3.1 above shall be provided.

9.3.3 The main propulsion engines shall be resilient-mounted to the ship's structure.

9.3.4 The main propulsion engines shall be marine diesel engines of proprietary make, electric started by 24 Volt-DC, and to have integral fresh water/sea water heat exchangers, fresh

water pump, sea water pump, LO pump, fuel lift pump (if necessary), FO filters, LO filters, engine-mounted instrumentation panel with essential gauges and protective devices, and any other ancillary equipment and fittings as recommended by the engine manufacturer for the efficient operation of the engines.

9.3.5 Engine-mounted charging alternator, capacity of not less than 60 amperes, with built-in voltage regulator shall be provided on each main engine for charging their respective starting batteries.

9.3.6 The Proposed Propulsion System including its control system shall be approved by the RO.

9.3.7 To facilitate LO renewal, a suitable hand pump connected to the LO sump shall be provided for each diesel engine so that LO can be drained from the lowest point of the engine LO sump.

9.3.8 The main engine's exhausts and silencers shall be protected according to the RO Requirements to avoid the hot surface danger to the personnel and minimise the heat transfer into the machinery space. All components of exhaust system shall be mounted or suspended by the hangers which will not transmit heat, noise or vibration to the Vessel's structure. The exhaust outlets shall be designed inboard hull ship side on the shell shall be positioned above the waterline.

9.3.9 Manufacturer's full power shop trial certificate for a continuous running test at full load for four hours for each main engine must be submitted to MD before the acceptable trials.

9.3.10 The governor control of the engine must be capable to properly control the engine when the engine is suddenly unloaded.

9.4 Main Propulsion Control

9.4.1 The design and installation of the main engines and E-Motors control shall follow the RO Requirements. The control and instrumentation of the main engines and E-Motors shall be designed for one-man operation in the wheelhouse, they shall be ergonomically laid out and grouped around the steering position in the wheelhouse control console.

9.4.2 Instrumentation and control systems for the main and auxiliary machineries shall be designed for unmanned machinery space operation.

9.4.3 Engine mounted instrumentation panel with the essential gauges shall be provided locally for each machinery to facilitate easy maintenance.

9.4.4 The monitoring probes and sensors fitted to the main and auxiliary machineries shall be of a type-approved by RO.

9.4.5 Instrumentation and controls for the Main Diesel Engines in the control console shall be comprehensive and shall include:

a) Starting and stopping of main engines from the wheelhouse;

b) Emergency stop button with guard cover;

c) Wheelhouse / local control change over switch and indicator;

d) Speed control device;

e) Engine tachometers with running hour meter;

f) Sea water cooling pressure;

g) Coolant water temperature and pressure;

h) Engine lubricating oil temperature and pressure gauges;

i) High cooling water temperature alarm and de-rate function;

j) Engine low lubricating oil pressure alarm and trip;

k) Gearbox lubricating oil low pressure gauge;

l) Gearbox lubricating oil low pressure alarm and trip;

m) Engine exhaust gas pyrometer; and

n) Over speed alarm and trip.

9.4.6 Standard engine maker's engine control panel shall be provided in the engine room.

9.5 Electrical Generating Sets

9.5.1 Two (2) identical, electrically started, fresh water-cooled diesel generator shall be installed on the vessel. These two (2) electric generating sets shall be of self-excited, brush-less, ventilated type and be from the same manufacturer.

9.5.2 The emission level of the two (2) diesel generator shall meet IMO Tier III emission requirements if found applicable. The EIAPP Certificate and technical file shall be supplied by the engine manufacturer in the in the ship delivery. The appropriate test cycle to suit the proposed diesel engine's application, in accordance with the NOx Technical Code 2008, as amended shall be stated in EIAPP.

9.5.3 Each diesel generator shall be capable to supply all full operational electrical loads for the whole Vessel including air conditioning system running at full capacity plus not less than a 15% reserve margin; and permitting the starting of the largest motor without causing any motor to stall or any other device to fail due to excessive voltage drop of the system when the electric generating sets are supplying full operational electrical load including air conditioning system running at full capacity of the whole Vessel.

9.5.4 The rating of each diesel engine shall be capable of developing power of no less than 110% of the alternator's continuous service rating for 15 minutes. Electrical load analysis and calculations shall be approved by the RO before submission to GNC.

9.5.5 The exhaust of the electric generating sets shall be arranged with a water-lock/lift-silencer with a view to reducing its noise levels. This shall be configured with a hose running from the gen-set (wet outlet) and a wet hose outlet.

9.5.6 The exhaust outlets leading to the tunnel between the hulls, at the aft end of the hull, shall be positioned above the waterline and be as high as practicable to prevent standing waves sealing the outlet. Exhaust pipe outlets shall be at a minimum of 300 mm vertical distance above loaded waterline and can be arranged via goose-neck type expansion bellow to the exhaust outlet fitted to shell above waterline for discharge.

9.5.7 The design and installation of diesel generators, switchboard and associated wiring shall be in accordance with the RO Requirements as well as the following:

a) Each diesel generator shall be provided with a Type Approval Certificate from a RO;

b) Each diesel generator shall be resiliently mounted; and

c) The arrangement of electrical and piping systems shall allow quick dismantling and replacement of the unit.

9.6 Electrical Generating Set Control

9.6.1 The controls and instrumentation of the electric generators shall be designed for one-man operation in the wheelhouse, the instrumentation and controls in the control console shall be comprehensive and shall include:

a) Remote start and stop;

b) Tachometer with running hour meter;

c) Cooling water temperature gauge;

d) Exhaust gas temperature gauge;

e) Lubricating oil pressure gauge;

f) Battery charger ammeter;

g) Fault indicating lights and alarms; and

h) Protective devices such as overspeed, low lubricating oil pressure trip etc. as recommended by the engine builder.

9.6.2 A standard manufacturer's local control panel shall be fitted in the engine room with the following instrumentation and alarm for generator sets:

a) Start / stop push buttons shall fitted with guard cover and running / stop indication lamp for each of the two generator engines; and

b) Volt-metre, Watt-metre for each generator.

9.6.3 The Primary generator which supplies propulsive power to the vessel when operating in hybrid mode shall have an automated control system which starts the generator when the hybrid mode is selected via a control at the helmsman's station and stops it upon de-selection.

9.7 Instrumentation and Control

9.7.1 A control station in the wheelhouse shall be provided with comprehensive instrumentation and controls for remote operation and monitoring of the main engines, electric generator sets and other auxiliaries to facilitate for unattended engine room operation.

9.7.2 At least two (2) independent means of stopping the main engines from the wheelhouse control station under any operating conditions shall be available. A changeover control switch be fitted at each of the engineer control consoles to prevent both from being active at the same time.

9.7.3 One (1) fire detector panel shall be provided.

9.7.4 All the instruments such as temperature sensors, pressure sensors, level gauges etc. shall have obtained type approval certificates issued by the RO or the manufacturer's certificate complying with the national standards of the place of manufacture of the relevant instrument.

9.7.5 All indication lights, illumination of instrumentation gauges fitted on the consoles of the wheelhouse control station shall be fitted with dimmers for day and night operation.

9.8 Reduction Gearboxes

9.8.1 The reduction gearboxes shall be reversible and resilient-mounted to the ship's structure. Gearboxes shall be provided with clutches, alarm senders and switches.

9.8.2 Gear oil heat exchangers shall be mounted on the reduction gearbox and piped to the engine cooling circuits as specified by the manufacturer. Gearbox oil coolers shall be sized to accommodate the heat generated by the clutches at less than full engagement.

9.8.3 Reduction gears shall be sized to provide both low and high-speed performance, shafts shall rotate outboard (over the top) when the Vessel is moving forwards.

9.8.4 The reduction gearboxes shall be capable to provide PTI and PTO function as stated in Chapter 14 of Part VII.

9.8.5 The gearboxes shall be provided with alarms for low oil level and oil temperature. Alarms shall be repeated both locally and at each remote-control station.

9.8.6 In order to operate vessel at maximum 5 knots loitering speed and to avoid repeated clutching in and out, the reduction gear box shall be fitted trolling clutch and other necessary fitting for low-speed operation.

9.8.7 The gearboxes shall be supplied with a Type Approval Certificate from RO.

9.9 Propeller Shafts, Stern Tubes and Propellers

9.9.1 All the components of the shafting system shall be in accordance with RO Requirements.

9.9.2 All the components of the shafting system shall be of adequate strength and stiffness to enable it to withstand the most adverse combination of the loads without exceeding acceptable stress levels for the material concerned.

9.9.3 Stern Tubes shall be:

a) Water lubricated ones Type Approved by RO. Propeller shaft bearing shall also be RO approved, water-lubricated cutlass rubber/composite type. Forward and after ends of stern tubes shall be bored for bearings and a dripless shaft seal system shall be fitted to the inboard side of each stern tube.

b) The material of the stern tube shall be bronze/ stainless steel 316L with antifouling protection.

9.9.4 The propeller shafts shall be manufactured from corrosion resistant material, such as 316L stainless-steel or equivalent approved by RO and to satisfaction of GNC.

9.9.5 The propellers shall be a fixed pitch type, designed to minimize the vibration in shell plating and hull girder.

9.9.6 Propellers shall turn outboard over the top when the Vessel is moving ahead.

9.9.7 Propellers shall be selected to achieve the Contract Speed when 100% Maximum Continuous Rating (MCR) engine power is applied. A shaft tachometer shall be fitted to measure the Vessel shaft speed and to validate the engine power output.

9.9.8 The propeller shaft brackets shall be of stainless-steel construction. The materials for shaft brackets, shafts, keys, locking nuts shall be compatible for use with the propeller material. All components shall be designed and submitted for approval by RO. All components shall be approved by RO.

9.9.9 Grease or packing containing graphite shall not be used.

9.9.10 Each propeller shall be fitted with a rope-cutting device.

9.9.11 The propellers and stern tubes shall be protected by a cathodic protection system for two (2) years' service life from Delivery Acceptance.

9.9.12 Torsional vibration analysis of the engine driveline and propeller shaft system shall be submitted to RO for approval. All the components of the shafting system design and installation shall follow the RO Requirements such as Torsional Vibration Calculation.

9.10 Steering Gear

9.10.1 The steering gear system shall be a twin rudder arrangement and shall comply with RO Requirements.

9.10.2 Electro-hydraulic steering gear with two (2) independent power units, each running unit capable of providing the maximum torque operating on twin rudders.

9.10.3 The system shall include motor driven pumps, reservoir/filter units, emergency manual helm pump, rudder transmitter limit switch, rudder angle indicators, actuating cylinders, master helm control and one non-follow-up controller.

9.10.4 The rudder(s) shall be controlled by a steering wheel and joystick in the control station of the wheelhouse. The steering wheel shall of a non-skid type of appropriate size acceptable to GNC. The power electro-hydraulic pump shall be capable of being started and stopped both in wheelhouse and in the steering gear room. Individual back-up control shall also be provided

9.10.5 Individual illuminated rudder angle indicators with dimmer switch, running and overload alarm shall be provided at the Wheelhouse Control station.

9.10.6 An emergency steering system shall be provided in accordance with RO Requirements.

9.10.7 A change-over electric switch shall be provided at the Wheelhouse Control station for switching the steering control between electric mode and manual mode.

9.11 Rudders and Rudder Stocks

9.11.1 The rudders shall be spade streamline type fabricated by corrosion resistant material such as ASTM 316L stainless steel or equivalent

9.11.2 The rudders shall be designed to meet the RO Requirements.

9.11.3 Rudder angle indicators shall be provided in each of the steering gear rooms. The port and starboard degree markings in intervals not greater than one degree shall be permanently marked and distinguished by red (port) and green (starboard) in English and traditional Chinese.

9.11.4 Extremes of rudder travel shall be provided by mechanical stoppers.

9.11.5 Lower bearings of rudder stock shall be water-lubricated.

9.11.6 The rudder stock shall be made of ASTM 316L stainless steel and shall be designed in accordance with the RO Requirements.

9.12 Bow Thrusters

9.12.1 Two (2) bow thrusters shall be fitted to the vessel, one in each hull.

9.12.2 The bow thrusters of AC electric variable speed type are to be fitted for docking and position keeping. Each Hull shall be equipped with one bow thruster making a total of two (2) bow thrusters. Centralised and individual back up controls are to be provided for the bow thrusters.

9.12.3 The bow thrusters shall be capable of manoeuvring the Vessel with rotation about the centre of gravity and shall be suitable for this size of vessel and the corresponding windage area.

9.12.4 The proposed system, components, arrangement and design shall be submitted for RO and GNC approval.

9.12.5 The bow thrusters shall enable the vessel to be capable of station keeping (manually), in conjunction with the electrical propulsion engines under weather conditions equivalent to WMO Sea State 5.

9.12.6 The bow thruster shall be positioned as far forward as is practicable. It shall be located below the waterline with sufficient depth to prevent air from being sucked into the tunnel but above the keel with the trim and dynamic motion responses considered.

9.12.7 The electric bow thruster shall be driven by a permanent magnet motor equipped with soft starting arrangement, variable frequency drive (VFD) of active front end type, and joystick control. The VFD shall be RO approved and equipped with:

a) Stall prevention;

b) Current limitation & overcurrent protection;

c) Short-circuit protection;

d) Undervoltage & overvoltage protection;

e) Ground fault protection;

f) Power supply phase failure protection; and

g) Motor thermal protection through sensing of the motor winding temperature.

9.12.8 The Wheelhouse navigation console shall be provided with joystick and basic panel with the following features:

a) VFD alarm;

b) Motor alarm (e.g. high temp and overload alarm etc.);

c) Power supply to the control system failure;

d) Indicator showing direction of thrust;

e) Load indicator of motor; and

f) The concerned alarm and status of the bow thruster shall also be provided on the wheelhouse engineer control console.

9.12.9 An aluminium alloy tube shall be incorporated into the Vessel structure to house the bronze/stainless steel propeller. The tube, if rolled, and welded shall be non-destructive tested before installation into the Vessel hull. Once fitted, the surrounding welds shall be non-destructive tested. This shall be carried out in accordance with the RO's Requirements.

9.12.10 A flexible coupling shall be fitted between the bow thruster motor and the drive shaft.

9.13 Position Keeping System

9.13.1 A position keeping system shall be provided. The system shall automatically hold the Vessel in a predetermined position and heading by controlling the speed (RPM) of the Vessel's propellers and bow thrusters. A control panel shall be fitted at the Wheelhouse Control Station within the reach of coxswain to enable the aforesaid control and adjustment.

9.13.2 In addition, the position keeping system shall also provide an additional function, namely weathervaning position keeping. When this position keeping function is selected, the system shall automatically hold the Vessel in a predetermined position but weathervane without holding a specific vessel heading in order to weathervane to a heading with the least combined environmental load from wind, wave and current.

9.13.3 The system shall provide a lost position alarm when the vessel drifts off the target position outside a pre-set range/radius. The user shall be able to adjust the range/radius.

9.13.4 It shall be possible to manually control the system to drive the Vessel using the joystick of the position keeping system, or by selecting the position (longitude & latitude) and required heading for position keeping, via a navigation display/control panel located at the Wheelhouse Control Station.

9.13.5 The position keeping system shall be designed and installed to receive input data from the DGPS, Gyro Compass and anemometer for wind speed/direction.

9.13.6 A RO DP notation for the Vessel and the position keeping system is not required.

9.14 Engine Room and other Machinery Space Ventilation

9.14.1 Mechanical ventilation consists of a minimum of two (2) forced in type fans (minimum of one (1) per engine room) shall be provided to engine room. The ventilation fans capacity shall be adequately to ensure full power operation of all machinery in all weather conditions, including heavy weather, an adequate supply of air shall be maintained to the compartment for the safety of personnel and the operation of the machinery.

9.14.2 The air supply inlet vents shall be connected to louvers of efficient design in preventing ingress of water during extreme weather conditions. All vents shall be provided with weather-tight covers, fire dampers and coaming of adequate height.

9.14.3 The engine room compartment shall be adequately ventilated to ensure that when machinery therein is operating at full power in all weather conditions, an adequate air supply is maintained to the compartment for the safety of personnel and the operation of the machinery.

9.14.4 All spaces containing machinery shall be provided with forced ventilation for combustion and ventilation air to meet the requirements of the prime movers and other heat sources with a minimum 50 air changes per hour for the machinery space. The ventilation design shall be such to avoid any hot spot or “dead air” area.

9.14.5 All ventilation ducts, intakes, and outlets shall be sized to minimise pressure drops and flow noise. For design purpose, air flow rates in ducting shall be kept at 10 m/s or less. Airflow rates at vents and louvres shall be as low as required to avoid flow noise (Typically 5 m/s depending on vent or louvre design).

9.14.6 All the hull compartments shall be adequately ventilated for the purpose of those compartments. The ventilation arrangements shall be adequate to ensure that the safe operation of the Vessel is not put at risk.

9.14.7 For guidance, the ventilation air to the Engine Room compartment as stated shall:

a) limit the temperature rise in a machinery space to 10°C above ambient temperature; and

b) as the prime movers draw combustion air from within the compartment, the total ventilation air be based on ISO 7547 “Standard for Shipbuilding - Air-conditioning and ventilation of accommodation spaces” as a minimum but shall not be less than that required for combustion plus 50%.

9.14.8 Automatic shut-off device shall be provided according to RO Requirements when fixed gas smoothering system is activated.

9.14.9 Calculation for the capacity of the fans to meet the minimum air changes requirements shall be submitted to the RO for approval.

9.15 Heating, Ventilation and Air Conditioning System

9.15.1 Proprietary make cold and warm split-type air cooled air-conditioning system including indoor and outdoor units for each of the following compartments shall be provided. The Contractor shall propose specific equipment for approval by GNC prior to purchasing.

a) Wheelhouse;

b) Air Laboratory;

c) Conference Room;

d) Galley and Crew Mess;

e) Wet lab & Monitoring Room; and

f) Workshop for Sampler.

9.15.2 Fresh air shall be induced into the fresh air pre-treatment unit and shall be pre-treated to avoid any formation of condensation anywhere inside the vessel.

9.15.3 The system described shall provide both heated and chilled air and be designed to accommodate an additional 50% cooling capacity.

9.15.4 The temperature of the compartments as stated in Paragraph 9.15.1 shall be maintained at 22°C for 60% relative humidity when the external ambient air temperature is 38°C at 85% relative humidity with full crew and full carrying capacity on board. An acceptance test of the complete air-conditioning system of the Vessel shall be carried out by GNC to verify the system is effective and complying to the requirements given here. The Contractor shall provide GNC a copy of this test report upon completion of the test.

9.15.5 The design of the cooling air shall be evenly distributed. An individual control shall be provided in each compartment.

9.15.6 The location of air-conditioning indoor and outdoor units shall not create any obstructions to the removal of any hatch covers or direct maintenance of any major machinery and equipment.

9.15.7 The support rack for each outdoor unit shall be provided. Removable covers shall be provided for protection the external unit of air-conditioner from sunlight / rain.

9.15.8 The refrigerant shall be CFC and HCFC free.

9.15.9 Emergency stop switches of the air conditioning system in addition to the normal power ‘on’ and ‘off’ switches shall be installed in the wheelhouse control station.

9.15.10 Sufficient fresh air induced to the air-conditioned area shall be based on ISO 7547 “Standard for Shipbuilding - Air-conditioning and ventilation of accommodation spaces”, all compartment; and there shall be not less than 25 m3/h per person so as to keep the CO2 level low enough for health reasons.

9.15.11 Bacteria resistant replaceable filters shall be fitted at air inlets.

9.15.12 The air-conditioning indoor units shall be located in the compartments for its efficient operation within the cabin environment, as recommended by the air-conditioner manufacturer, with due regards to air moisture at sea environment to avoid undue condensation formation. In view of design constraints with respect to the already compact cabin space and its other installed fixtures and fittings, the exact installation position of the indoor units shall be agreed by GNC before installing the indoor units in the cabin(s).

9.16 Refrigerating System

9.16.1 The Cold store stated in Chapter 5 of Part VII shall be equipped with a refrigerating system capable to maintain the cold store temperature range of 2ºC – 4ºC. A Proprietary Make cooling system shall be housed in the port hull tank room, this system shall be sea water cooled, via a heat-exchanger.

9.16.2 The area of the cold room shall be 7 m².

9.16.3 The cold store shall:

a) be properly insulated in order to properly maintain the temperature;

b) have thermostat controls (with integral temperature gauge readouts) in both the Cold store but also the workshop for sampler; and

c) be equipped with a warning system in the workshop for sampler & laboratory in case of system failure or the temperature of the cold store rising above the threshold limit of 4ºC.

9.16.4 The details of internal arrangement shall be discussed after tender has been awarded and subject to final agreement by user department.

9.17 Piping System

9.17.1 Piping connections and joints shall be constructed and designed in accordance with the RO's requirements. Pipe bends shall be kept to a minimum in number and shall have sufficiently large radii to facilitate a smooth flow.

9.17.2 The piping material shall be marine grade 316L stainless steel or equivalent agreed by the GNC. The thickness and material shall be acceptable to the RO.

9.17.3 All pipes shall be secured in position to prevent chafing or lateral movement. Long or heavy lengths of pipe shall be supported by bearers, so that no undue load is carried by the pipe connections, pumps or fittings to which they are attached. Proper insulation shall be applied to avoid galvanic corrosion.

9.17.4 Suitable provision for expansion shall be made, where necessary.

9.17.5 Where expansion/flexible pieces are fitted, arrangements shall be provided to protect against over extension and compression. The adjoining pipes shall be suitably aligned, supported, guided and anchored, where necessary, expansion pieces of the bellows type shall be used to protect the system against mechanical damage.

9.17.6 As far as practicable, pipelines, including exhaust pipes from engines, are not to be routed in the vicinity of switchboards or other electrical appliances in positions where the drip or escape of fluids or gas from joints or fittings could cause damage to the electrical installation.

9.17.7 Watertight bulkheads, decks or structural members having pipeline penetrations shall be designed and installed in accordance with the RO's Requirements. Watertight and structural integrity must be maintained and approved by the RO and to the satisfaction of GNC.

9.17.8 The material of gaskets shall be capable of resisting chemical attack from the fluid being conveyed. Means to prevent galvanic corrosion shall be provided if different materials are used in the system.

9.17.9 All piping and equipment shall be labelled and colour-coded. Each pipe running through each compartment shall be colour-coded, labelled and have the direction of flow marked, in at least two (2) places. Colour coding of machinery and piping shall be in accordance with ISO 14726:2008.

9.18 Fuel Oil System

9.18.1 As Government vessels are committed to utilise sustainable / renewable fuel blends. The fresh water-cooled marine diesel engines for the Proposed Propulsion System and separately for the electric generating sets of the Vessel shall be able to use ASTM D975-08a B5 blends diesel fuel (5% biodiesel, 95% diesel labelled B5) and approved by the engine makers.

9.18.2 The fuel oil for the fresh water-cooled marine diesel engines for the Propulsion and electric generating sets shall be separately supplied from two (2) fuel oil tanks. Endurance for fuel capacity shall be as stated in Chapter 2 of this Part VII.

9.18.3 The design, materials and installation for the Fuel Oil system and tanks shall meet the RO requirements. Individual components of the system, and the system as a whole, shall be designed to withstand the combined conditions of pressure, vibration, shocks, corrosion and movement encountered under normal operating conditions and storage.

9.18.4 An easily removable coarse strainer shall be built into the filling line, if required.

9.18.5 Flexible pipes of approved type shall be used as short joining lengths to the engine where necessary.

9.18.6 Fuel filling system shall be properly earthed.

9.18.7 The filling pipe shall be of metallic construction and a permanent fixture led from the deck and secured to the tank by an approved connection. A screwed cap and name plate inscribed 'Fuel Oil' shall be provided at the filling point. Flexible hoses are not permitted as filling pipes. The fuel oil inlet and inlet pipe size shall be properly enlarged to the satisfaction of GNC and the user department.

9.18.8 Two (2) separate fuel oil tanks shall be provided. The fuel oil tanks shall be symmetrical (equal numbers and capacity in port and starboard hulls).

9.18.9 The FO tanks shall be independent unless otherwise agreed by GNC and shall be as follows:

a) The tanks(s) shall be manufactured from grade 316 stainless steel.

b) Fuel piping material shall be 316L stainless steel. The thickness shall accords with RO requirement.

c) The fuel oil tanks shall be installed so that the loads due to the mass of the full tank are safely induced into the structure, with due consideration given to upward and downward acceleration due to the Vessel's movements at maximum speed in the sea.

d) Quick closing valves (control from above the main deck) shall be fitted to the fuel oil tanks outlets.

e) Fuel filters shall be mounted near the fuel tank on the suction side of the fuel pump. The system design and filtration systems shall be approved by the engine and generator system manufacturer.

f) The tanks shall be hydrostatically tested as required by an approved standard and connections shall be proven tight.

g) An electric motor-driven pump shall be provided for transferring the fuel between bottom of the tanks/hulls to the shore.

h) Two (2) duplex filters shall be fitted in the oil fuel supply lines to the main and auxiliary engines, and the arrangements shall be such that any filter can be cleaned without interrupting the supply of filtered fuel oil to the engines.

i) Water separators shall be fitted to the fuel supply line, if required.

j) A tank content gauge and low level alarm shall be fitted in the console. A level gauge in litres shall be provided for each tank.

k) An inspection hole, air vent with flame arrester on deck and discharge valve with remote operated quick closing device shall be provided. Fuel tank inspection hatch shall be sized to allow proper inspection of the entire tank interior. The inspection hatch shall have gasket covers secured by stainless steel\ bolts and self-locking nuts.

l) Suitable provision such as drip tray shall be made for collecting the oil discharge.

m) Baffle openings shall be designed so that they do not prevent the fuel flow across the bottom or trap vapour across the top of the tank.

n) Sounding pipes with chained cap shall be provided.

o) Water drainage valve and Tank drain shall be provided.

p) Except the electric wires for the fuel oil tank level sensor(s), no other shall pass through any fuel tank.

q) Ventilation for the fuel tank shall comply with RO requirement.

r) The total capacity of the diesel oil tank shall be provided. Fuel supplied shall not be less than requirement of the Vessel's operation as per Paragraph 2.8 of this Part VII with 10% margin.

9.19 Fresh Water System

9.19.1 One (1) independent stainless steel 316L fresh water tank with a total capacity of not less than 2,000 litres shall be arranged in the Vessel to supply fresh water to the users on the vessel.

9.19.2 Fresh water shall be supplied to the following locations:

a) Toilet basins;

b) Showers;

c) All wash basins in compartments; and

d) Aft Deck.

9.19.3 The fresh water shall be supplied by a fresh water pump to achieve a stable pressure to GNC's satisfaction. The system shall provide potable fresh water throughout the Vessel. Cold freshwater taps with PVC braided/reinforced transparent hoses shall be fitted to locations to provide a rinse off facility for cleansing purposes and shall be to the satisfaction of GNC and the EPD.

9.19.4 The fresh water tank shall be designed to easily accessible for maintenance. It shall also be arranged with its own fill and vent pipes with gauze to prevent ingress of material / bugs to the tank. The freshwater tank shall be fitted with the following:

a) Inspection / cleaning access cover;

b) Filling / sounding pipe;

c) Air pipe;

d) A tank content level gauge in litres; and

e) low level alarm shall be fitted on the wheelhouse control station.

9.19.5 The freshwater tank shall not be directly adjacent to any other tanks carrying liquid of any kind.

9.19.6 The fresh water pump shall be provided with a starter, pressure switch, pressure gauge, Accumulator shall be fitted in the system to keep stable the system pressure automatically

9.19.7 Marine grade stainless steel 316L shall be used for fresh water tank. The fresh water tank shall be flushed clean before installation and delivery of Vessel.

9.19.8 Domestic freshwater piping shall be made of copper or stainless steel 316L. Certificate of piping material shall be submitted before the delivery of the Vessel. The welding joints of the domestic fresh water piping's shall be free from lead. The domestic fresh water from the fresh water tank shall be free from any substance harmful to health and shall comply with the Government requirements for domestic water.

9.19.9 Cold freshwater taps shall be fitted on the main deck aft and upper deck to provide a rinse off facility for cleaning purposes. Suitable hoses and storage shall be provided.

9.20 Bilge System

9.20.1 The Vessel shall be fitted with a bilge system designed and installed in accordance with the RO Requirements.

9.20.2 A bilge audible and visual alarm panel shall be fitted in the wheelhouse control station for all subdivision compartment spaces.

9.20.3 When the Vessel is afloat and unmanned, the bilge audible and visual alarm system shall continue to function. When the audible and visual alarm is not acknowledged after a time period such as 5 minutes (can be adjusted), the audible and visual alarm shall be extended

externally to an audible and visual alarm fitted on the top of the deckhouse to bring the attention of the persons ashore or the guard of the Government Dockyard. The additional protection shall be able to be turned on and off when required.

9.20.4 A bilge water holding tank of capacity according to the requirements of RO shall be provided. A suitable oily water separator (OWS) complying with updated MARPOL and MEPC requirements for discharging oily water shall be installed on board. The separated oil and the accumulated waste oils from OWS and from drip trays under oil filters, fuel filters and fuel pumps shall be held in an independent stainless wasted oil tank with associated piping for pumping out the waste oil ashore. The arrangement shall meet with the requirement of RO and get to the satisfaction of GNC.

9.20.5 The bilge of the engine room and steering gear room within each hull shall lead to a bilge water holding tank. An electric motor-driven pump fitted in each engine room with associated piping shall be provided in pumping out bilge water ashore or to the bilge water holding tank. A suitable electric motor-driven pump shall be provided to pump out the dirty oil ashore. A direct overboard shall be provided in case of emergency affecting the safety of the Vessel.

9.20.6 Bilge piping shall be of stainless steel. It is to be designed and installed in accordance with RO Requirements to the satisfaction of GNC.

9.21 Seawater System

9.21.1 All sea valves shall be compatible with the hull material, connected to the sea chests shall be tested according to RO Requirements.

9.21.2 Sea chests provided for the main and auxiliary machineries shall be installed in the vicinity of their respective seawater pump suctions and with adequate distance between each other to avoid water flow disturbance.

9.21.3 Seawater piping shall be constructed of marine grade 316L stainless steel pipe or equivalent in accordance with the RO's Requirements and to the satisfaction of GNC. A suitable strainer with isolation valves and air vent shall be fitted to each seawater system. Due consideration shall also be given to the provision of quick and easy access to the seawater strainers.

9.21.4 The Cathodic protection and marine growth protection system shall be installed as detailed in this Part VII.

9.22 Sanitary, Black & Grey water system

9.22.1 There shall be two (2) toilets in the Vessel. These are located in the dedicated heads compartment on the main deck. All toilets shall use pressurized sea water for flushing.

9.22.2 A sanitary/sea water pump shall be installed in one of the engine rooms to supply sea water for sanitary service.

9.22.3 Toilets, basins, showers, shower and toilet floor drains and galley sinks shall discharge into the back/grey water holding tank.

9.22.4 The black/grey water holding tank shall be stainless steel with capacity of not less than 500 litres installed in the tank space.

9.22.5 The tank shall be fitted with a level gauge and a “Tank Full” indicator installed in a highly visible location in the wheelhouse.

9.22.6 A discharge macerator electric pump shall be provided for pumping out the contents of the holding tank.

9.22.7 Alternative piping shall be arranged for the wash basins/toilets to be discharged directly overboard through a non-return shipside valve if necessary.

9.23 Marine Growth Protection System

9.23.1 The Vessel shall be fitted with a Marine Growth Protection System. The system is to produce copper ion in the water system to protect the pipeline/machinery systems from marine growth.

9.23.2 Within each sea strainer/sea chest, an anode shall be fitted. The anodes are to be controlled by a DC control panel which shall be controlled and managed by the Vessel engineer.

9.23.3 Each Copper Anode shall be suitably sized to suit the total flow rate of sea water through each strainer. This shall be calculated and shall be submitted for approval by GNC prior to installation.

9.23.4 Each anode shall be supplied with an integral nylon mounting arrangement and its own integral cathode to ensure that currents are correctly controlled.

9.24 Floor Plates, Handrails and Guards

9.24.1 The floor in all compartments under main deck shall be covered with unpainted aluminium chequer plate for safe operational use.

9.24.2 All boundary bars, handrails, gratings, ladders, platforms, stanchions and vertical supports in the compartments shall be of lightweight construction. Aluminium chequer floor plates shall be secured by fixing with sections but shall be readily removable for access to the components including but not limited to bilges, pumps, shaft, pipe work and strainers for ease of maintenance.

9.24.3 Hinged access plates shall be fitted in way of valves. Suitable arrangements shall be provided for hinged plates to avoid rattling noise.

9.24.4 Removable guards for the protection of personnel and machinery shall be provided over exposed moving parts of the components including but not limited to machinery and hot pipe work.

9.24.5 Removable guards for the protection of personnel from falling overboard shall be provided on ship sides if fixed guard rails or bulwarks are not fitted.

9.24.6 Components including but not limited to splash plates, casings, fenders and screens shall be provided for the protection of personnel and machinery.

Chapter 10 Electrical System

10.1 General Requirements

10.1.1 All the electrical equipment and their installations shall be complied with the RO Requirements.

10.1.2 All electrical equipment and their installations shall comply with the latest Regulations of the International Electrotechnical Commission (hereinafter referred to IEC), Electrical Installations on Ships.

10.1.3 Protective devices such as circuit-breakers or fuses shall be provided at the source of power, e.g. the switchboard, to interrupt any overload current in circuit conductors before heat can damage the conductor insulation, connections or wiring-system terminals.

10.1.4 The tripping and response time of protective device shall all be taken into consideration in order electrical faults shall not affect interruption of other electrical circuit so far as possible.

10.1.5 The difference in the tripping and response characteristic of AC and DC system shall be taken into account in the selection of protective system and device. And the selection shall comply with RO and IEC requirement and agreed by GNC.

10.1.6 Back-up DC supply shall be provided for the control circuit of essential power sources (e.g. generator engine, AC DC converter inverter for DC grid, Hybrid battery, (ESS), Shore supply etc.). The arrangement is to ensure the system can retain normal functioning during power failure or started from cold.

10.1.7 All electrical apparatus shall be so constructed and installed as not to cause injury when handled or touched in the normal manner.

10.1.8 Exposed metal parts of electrical machines or equipment which are not intended to be live but which are liable under fault conditions to become live shall be earthed.

10.1.9 NOT USED

10.1.10 Three phase three wire system with insulated neutral shall be adopted for AC distribution system. Neither earthed neutral nor hull return system shall be accepted.

10.1.11 Two wire insulated distribution system shall be used for DC system.

10.1.12 All metal sheaths and armour of cables shall be electrically continuous and shall be earthed.

10.1.13 All electric cables and wiring external to equipment shall be at least of a flame-retardant type and shall be so installed as not to impair their original flame-retardant properties.

10.1.14 Cables and wiring serving essential or emergency power, lighting, internal communications or signals shall so far as practicable be routed clear of galleys, laundries, and order high fire risk areas.

10.1.15 Cables and wiring shall be installed and supported in such a manner to avoid chafing or other damage.

10.1.16 All component shall be marked in both English and traditional Chinese to indicate their use unless the purpose of the switch is obvious, and mal-operation of which will not cause a hazardous condition. Each cable shall be clearly labelled and carry its own unique identification code. The language on all control panels shall be in both English and traditional Chinese.

10.1.17 For each main and distribution system whether primary or secondary, for power, heating or lighting, insulation level to earth shall be continuously monitored and gave audible or visual indication of abnormally low insulation values.

10.1.18 The Contractor shall submit a layout plan showing the exact locations of the Equipment. All Equipment shall be accessed easily and safely for inspection and maintenance.

10.1.19 Essential drawings and detailed particulars (such as the rating and capacity, type of all electrical Equipment as well as the wiring, circuit breakers, lighting and sockets, etc.) shall be submitted to RO for approval and GNC for endorsement before installation.

10.1.20 All installations shall be provided with manuals in both English and traditional Chinese for operation and maintenance.

10.1.21 The standard of installation shall enhance the Equipment's safety features. It shall not present any hazards to the operator, e.g. all metal panels exposed to the operator shall be grounded. Warnings of any potential hazards shall be displayed in both English and traditional Chinese, or with internationally recognized labels to the satisfaction of GNC.

10.1.22 The system shall be incorporated with the hybrid system and the requirement of this chapter shall apply to the on-board electrical systems as a whole wherever applicable.

10.1.23 Capacitors used in the system (e.g. electronic equipment, semi-conductor converter, VFD) shall have a discharge rate in compliance with IEC and RO requirement. Protection shall be provided to avoid personnel came into contact with the capacitor unless the voltage has come to safe level.

10.1.24 For the complete system (including semi-conductor converter protection, motor drive, etc.) due to the difference in response time between DC and AC side, arrangement shall be made to provide sufficient current for activating the protective device in tripping the circuit.

10.1.25 All equipment installed on board shall comply with IEC and RO requirement and subject to final approval from GNC.

10.1.26 A Schematic diagram for the electrical system is presented in Annex 8 of Part VII. This diagram shall only be taken as a guidance for better understanding of this chapter of Part VII.

10.2 Electrical Power Main system

10.2.1 Main sources of electrical power of sufficient capacity to supply all those services necessary for the operation of the vessel, including hotel loads and propulsion, shall be provided. These main sources shall consist of two (2) diesel generators and the battery bank (ESS) mentioned in the Chapter 14 of Part VII.

10.2.2 The electrical power supply shall be mainly provided by two (2) or more main Diesel Generators subject to the actual design (380V), three phase, three (3) Wire insulated system. The generator shall have unrestricted continuous rating and be located in the Engine Room.

10.2.3 The capacity of each one diesel generators shall be capable to supply those services necessary to provide normal operational conditions of propulsion and safety. Each generator engine shall be able to take up the normal operation load and propulsive load requirement.

10.2.4 In addition, the ESS shall be such as to ensure that with all the diesel generators or their primary source of power out of operation, it shall be capable of providing the electrical services necessary to start the main diesel engines, and feed the E-motors for propulsion, from a dead ship condition.

10.2.5 The system shall be so arranged that the electrical power supply shall be maintained or immediately restored in the case of loss of any one of the diesel generators and/or the ESS.

10.2.6 The main (DC) busbar shall be subdivided into at least two (2) parts and to be connected by suitable device (e.g. solid state switch) circuit breakers or other approved means. This shall enable the isolation of the defective sector and to avoid the interruption of the normal sectors. So far is practicable, the connection of diesel generators and other duplicated equipment shall be equally divided between the parts.

10.2.7 The AC output of the generators shall be rectified and boost up to required DC voltage and fed to the DC busbar.

10.2.8 The output of the E-motor (when acting as generator) shall fed to DC grid via AC/DC converter. Switchboard shall be of Active Front End type to enable power to be transformed from/to between E-motor and DC Busbar.

10.2.9 The boost up and change of DC voltage shall be achieved by semi-conductor inverter with prior acceptance by RO and GNC.

10.2.10 Automatic generator synchronization device and arrangement shall be provided. Automatic equal power sharing shall be provided.

10.2.11 The voltage variation of the complete electrical system (AC and DC main and sector) shall always be controlled within the required limit in accordance with RO and IEC requirement. The voltage drop caused by supply to distribution system (AC and DC) shall also be within the prescribed limit of RO and IEC.

10.2.12 The frequency and harmonic distortion of the AC electrical system shall always be controlled within the required limit in accordance with RO and IEC requirement. And protection shall be provided to safeguard against this.

10.2.13 An electrical single line diagram and load schedule assessment for both the AC and DC systems shall be developed by the Contractor in accordance with RO Requirements. The generator shall be sized based on a 15% growth margin above the predicted maximum load condition.

10.2.14 Vessel's electrical load schedule assessment shall include summer and winter, static and transient, loads on AC, DC and shore power. The Vessel's electrical load schedule assessment shall be approved by the RO and GNC prior to installation onboard the Vessel.

10.2.15 The generator shall maintain an output voltage within ±5% over the entire load and within a frequency range of ±1.5Hz.

10.2.16 The generator starting circuit shall be 24V DC. Starting and normal shutdown controls shall be mounted at the Wheelhouse Remote Engine Control Console and Engine Room Control Console along with generator engine key parameters monitor. An AC voltmeter and ammeter shall be directly connected to existing wiring systems with the use of a double-pole, double-throw (DPDT) transfer switch/center-off switch for an ammeter to read both legs (AC Voltage reading). A local operating panel shall also be fitted on the generator engines.

10.2.17 The generators shall be protected against short-circuits and overloads by multipole circuit breakers (overload protector).

10.3 Electrical Power Distribution System

10.3.1 Electrical power supply system shall comprise DC main system (DC grid) and AC and DC sub-system and hybrid switchboard, etc. **[E]**

10.3.2 AC sub-system shall comprise with and not limit to: AC switchboards (all main and distribution including 380V and 220V), AC transformer, switchgears, cabling and equipment.

10.3.3 DC sub-system shall comprise with and not limit to: DC switchboards, switchgears, cabling and equipment.

10.3.4 Semi-conductor converter and associated equipment shall comply with RO and IEC requirement wherever applicable and agreed by GNC.

10.3.5 When Pulse Width Modulation (PWM) is adopted for DC/AC inverter, the connected equipment (e.g. cabling, motor etc.,) shall be capable to withstand the rate of voltage increase.

10.3.6 The DC grid shall be divided into at least two (2) sections with electronic protective device in between. The arrangement shall enhance the response of protection and also prevent the complete power failure due to single electrical fault. **[E]**

10.3.7 The protective device shall be selected for the purpose served and the circuit (i.e. AC or DC) to be protected. The activation of the protective device shall protect the equipment being protected and the tripping of which shall not cause the interruption of other equipment. Therefore, the time, current characteristic and hierarchical position of the protection shall be duly considered.

10.3.8 The DC grid shall provide power to AC and DC sub-system. It shall be connected to hybrid switchboard, VFD of variable speed motors (i.e. Bow thruster drive pumps) and all other sub-circuits via suitable protective device. **[E]**

10.3.9 Each section of the DC busbar of DC grid shall be connected to AC sub-system via the inverter. Isolating transformer installed in between the inverter and the AC sub-system. The arrangement shall be such that electrical fault on either side would not have direct impact on the other side.

10.3.10 The output of the isolating transformer shall be 3-phase with insulated neutral.

10.3.11 The output from each isolating transformer shall be capable to be cross connected to the other and capable to take-up the total AC loading.

10.3.12 Irrespective of above, arrangement shall be provided to allow the isolating transformers to run in parallel whenever necessary.

10.3.13 Regenerated power which may be produced by then motor (e.g. bow thruster, fire pump) shall be taken care with by measures braking resistors, active front end etc.

10.4 Switchboard

10.4.1 The switchboard shall comprise AC switchboard, DC switchboard, Hybrid switchboard which provide main and emergency power of the electrical system and shall be designed in conjunction with the Hybrid System Supplier, to incorporate hybrid propulsion and hybrid charging system. The hybrid switchboard is to be designed and installed in accordance with the requirements of the Hybrid System Supplier, the RO and to the satisfaction of GNC.

10.4.2 Main and distribution switchboards shall be so arranged as to give easy access may be needed to apparatus and equipment, without danger to personnel. The sides and the rear, where necessary, the front of switchboards shall be suitably guarded. Exposed parts having voltages to earth exceeding 50 V shall not be installed on the front of such switchboards. Where necessary, non-conducting mats or gratings shall be provided at the front and rear of the switchboard.

10.4.3 Switchboards for main and emergency power supplies shall be installed such that the control elements, indicating instruments, circuit-breakers and fuses are readily accessible. The terminal side shall be accessible.

10.4.4 Instrument for indication of voltage, frequency, current, power shall be provided for the whole system (AC and DC and each sector) in accordance with RO and IEC requirement and agreed by GNC.

10.4.5 The free passageway in front of, or behind the switchboard shall give unobstructed access to a door for easy escape in case of emergency e.g. fire.

10.4.6 Under all normal conditions of operation, power is distributed from the main switchboard and the distribution system shall be designed to keep cable costs to a minimum by distributing power panels located close to the user services. Connections and components on panel-boards shall be in locations protected from the expected condition in accordance with IEC 60529:

(i) IP 67 as a minimum, if exposed to short-term immersion;

(ii) IP 55 as a minimum, if exposed to splashing water; and

(iii) IP 20 as a minimum, if located in protected location within the Vessel.

10.4.7 Earthing monitor system and indicator shall be provided through the AC system and be available at different sector of system (including AC and DC, primary and secondary) to facilitate the identification of the earthing fault.

10.4.8 Switchboards shall be permanently marked with the nominal system Voltage.

10.4.9 Self-standing dead front marine type switchboard of steel and aluminum construction with adequate ventilation louvres shall be fitted in an accessible and well-ventilated position in the engine room/ engine room control console.

10.4.10 Due consideration shall be given in respect of the switchboard location to avoid any risk of damage or electrical fault resulting from oil and water spray, coolant leakage of whatever any kind, or other mechanical hazards. Adequate guardrail(s) and insulated mat(s) shall also be provided. The switchboard location shall be approved by RO and GNC prior to installation onboard the Vessel.

10.4.11 Switchboard panels shall be hinged at the front for easy opening. Anti-rattle rubber strips or equivalent shall be fitted to doors. All parts shall be accessible for inspection, maintenance or replacement to satisfaction of GNC.

10.4.12 Megger test and other relevant tests shall be carried out and witnessed by GNC. The results for these tests shall form part of Sea Trial Report that shall be submitted to GNC before Delivery Acceptance.

10.4.13 An appropriate laminated electrical diagram shall be attached on each switchboard.

10.4.14 All switchboard instruments, controls, and all circuit breakers, both on external panels and inside the switchboard, shall be provided with labels of durable flame-retardant material bearing clear and indelible indications. The appropriate ratings of fuses, the setting of adjustable protective devices and the full load current of the generator shall be indicated.

10.4.15 Apart from the spare feeder breakers, the switchboard shall contain but not be limited to the following:

(i) Circuit breaker/Fuse of adequate capacity with over-current trip and short circuit trip;
(ii) Indication lights for "Power Available", "Circuit Opened" and "Circuit Closed“; and
(iii) All necessary fittings and other protective devices.

10.4.16 For AC distribution board and panel, the followings shall be provided with:

(i) Meters or earth lamps to indicate the state of insulation;
(ii) Molded case circuit breakers with over-current and short circuit trips for the distribution of 220V AC power supply to lighting services, fans, motors, etc.; and
(iii) Any other necessary fittings and protective devices.

10.4.17 24V DC sector shall be provided with the following:

(i) Transformer / rectifier / DC-DC converter of adequate capacity for converting AC and DC power to DC power. The rectifier if adopted shall be of 1-phase full wave regulated type with voltage regulation ±5% and ripple factor 4% at 100Hz;
(ii) Magnetic automatic relay switch (automatic interlock device) for activating emergency 24V DC supply in event of AC power failure;
(iii) Supply source indicator lamp for transformer / rectifier;
(iv) Ammeter for charging unit;
(v) Voltmeter with selector switch;
(vi) Meters or earth lamps to indicate the state of insulation;

(vii) Molded case circuit breakers with over-current and short circuit trips for 24V DC bus and feeder circuits; and

(viii) Any other necessary fittings and protective devices.

10.5 Electricity Distribution Network

10.5.1 The distribution of the electricity to the equipment is through circuit breakers fitted on an electrical distribution panel.

10.5.2 Power distribution panels/electrical distribution boards shall be located at the Engine Room Control Office.

10.5.3 Circuit breakers / Fuse shall be provided for each circuit. The adoption and selection of the protective device shall be in accordance with IEC and RO requirement and accepted by GNC.

10.5.4 The circuit breaker and fuse shall have fault current withstand and interruption capacity not less than the maximum short circuit current at the relevant point of their installation.

10.5.6 Fuse switches using fuse element making and breaking contacts shall be not accepted in place of switches.

10.5.7 Circuit breakers shall be of the proper voltage rating, manual reset type, designed for inverse time delay, instantaneous short circuit protection, and capable of repeatedly opening the circuit in which it shall be used without damage to the circuit breaker. Open and Close position indicators shall be provided for each and every Circuit breaker. All circuit breakers shall be labelled to identify the circuit being protected.

10.5.7 Twenty (20) percent (minimum of three) spare circuit breakers shall be provided in each distribution panel, both AC and DC. The Vessel's electronic navigation equipment shall be supplied from an independent distribution panel, which shall in turn be supplied from a single breaker in the main DC Panel.

10.5.8 Twenty (20) percent spare wiring penetrations or two spare wiring penetrations, whichever is greater, shall be provided through each bulkhead except the forward collision bulkhead. Spare penetrations shall be plugged watertight using a type approved gland to the satisfaction of the RO and GNC.

10.5.9 A 24V DC two (2) wire insulated distribution system shall be installed onboard the Vessel for critical emergency electrical systems including emergency lighting, controls of diesel generators and main diesel engines, and the ENEs, etc., in accordance with RO Requirements.

10.5.10 All 24V DC supply panels shall be fitted with miniature circuit breakers of double-pole type with overcurrent/short circuit trips. All junction boxes shall be readily accessible, and the prime supply panel shall be positioned inside the wheelhouse. A special arrangement shall be required for the navigational lights supplied from this prime panel.

10.6 DC Power Source

10.6.1 DC power (24V) shall be provided for routine and emergency power circuit.

10.6.2 Main DC power source is be fed from DC main switchboard (via distribution switchboard). The output of the DC main switchboard busbar is connected to 24V routine supply circuit via DC/DC converter. the configuration shall be approved by RO and accepted by GNC.

10.6.3 Hybrid battery (ESS) shall be connected to the DC main switchboard via DC/DC converter. The output of diesel generator shall be connected to DC main switchboard via AC/DC converter. The load sharing of which shall be determined by Power Management System described in Chapter 14 of Part VII.

10.6.4 DC power for Main Engines and Generator Starting:

a) Independent bank of 24V batteries or supply via DC/DC converter from DC main switchboard shall be provided for starting of each of the main engines and each of the generator. The arrangement shall be approved by RO and accepted by GNC.

b) The capacity of the supply power shall be sufficient to provide at least six (6) consecutive starts of each one of the main engines, and at least six (6) consecutive starts of each of the generator from cold, without recharging.

c) Electrical connections shall be arranged so that alternate power supply can be used to start any main engines or generator by operating a change-over switch in the engine room control console or wheelhouse remote engine control console.

d) The batteries if applicable shall be charged by engine driven alternators with backup service provided by an automatic battery charger. If not inherent in equipment design, interlock or protective devices shall be provided to prevent simultaneous charging from the charger and the alternator. The battery charger shall also be prevented from charging the batteries during engine starting.

e) The battery chargers if provided shall provide automatic control between float and bulk or absorption charge modes. Each charger shall also be provided with a voltmeter, voltage regulator, selector switch, blocking rectifier, and the required devices for protecting the chargers against short circuit, reverse connection, excessive temperature and overloading. The capacity of each battery charger shall be sufficient for charging one set of completely discharged starting batteries to a fully charged condition within ten (10) hours. Battery chargers shall be able to perform a quick charge function, which is manually selected as required.

f) Batteries if provided to be of maintenance-free type:

(i) There shall be one battery set allocated to each engine; and

(ii) Power supply batteries shall be portable, maintenance free, heavy duty, deep cycle and produced from environmentally friendly materials. They shall have a minimum life expectancy of five (5) years, or 200 full discharge cycles at full load, rated in accordance with cognizant regulatory body requirements.

g) Each engine driven alternator shall have its own built-in voltage regulators, automatic cut-off, and any other required protective devices.

h) The batteries shall be located as close as practicable to the engines in order to minimize the voltage drop. The battery bank shall be housed in a separate GRP or GRP lined storage box. Each box shall be provided with a removable cover with locking clips for ease of maintenance.

i) The ventilation piping shall be routed to/from a protected location where any evolved gases will be safely dispersed. Cable glands shall be provided to maintain the integrity of the battery box ventilation.

10.6.5 DC power for Routine and Emergency supply shall comprise:

a) 24V batteries power supply shall be provided by main switchboard via DC/DC converter for normal DC.

b) Dedicated 24V batteries shall be provided for emergency DC supply.

c) In event of main electrical AC power failure, 24V DC batteries for emergency DC supply shall act as an uninterrupted emergency supply for all communication equipment, navigation and emergency lighting, steering, fire monitoring and control system, and other vital instrumentation and control systems for the Vessel to return to base.

d) This emergency supply shall come into operation automatically in the event of main electrical power supply failure. The capacities of these sets of batteries shall be sufficient to maintain the emergency supply in accordance with RO Requirements, but in no case shall be less than a period of six (6) hours. The emergency source of electrical power for emergency lighting and the emergency lighting switchboard shall be located above the uppermost continuous deck and shall be readily accessible from the open deck. They shall not be located forward of the collision bulkhead. The emergency lighting battery shall be capable of maintaining its voltage throughout the discharge period within 12% above or below its normal voltage without recharging. The battery shall automatically connect to the emergency lighting system in the event of failure of the main electrical power supply

e) The emergency batteries shall be installed in a separate compartment located outside of the engine room above deck. The compartment shall be well ventilated and prevent ingress of water. The batteries shall be positioned and installed in accordance with RO Requirements to the satisfaction of GNC.

10.6.6 Emergency Batteries for Electronic Equipment shall be as follows:

a) 24V DC shall be provided solely for electronic equipment; and

b) The batteries shall be installed in a separate compartment located outside the engine room above deck. The compartment shall be well ventilated and prevent the ingress of water.

10.6.7 Emergency 24V DC services shall be supplied from the switchboard through a 2-wire insulated system to the following items:

a) Navigation light control panel and navigation lights;

b) Horn;

c) General lighting;

d) Compass light;

e) Instrument panel in wheelhouse control console, wheelhouse remote engine control console and engine room control console;

f) Public address;

g) One hand-held searchlight and fixed searchlight(s);

h) Siren; and

i) Any other navigational and electronic equipment.

10.6.8 The batteries as required in Paragraphs 10.6.4 (if applicable) and 10.6.5 above shall be subject to continuous float charge under normal operation of the Vessel by an automatic battery charger.

10.6.9 Battery charger installations shall meet RO Requirements including:

a) The chargers shall be sized such that a completely discharged battery bank can be recharged to 80% capacity within 8 hours (100% at 10 hours). The battery chargers shall use bulk and absorption modes of charging, such that at the end of the charge, the current shall be tapered by a float mode.

b) The chargers shall be fitted with a pilot lamp, a charging adjustment, a voltmeter and an ammeter indicating charging current.

c) Discharge protection shall be provided to prevent a failed charger component from discharging the battery bank.

d) Battery charging facilities shall be available via the engine alternators and the main 380V AC switchboard. Battery chargers shall not be mounted directly over batteries.

e) Battery selector/isolator switches shall be provided between battery chargers and the battery banks they serve.

f) Provisions shall be made to allow either main engine to be started by the other engine's starting batteries.

10.6.10 An instruction plate with a schematic wiring diagram illustrating the operating procedures and precautions for the selection of battery banks and charging of batteries shall be provided in the vicinity of the charger, battery selection switchboard and charging distribution board. All charging control shall be conducted at either the wheelhouse remote engine control console or the engine room control console.

10.6.11 Batteries shall be permanently installed in a dry, ventilated location above the anticipated loaded waterline level.

a) Battery compartment(s) shall be actively ventilated whenever batteries are charging.

b) Emergency batteries shall be located in the area outside the engine room.

c) All battery storage boxes shall be provided with removable covers and locking clips for ease of maintenance.

d) Drainage shall also be provided to avoid accumulation of moisture.

10.6.12 Batteries shall not be installed directly above or below a fuel tank or fuel filter.

10.6.13 Any metallic component of the fuel system within 300 mm above the battery top, as installed, shall be electrically insulated.

10.6.14 Battery cable terminals shall not depend on spring tension for mechanical connection to them.

10.6.15 A battery-disconnect switch shall be installed in the positive and negative conductor from the battery, or group of batteries, connected to the supply system. The switch shall be in a readily accessible location, as close as practical to the battery or group of batteries. Circuits for engine starting, navigation lighting, electronic devices with protected memory and protective devices such as bilge-pumps and alarms, if individually protected by a circuit-

breaker or fuse as close as practical to the battery terminal, do not require a battery isolator switch.

10.6.17 Local information plates showing the Voltage, Ampere-hour rating, group number and application shall be provided for each battery set.

10.7 Shore Power Supply and Connection

10.7.1 The shore power shall be capable to supply the AC loading of the vessel whilst it is berthed alongside and supply the power of charging-up of the hybrid battery (ESS) starting from cold.

10.7.2 An isolation transformer shall be fitted to prevent galvanic corrosion. Molded case circuit breaker for shore connection box shall be provided on the main switchboard.

10.7.3 The shore connection box shall be capable of receiving 380-415V three phase 50Hz system, and the cables between the connection box and the switchboard shall be of sufficient capacity to supply the necessary electrical equipment;

10.7.4 The shore power shall be arranged to supply the loading of the vessel whilst the vessel is berthed alongside (i.e. particular distribution panel to be provided). The arrangement shall be such that to avoid starting up of the generator whilst the vessel is alongside. The capacity of the power source and the equipment supplied shall be discussed and agreed by GNC in the kick-off meeting.

10.7.5 The electrical system shall include the provision for shore power supply (380-415V AC, three phases (50Hz) designed to an approved standard.

10.7.6 An earth terminal shall be provided for connection of the Vessel's earth to the shore earth.

10.7.8 An instruction shall be provided at the connection box to give full information of the system and the procedures for carrying out the connection.

10.7.9 The shore power system shall be interlocked to prevent the Vessel's generator from providing power to the shore at the same time. Indicating lights for "shore power available", "shore power breaker on" and "shore power breaker closed" shall be fitted.

10.7.10 The Contractor shall provide a 1:1 isolation transformer for the shore power supply to the AC loading. The earth wire of the shore power cable shall be connected to the shielded core of the isolation transformer. The core of the isolation transformer shall be completely insulated from the case. It shall be convection cooled and shall have no moving parts. The transformer enclosure shall be drip-proof and the isolation transformer shall be rated for continuous operation at full capacity of the shore power connection.

10.7.11 There shall be direct connection in between the shore power supply and the ESS shall be via AC/DC converter.

10.7.12 The watertight connection box shall be designed with a quick release receptacle.

10.7.13 Not less than 15 meters longshore connection power cable of adequate rating with quick release watertight plug shall be provided.

10.7.14 The shore connection power cable shall terminate with compatible connections to mate with existing facilities on Government Dockyard, as identified by GNC. Suitable stowage on board shall be provided for the cable.

10.8 AC Distribution Boards and Circuit Breakers

10.8.1 For AC electrical distribution it is required that several electrical distribution panels shall be installed throughout the Vessel. Panels shall be IP 23 drip proof steel construction with hinged doors.

10.8.2 Molded case circuit breakers shall be fitted as far as possible on all sub-circuits. Where this is not possible, fuses shall be used. Where the sub-circuit is three phase or where current is above 60A, it is required that molded case circuit breakers shall be fitted with thermal and magnetic trip devices.

10.8.3 All circuit breakers shall have time delay thermal overload trip and instantaneous short circuit current trip. The overload trip shall be set a t 110% of the maximum circuit load current. The cable rating shall be in excess of the circuit breaker overload tripping current.

10.8.4 Circuit breaker shall act as a protective device only and shall not use for switching purposes. An individual on/off switch shall be installed for each electrical fitting.

10.8.5 All circuit breakers and isolators shall be capable of being padlocked in the off position for safe maintenance.

10.8.6 All distribution boards and circuit breakers shall be clearly labelled stating the name of each circuit. Labels to be in both English and Traditional Chinese.

10.9 Motor and Control Gear

10.9.1 Where a starter is situated remotely from the motor, stop and start buttons shall be provided near the motor for local operation. All electric motors of essential services shall have separate start and stop push buttons plus running indication lights (with dimmer control) inside at the wheelhouse remote engine control station and engine room control station.

10.9.2 The requirement of Chapter 14 of Part VII shall apply to Hybrid motor and its associated electronic equipment (e.g. VFD, semi-conductor converter, etc.) adopted in the system.

10.9.3 Soft-starting shall always be taken into consideration to avoid excessive voltage drop of the system in particular VFD is employed for motor speed control.

10.9.4 Motors installed in the engine room and other enclosed spaces shall be of semi-enclosed drip proof type. Motors installed in locations exposed to weather or moisture shall be of waterproof construction. Insulation of motors shall not be less than Class B standard.

10.9.5 A circuit diagram shall be placed in the local control box of each electrical installation.

10.10 Cable, Wiring and Fuses

10.10.1 Cables which may be exposed to physical damage shall be protected by sheaths, conduits or other equivalent means. Cables passing through bulkheads or structural members shall be protected against damage to insulation by chafing.

10.10.2 Where cables are protected by pipe conduits, the space factors of the pipe conduit shall conform to IEC regulations in order to prevent bunching of wires and to minimize earth faults.

10.10.3 Cables shall have minimum dimensions in accordance with IEC regulations or other equivalent international standard acceptance to GNC, or the conductor manufacturer's rated current carrying capacity, based on the load shall be supplied and allowable voltage drop for the load to be carried.

10.10.4 Cables shall be flame-retardant, marine type, low smoke, zero halogen according to IEC 60332-3 and their selection and method of application shall comply with IEC 60092-352 and the RO Requirements.

10.10.5 Cabling for emergency systems shall also comply with the higher fire survival rate stipulated in IEC 60331 and the RO Requirements.

10.10.6 Cables in voltage-critical circuits, such as starter motor circuits and navigation light circuits, whose output may vary with system voltage, shall be sized in compliance with the component manufacturer's requirements.

10.10.7 The metallic sheathing, armor or braid of cable shall be properly earthed at both ends. All bare terminals shall be properly insulated by approved cable insulators.

10.10.8 Cables that are not sheathed shall be supported throughout their length in conduits, cable trunking, or trays, or by individual supports at maximum intervals of 300 mm. Cushion/protection on the overhead cable trunk for preventing head injury of crew shall be provided in the engine room.

10.10.9 Sheathed cables and battery cables to the battery disconnect switch shall be supported at maximum intervals of 300 mm, with the first support not more than 1m from the terminal. Other sheathed conductors shall be supported at maximum intervals of 450 mm. Sheathed engine starter conductors constitute an exception to this requirement.

10.10.10 Wiring shall be run along perforated metal trays and shall be secured in such positions as to allow easy maintenance.

10.10.11 Wiring shall not be installed below the engine room floor plates.

10.10.12 Cables and wiring inside accommodation areas shall run behind linings which shall have removable panels for inspection and maintenance.

10.10.13 Where electric cables have to be fitted on the decorative surface of bulkheads, they shall be enclosed in conduits.

10.10.14 RO approved watertight, Fire resistant and gastight cable transit system shall be provided in way of watertight bulkhead or deck penetrations. The penetration shall be located as high as practicable and well clear from the ship side.

10.10.15 Separation shall be provided on cable runs for power cables, instrument and control cables, computer network cables in accordance with manufacturer's recommendations and in line with requirements of IEC 60533 Annex 'C'.

10.10.16 Each electrical cable that is part of the electrical system shall have a means to identify its function in the system, except for conductor's integral with engines as supplied by their manufacturers.

10.10.17 Cables and the wiring terminals of different AC and DC power supply voltages in the junction box, fuse box as well as the equipment terminal box shall be laid separately and shall have a distinctive code and labelling system for easy identification to facilitate tracing.

10.10.18 Tally plates showing the cable size and the number of cores shall be provided for each of the main power cables.

10.10.19 All fuses shall preferably be of cartridge type and rated adequately for the protected circuits.

10.10.20 Electric wiring (whether single core or multi-core type) shall use approved (by an authority acceptable to GNC) type of bulkhead/deck penetration gland/fitting when they pass through watertight bulkheads or the weather deck.

10.11 Lighting Fixtures

10.11.1 General lighting shall be provided for all compartments and shall be arranged to give sufficient illumination to all working areas for normal operation. All lighting shall be equipped with LED bulbs including the navigation lights.

10.11.2 The general lighting system described herein shall be composed of fixtures permanently installed as necessary to provide the levels of illumination required to an approved standard. The system shall include fixtures, switches, panels, boxes, and cabling for the distribution system supplying the lighting fixtures. Fixtures shall be accessible for re-lamping and cleaning.

10.11.3 General lighting shall have individual or group switches to conserve power, unless agreed with GNC, all light sources, including signalling, shall be of LED type.

10.11.4 All lighting in the wheelhouse control panel shall be fitted with a dimmer control at night. It shall also be possible to set internal lights within the wheelhouse and accommodations space to red light for night operations. Emergency lighting of 24V DC supply shall be provided for all compartments, emergency embarkation stations and open decks as per RO Requirements.

10.11.5 Emergency exit routes shall be identified and illuminated as required by RO Requirements. Supplementary lighting shall be provided in all cabins and the internal passageways to clearly indicate the exit so that occupants will be able to find their way to get out of the accommodation. Such lighting shall be connected to the emergency lighting switchboard. Such lighting shall automatically illuminate when power to the normal lighting is lost and remain on for a minimum of 30 minutes.

10.11.6 Suitable lighting shall be provided in all working areas such as galley, crew/commander's desks, sick bay, chart table and other areas determined by GNC.

10.11.7 Controls shall be provided within each compartment for the illumination therein. Each light shall have a manually controlled switch located at the primary entrance to that compartment and switches for this purpose shall be installed near the access and located so as not to be obscured when the door is open. A separate switch shall be provided in each compartment to control each group of lights. Switches shall break both sides of the circuit (double pole). Fixtures shall be installed so that illumination there from will not be obstructed by fixed pipes, ducts, bins and berths.

10.11.8 Fixtures shall be mounted so as not to vibrate in any operating condition and so that the Vessel vibration will not harm the fixture. Fixtures shall be selected and mounted to maintain the maximum possible headroom.

10.11.9 All sockets, terminal blocks, and switch and receptacle interiors shall be made of non-flammable phenolic material.

10.12 Navigation Lights

10.12.1 All navigational and signal lights to be provided shall be in compliance with the International Regulations for Preventing Collisions at Sea (1972 as amended) (IRPCS) and all the effective Resolutions as amended by International Maritime Organization (IMO). Type approval certificate in respect of each model of the navigational and signal lights issued by an RO shall be provided on or before the Delivery Acceptance at the latest.

10.12.2 The lighting shall be controlled from a control and alarm signal panel in the wheelhouse. Each navigation light circuit shall be provided with a switch, protection fuse, indicating lamp and alarm. A dimmer for the panel indication lights, buzzer stop, and lamp test buttons shall be fitted.

10.12.3 Navigation light circuits shall be independent of any other circuit. There shall be two separate power supply systems to the distribution board: one from the main AC power source and one from the emergency DC power source.

10.12.4 The following navigational and signal lights (with double-pole circuit breakers) and shapes shall be provided:

a) Port-side light;

b) Starboard-side light;

c) Stern light;

d) Masthead light;

e) Anchor light;

f) Combined not under commanded (NUC) and diving lights as follows: three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white, all lights shall be independently operated for different use;

g) Two (2) masthead white lights in vertical line (forward arc) and a towing light above the stern light as per IRPCS (indicate tow less than 200m);

h) Black Ball (3 nos);

i) Black diamond;

j) Whistle;

k) Bell; and

l) Any other navigation lights as required.

10.12.5 Three (3) sets of spare bulbs (one per light) shall be provided for the navigational and signal lights.

10.12.6 Power sockets on the weather deck, in the engine room and other damp locations shall be watertight and be provided with watertight covers and switches. All power plugs provided for the portable equipment intended to be used in these areas shall also be of weatherproof marine type.

10.12.7 Only flameproof or intrinsically safe electrical equipment shall be used in dangerous areas.

10.12.8 Any cabling which is required within the space shall be screened and earthed in accordance with RO Requirements. Where access to cabling is required, dust tight conduit boxes shall to be provided.

10.12.9 Starters, socket outlets and light switches shall not be installed within the hazardous spaces.

10.13 Searchlight

10.13.1 Two (2) proprietary make 220V AC LED (with luminosity equivalent to not less than 600 W conventional type) adjustable remote control searchlights are required for forward operation. Two (2) switches for the searchlight shall be mounted adjacent to the searchlight control joysticks on wheelhouse console. Additional an IP56 remote control joystick fix beside this searchlight, this joystick shall be installed in a watertight box. It can be easily taken out of the watertight box during operation.

10.13.2 One (1) proprietary make 220V AC LED (with luminosity equivalent to not less than 600 W conventional type) adjustable remote control searchlights are required for stern operation. A switch for the searchlight shall be mounted adjacent to the searchlight control joystick.

10.13.3 The searchlights shall be installed on the top of the wheelhouse forward and aft. The searchlights shall be remotely controlled by electric joystick located in the wheelhouse control station for turning and tilting.

10.13.4 One 24V DC LED portable search lights (with luminosity equivalent to not less than 150 W conventional type) with 30 meters water proof cable reels and plugs shall be provided in the wheelhouse.

10.14 Floodlight

One (1) set of 6 x 2000W marine use weathertight floodlights mounted on a telescopic mast with remote control and indication inside the wheelhouse for rotation (360 degree), titling (down-seeing capability) and elevation shall be provided for illumination of the sea. The telescopic mast shall be operated by hydraulic pump and its extended height is about seven (7) metres from bridge deck. All maker's standard fittings and accessories shall be provided.

10.15 Power Receptacles / Sockets

10.15.1 Receptacles/sockets installed in locations subject to rain, spray or splashing shall have a minimum protection of IP56, in accordance with IEC60529 when not in use, e.g. protected by a cover with an effective weatherproof seal.

10.15.2 A system of 220V AC, 13A and 24V DC 5A socket outlets shall be provided in the engine room, fore and aft ends of the Vessel on the main deck and in the fore peak of the Vessel.

10.15.3 Socket outlets for 220V AC (with USB charging socket 5V 2A), 24V DC or 12V DC shall be provided throughout the Vessel. The Contractor shall design and install the socket outlets as required and to the satisfaction of GNC and the EPD.

10.15.4 Each socket outlet shall be integrated with an 'On/Off' switch to facilitate local switching of the electrical equipment. The 220V AC socket outlets shall be supplied with 13A 3-square-pin fused plugs. The 24V DC socket outlets shall be supplied with fused plugs**.**

10.15.5 Sockets for different voltage systems shall be clearly labelled and with different pin sizes so that one system cannot plug into the other.

10.15.6 Power sockets on the weather deck, in the engine room and other damp locations shall be watertight and be provided with watertight covers and switches. All power plugs provided for the portable equipment intended to be used in these areas shall also be of weatherproof marine type.

10.16 Engine Condition Monitoring System (ECMS)

10.16.1 The Contractor shall provide an ECMS showing the information and functions specified below:

a) All the main engine alarm and running parameters;

b) All the generator alarm and running parameters;

c) All the Gearbox alarm and running parameters;

d) Electrical motor alarm and running parameters;

e) Fire detecting system;

f) Level alarms and indicator data;

g) Fans (under main deck) control;

h) Marine growth protection system;

i) Bilge alarm & pump control; and

j) Other related alarm signal, as agreed with the GNC.

Audible and visual alarm together with mute and acknowledge button shall be provided.

10.16.2 The system shall comprise a central processing unit, signal acquisition module, signal output module, Human-Machine-Interface workstation, extended alarm board and other hardware as necessary. The system hardware shall support the hot swap function and replace the hardware without interrupting the system.

10.16.3 Input channels shall be continuously monitored and when any input of them deviates from the pre-set value, an alarm shall be activated with audible and visual signals generated by the annunciator unit.

10.16.3 An Uninterruptible Power System (UPS) shall be provided for the Monitoring and Control System.

10.16.4 The monitoring, control and operation of the engineering systems shall be provided in in the Wheelhouse Engine Remote Control Console.

10.16.5 The system shall have at least three (3) 26” or larger multifunction displays, acceptable to GNC. One of them shall be provided for Wheelhouse Remote Engine Control Console. The location of the other two shall be discussed in the kick-off meeting. All of them shall be provided with independent control and capable to select the control and monitor display of their own. The multifunction displays shall be dedicated for operating and primarily displaying the MCS and shall also be able to switch between MCS and CCTV system. The displays shall be fitted within a console which is to be angled such that the view on the display(s) is not compromise.

10.17 Lightning protection

10.17.1 The Vessel shall be fitted with a proven lightning protection system to protect the personnel on board and the electronic equipment installed.

10.17.2 The method and working principle of protection shall be approved by the RO or other entities acceptable by GNC before submission to MD by the completion date stipulated in Annex 3 of this Part VII for endorsement.

10.17.3 The lightning protection shall prevent lightning from striking vessel by neutralizing and de-ionizing electrical charges in the atmosphere as per IEC 62305 or equivalent.

Chapter 11 Fire Safety Equipment

11.1 General Provisions

11.1.1 The Vessel shall be enclosed by fire-resisting divisions complying with the requirements of the International Code for Application of Fire Test Procedures (FTP Code), as defined in Chapter II-2 of SOLAS.

11.1.2 Fire-resisting bulkheads and decks shall be constructed to resist exposure to the fire as per RO Requirements for that specific location. The main load-carrying structures shall be arranged to distribute load such that there will be no collapse of the construction of the hull and deckhouse when it is exposed to fire.

11.1.3 The hull, structural stiffeners, bulkheads, decks, deck houses and pillars shall be constructed of approved non-combustible materials as required in the FTP Code and having adequate structural properties.

11.1.4 The arrangement of pipes, ducts, electrical cables etc., penetrating into fire-resisting divisions shall be made to ensure that the fire-resisting integrity of the division is not impaired, and necessary testing shall be carried out in accordance with the FTP Code.

11.1.5 All furniture shall be constructed entirely of approved non-combustible or fire-restricting materials, except that a combustible veneer with a calorific value not exceeding 45 MJ/m^2 may be used on the exposed surface of such articles.

11.1.6 All upholstered furniture, draperies, curtains, suspended textile materials shall have the qualities of resistance to the propagation of flame in accordance with the FTP Code.

11.1.7 All deck finish materials shall comply with the FTP Code.

11.1.8 All the exposed surfaces and surfaces in concealed or inaccessible spaces in corridors and stairway enclosures, and of bulkheads (including windows), wall and ceiling linings in all compartments shall be constructed of materials having low flame-spread characteristics as required in FTP Code.

11.1.9 Any thermal and acoustic insulation shall be of non-combustible or of fire-restricting material. Vapour barriers and adhesives used in conjunction with insulation, as well as insulation of pipe fittings for cold service systems need not be non-combustible or fire restricting, but they shall be kept to the minimum quantity practicable and their exposed surfaces shall have low flame spread characteristics.

11.1.10 Exposed surfaces in corridors and stairway enclosures, and of bulkheads (including windows), wall and ceiling linings, in all compartments shall be constructed of materials which, when exposed to fire, are not capable of producing excessive quantities of smoke or toxic products, this being determined in accordance with the FTP Code.

11.1.11 Engine room and machinery space bulkheads and crown shall be insulated against fire and sound with asbestos-free materials in accordance with IMO regulations and requirements applicable to the Vessel as a passenger carrying vessel.

11.1.12 The noise level throughout the Vessel shall be in accordance with IMO regulations and requirements applicable to the Vessel as a passenger carrying vessel.

11.2 Fire Detection System

11.2.1 An approved automatic fire detection system, in accordance with the 2000 HSC Code and RO Requirements, shall be fitted on the Vessel.

11.2.2 The fire detection master control panel shall be located at the Wheelhouse Engine Remote Control Console with a repeater panel at the Engine Control Console in the Engine Room Control Office.

11.2.3 The fire detection system shall initiate audible and visual alarms which are distinct in both respects from the alarms of any other systems onboard that do not indicate fire. The alarms shall be of sufficient volume and distribution, so to ensure that the alarms are heard throughout the Vessel including all the machinery spaces and observed at the Wheelhouse Engine Remote Console and the Engine Control Console in the Engine Room Control Office.

11.2.4 Fire detectors shall be installed in all compartments throughout the Vessel. The detection system is to consist of both heat and smoke detectors in accordance with the 2000 HSC Code and RO Requirements and to the acceptance of GNC and EPD.

11.3 Fixed Firefighting System

11.3.1 Fixed Fire extinguishing systems in the Engine Rooms and other applicable spaces including but not limited to Bow Thruster Rooms, Battery Space(s), etc. shall be a fixed FM200 fire-fighting system in complying with the applicable 2000 HSC Code and RO requirements for Engine Rooms / machinery spaces protection.

11.3.2 The FM200 fire-fighting system including the control station and storeroom shall be protected from accidental activation. An audible and visual alarm shall be triggered once the system is accessed/activated. The sound and visual alarms shall be distinguished from other alarms. The sound and visual alarms shall be audible and visible in the spaces to be protected e.g. Wheelhouse, Engine Rooms, Engine control room, and the other applicable machinery spaces.

11.3.3 The FM200 fire-fighting system control station shall incorporate various designs/devices to ensure the following actions are properly completed in sequence before releasing the FM200:

a) Shut-off the power supply to the fuel pumps, ventilation fans, air-conditioning system circulation fans, etc. and triggering an audible and visual activation alarm of the FM200 system throughout the Vessel. This shall include but not be limited to the Wheelhouse, Engine Rooms, Engine Control Room and other applicable spaces;

b) Shut-off the fuel supply from the fuel tanks to the engines, and the outlets of any other oil tanks in the Engine Rooms, via quick-closing devices; and

c) Close the fire dampers of the Engine Room ventilation system and the air-conditioning system if applicable.

11.3.4 The gas bottles for the system shall be stowed outside the space they are protecting, but if possible, close by to prevent the need for long pipe runs. The bottles shall be adequately protected from the external weather environment, and due consideration shall be given to the ventilation of the storage space. A forced mechanical ventilation system shall be provided if the storage space is located below the main deck.

11.3.5 The fixed fire-fighting system diagram shall be submitted to the RO for approval and subsequently to GNC prior to installation onboard the Vessel.

11.4 Portable Fire Extinguishers

11.4.1 Adequate number of portable fire extinguishers shall be provided to serve all compartments in the Vessel and so positioned, as to be readily available for immediate use. The quantity and position of portable fire extinguishers shall also comply with relevant requirements as said in the Code of Practice - Safety Standards for the relevant Vessel type issued by Local Vessels Safety Section of Hong Kong Marine Department.

11.4.2 Fire extinguishers shall be type-approved by the RO or other international standards acceptable to GNC. Certificates shall be submitted to GNC before Delivery Acceptance.

11.4.3 Fire extinguishers shall be ready for use and located in easily visible places such that they can be reached quickly and easily at any time in the event of a fire. Portable fire extinguishers shall be properly secured in place.

11.5 Fire Pumps

11.5.1 At least two (2) fire pumps shall be provided. The arrangement of the fire pumps shall be such that in the event of a fire in any compartment, at least one (1) fire pump shall remain operational.

11.5.2 One (1) fire pump located outside of the machinery space shall be provided to have sufficient capacity to pump water from the sea-chest to deck hydrant with a jet throw of at least 12 metres. The fire main and fire pump design shall meet RO and relevant requirements as said in the Code of Practice - Safety Standards for the relevant Vessel type issued by Local Vessels Safety Section of Hong Kong Marine Department.

11.5.3 Isolating valves shall be fitted at appropriate locations and at hydrant outlets. The hydrant shall be supplied with a complete set of fire-fighting accessories including appropriate length of fire hose made of suitable material and spray/nozzle. The hose and nozzle shall be stowed inside a fire box located in the vicinity of the hydrant.

11.5.4 A deck washing pipe line shall be branched off from a fire main line. Fire water shall be provided for anchor chain flushing.

11.6 Fire Control and Safety Plan

11.6.1 The fire control and safety plan shall be permanently exhibited for the guidance of the ship's in the Wheelhouse and crew mess, using graphical symbols in accordance with IMO Resolution A.654 (16) as amended.

11.6.2 The contents of the safety plan shall meet the relevant regulations of MD.

11.6.3 The fire control and safety plan shall be approved by the RO and commented by GNC before Vessel acceptance.

11.6.4 The text of such plan shall be in the languages of English and traditional Chinese.

11.7 Additional Protection

11.7.1 When the Vessel is afloat and unmanned, the fire detection system and the bilge alarm system shall continue to function. When the audible and visual alarm is not acknowledged after a time period of five (5) minutes (can be adjusted), the audible and visual alarm shall be extended externally to an audible and visual alarm fitted on the top of the deckhouse to bring the attention of the persons ashore or the guard of the Government Dockyard.

11.7.2 The additional protection shall be able to be turned on and off when required.

Chapter 12 Life-Saving Appliance (LSA)

12.1 General Provisions

12.1.1 Lifesaving appliances and arrangements shall be provided as per Merchant Shipping (Local Vessel) Ordinance Cap 548G and the Code of Practice issued by the Hong Kong Government HKSARG regarding the Vessel of this type.

12.1.2 Lifesaving appliances shall be provided in the Vessel at appropriate locations in accordance with the RO Requirements. All the required Life jackets shall be Inflatable Life jackets.

12.1.3 Lifesaving appliances shall be of approved types conforming to the latest International Life-Saving Appliance Code (LSA Code) adopted by the Maritime Safety Committee of the Organization and approved by the RO.

12.1.4 Life jackets shall be so placed as to be readily accessible and their positions shall be clearly indicated. Donning instructions shall be posted at suitable positions in the Vessel.

12.1.5 Adequate number of lifebuoys shall be provided as per the relevant requirements in the Code of Practice - Safety Standards for the relevant vessel type issued by Local Vessels Safety Section of Hong Kong Marine Department. Lifebuoys shall be marked with ship names on both sides.

12.1.6 Liferaft(s) shall be provided and installed in accordance with the Code of Practice, LSA Code and RO requirements.

12.1.7 Liferaft(s) shall be fitted with a hydrostatic release. In addition, liferaft(s) shall be installed with a quick deployment cradle such that one (1) person can manually deploy the liferaft(s) in adverse sea and weather conditions

12.1.8 Approved LSA Plan by RO in frame shall be posted on the wall of wheelhouse and crew mess room.

12.1.9 Man Overboard Life-buoy

a) The vessel shall be equipped with two (2) man overboard marker attached with life-buoy.

b) The equipment and arrangement shall comply with SOLAS requirement.

c) The rescue operation shall also be included into the training manual of the vessel.

Chapter 13 Electronic Equipment

13.1 General Requirements

13.1.1 The Contractor shall be responsible for the supply, delivery, testing, installation, commissioning, and warranty (12 months from the date of the Acceptance Certificate) and provision of operational and maintenance service manual and training of the following equipment/systems to be fitted onboard the Vessel for GNC:

a) Loudhailer/Siren and public address system with USB player;

b) Magnetic compass and fluxgate compass;

c) Differential Global Positioning System;

d) Marine Radar (x-band) for navigation;

e) Navigation Electronic Chart Display and Information System (ECDIS);

f) Back up for ENC or ECDIS (paper nautical charts);

g) Echo sounder;

h) International Maritime Mobile (IMM) VHF Radio with GMDSS;

i) Marine Band Hand-held Waterproof Radio Transceiver;

j) Automatic Identification System (AIS) transponder (Include the receiver and transmitter modules);

k) Radar Transponder;

l) Satellite Emergency Position Indicating Radio Beacon (“EPIRB”);

m) Voyage Data Recorder;

n) CCTV System;

o) Electric horn confirming to IMO requirements;

p) Integrated Navigation System; and

q) Wired Intercom System.

13.1.2 The Contractor shall provide all labour, material, transportation, installation calibration, testing and commissioning, Warranty Services in Warranty Period, test equipment and all other tools and equipment which are necessary to complete the work required in this Chapter. References to “Equipment” in this Chapter shall mean the above-mentioned Equipment. References to “Electronic Navigation Equipment” or “ENE” or “Electronic Navigational Equipment” throughout the Tender Documents or Contract shall mean the Equipment within this chapter.

13.1.3 An integrated system is adopted for ENE, so that information and also the display monitors of different systems, such as colour plotter system, radar system, can be shared in order to utilise the limited space available in coxswain operation area and to provide users a better displaying interface ("Integrated Navigation System" or "INS").

13.1.4 All ENE offered shall be designed for marine applications and shall allow effective operation under most arduous condition such as poor weather, strong winds and heavy rains and severe vibration. Exposed components shall be weather-proof and adequate protection against splash and water shall be provided for all electronic equipment fitted on board.

13.1.5 All components of the equipment exposed to the weather shall be sea water corrosion resistance. Internal components shall be fully enclosed with heavy duty seals and sufficient heat dissipation mechanism such as ventilation and conduction to protect the Equipment.

13.1.6 The Contractor shall pay attention to the compass safe distance of the equipment and the radiation hazard zone of the radar scanner in the Vessel design.

13.1.7 All radar and radio equipment shall meet the licensing requirements of the Office of the Communications Authority of Hong Kong.

13.1.8 All siting, installation and cabling in respect of components including but not limited to compass, VHF and radar shall comply with the relevant rules and regulations of Hong Kong.

13.1.9 All ENE shall have warranty support services in Hong Kong and on-site maintenance shall be available in Hong Kong.

13.1.10 When the generation / use of calendars are employed for logging of reports, activation off equipment, or as any essential part of logic for the proper functioning of the system, then the calendar generation shall function without any error or manual intervention for all leap years.

13.1.11 The circuit breaker for the ENE shall equip with lockout device so that the breaker can be locked during the equipment maintenance.

13.1.12 Lightning protection shall be provided and installed wherever applicable. The lightning arresters for all outdoor antennas shall be installed at the antenna ends.

13.1.13 Equipment supplied shall complete with all standard and/or maker recommended accessories as required for normal operation.

13.1.14 All the ENE control system on wheelhouse console shall not use touch screen (Except for ECDIS).

13.2 Loudhailer / Siren System and Public Address System with USB Player

13.2.1 The system shall function as a loudhailer/siren system for external broadcast specially designed for maritime purposes. The system shall also consist of a public address system for internal broadcast in the crew area. The whole system shall be marine type.

13.2.2 Loudhailer/Siren:

a) The system shall comprise two (2) master control units in wheelhouse and two (2) weather proof horn type loudspeakers, in conformance to IPX5 or better, located at forward and aft of the Vessel respectively.

b) The system shall have the capacity to generate a "Yelp" siren and a horn signal sound in manual mode. It shall also have a selection of at least six (6) warning signal sounds in automatic mode for general marine navigational uses, namely Underway, Stopped, Sail, Tow, Anchored, and Aground.

c) There shall be a volume control on external broadcasting speaker so it shall be adjustable to full power for messages to be heard 0.5 km away from the Vessel and down to minimum of 0.1 km for night operations.

d) Two (2) master control units, which shall be completed with fist microphone and microphone hanger, shall be recessed mounted in the wheelhouse with the following facilities provided at the front panel:

(i) Power ON / OFF

(ii) Hail volume control

(iii) Function control

e) Speech shall be delivered through a fist microphone hanging on the console. The fist microphone shall be splash-proof, and preferably water-proof.

f) The amplifier shall be with a rated power output of not less than 30 watts per speaker and shall have the following characteristics:

g) Mic in (hail) sensitivity: Not greater than 30 mV for 30 watts output at 1 kHz

h) Hail distortion: Not greater than 10% at 30 watts output at 1 kHz

i) The horn type loudspeaker shall be weatherproof reflex type, 8 ohms impedance with power rating not less than 30 watts (actual rating shall match with the amplifier).

j) A USB player shall be provided with the system in such a configuration that the audio signal from the USB player can be broadcasted through the loudhailer system.

13.3 Internal Public Address System

13.3.1 There shall be at least two (2) speakers installed around the crew area for a one-way internal broadcast to the crew from the microphone at either of two (2) control panel units. There shall be volume control for these internal broadcast speakers for adjusting acoustic levels to comfortable levels for the crew and at the same time avoid excessive acoustic feedback to the microphone. These internal broadcast speakers shall be waterproof to IPX5 or better and suitable for the location of installation.

13.3.2 The positions of the master control units of loudhailer/siren system, control panel and both the position and quantity of speakers of public address system shall be finalised in the detailed design stage.

13.4 Magnetic Compass with Back Lighting and Fluxgate Compass

13.4.1 The Contractor shall provide one (1) magnetic compass and one (1) fluxgate compass with digital display.

13.4.2 The magnetic compass shall be provided with back lighting.

13.4.3 The fluxgate compass shall consist of at least a sensor unit and a display unit, and be compact and easy to operate. It shall have direct connection to the radar.

13.4.4 An electronic display unit shall be installed at a position for easy viewing of Vessel heading by the coxswain.

13.4.5 The fluxgate compass shall be electronic such that GPS/DGPS shall not cause deviation.

13.4.6 The fluxgate compass shall be provided to allow the operation of the radar in north stabilised mode and supply heading direction information to colour plotter system.

13.4.7 Performance Requirements of fluxgate compass:

a) Reference: Either magnetic north or true north.

b) Accuracy: ±1.00 typical or better.

c) Resolution: 0.10 or better.

d) Deviation Compensation: Automatic.

e) Operating Temperatures: 0℃ to 50℃.

f) Waterproofing: IPX5 or better.

13.5 Differential Global Positioning System

13.5.1 The Contractor shall supply and install one (1) set of DGPS consist of the following:

a) 7” color touch-screen LCD display;

b) Antenna /receiver;

c) Associated cables and accessories.

13.5.2 The DGPS shall integrate with the radar, ECDIS, for providing real time Vessel position and clock signal in the NMEA 0183 or NMEA 2000 format.

13.5.3 The DGPS shall consist of the following：

a) DGPS to be compatible with GPS or GLONASS networks;

b) DGPS to have receiver autonomous integrity monitoring (RAIM) functionality to alert when position accuracy is below user set limit;

c) DGPS to be displayed at Wheelhouse Control Station and anywhere else required by GNC;

d) Automatic, manual, or remote dimming;

e) Capable or integrating with AIS, radar, ECDIS.

f) The DGPS antenna/receiver shall be connected to the radar for the provision of GPS-related data, such as position fix, time, speed over ground and course over ground;

g) The GPS system shall support Serial NMEA 0183, Serial 26-pin D-sub, Serial 9-wire RS232, Serial 3-wire RS232 and Ethernet (NMEA 2000);

h) The GPS system shall support at least the following data displayed at the GPS display unit and through outputs to the radar display;

i) Position (latitude/longitude): to at least four (4) decimal points;

j) Horizontal Position accuracy (at speed of 15 knots): less than or equal to 10m;

k) Course: 1 resolution;

l) Speed: 0.1 knot or 0.1 km/hour resolutions with at least three (3) digits;

m) Date and time: selectable as GMT or local mode; and

n) Satellite status information.

13.5.4 The GPS system's antenna/receiver shall fulfil the following technical requirements:

a)	Receiver Type:	8 or more channel parallel receiver
b)	Receiving Frequency and Code:	1,575.42 MHz (C/A code)
c)	Position Accuracy:	Within + or - 30 metres rms or better 95% of the time
d)	Warm Start Time:	Less than 30 seconds
e)	Ambient temperature:	0°C to 55°C or better
f)	Waterproofing:	IPX7 or better

13.6 Marine Radar (x-band) for navigation

13.6.1 General Requirements

a) The equipment shall be a relative motion high performance radar suitable for small vessels and comprise a transceiver, an antenna and a colour display unit, suitable for bright daylight and night viewing.

b) The radar shall be able to track high speed small crafts easily.

c) The radar shall also be able to detect tiny targets such as small buoys or wooden stakes.

d) The Contractors shall ensure that the type and the number of provisions of the radar are appropriate to the class of the Vessel.

e) The radar shall be equipped with a collision avoidance system that is an Automatic Radar Plotting Aid – ARPA or other equivalent function capable of tracking at least 10 targets.

f) The transceiver shall be housed in the scanner unit and shall be designed for aloft mounted construction and capable of satisfactory operation at high wind speeds. The scanner assembly shall be housed in a weatherproof housing.

g) The radar scanner unit shall be installed well clear of obstructions to minimise undue interference and Non-Ionizing Radiation (NIR hazards). Care shall also be taken to ensure the scanner mounting does not give excessive shadow sectors for navigation lights.

h) Complete interface kit shall be provided to interface the radar for the fluxgate compass, GPS/DGPS, colour plotter and AIS. The radar shall have interface to accept and display navigation data such as latitude and longitude positions of the Vessel given by the GPS/DGPS receiver.

i) There shall be interface provided to the radar for AIS. The radar shall have interface to accept and display AIS information such as Vessel names, call signs, heading, destination, maritime mobile service identity (MMSI), latitude, and longitude and other navigation data given by the AIS.

j) The Contractor shall pay special attention to any possible radar blind zone, and shall address this during the design stage and verify it after installation, and rectify it if required. The Contactor shall pay special attention to the equipment installed before the radar scanner like flood lights and/or horn speakers. Care shall also be taken to ensure the mounting does not obstruct the navigation lights.

k) The radar shall have standard NMEA 0183 OR NMEA 2000 interface ports, i.e. National Marine Electronics Association (NMEA) Standard, capable of accepting navigational data from a wide selection of GPS/DGPS Receivers and Electronic Compasses, AIS and to output comprehensive data on all tracked targets in the form of a track table to a wide selection of electronic chart plotters. However, connection of the radar system to the other systems supplied under this Contract via other standard or proprietary interface types equivalent to NMEA 0183 OR NMEA 2000 is acceptable.

l) The power for the equipment shall be supplied from the DC 24V system of the Vessel.

m) The radar transceiver shall be housed in a radome antenna/scanner unit of maritime type. It shall be designed for aloft mounted construction and capable of satisfactory operation at high relative wind speeds of not less than 70 knots.

n) Guard zones and alarm functions shall be provided in the radar. The zone shall be set and shown on the display screen. Audible alarm shall be activated if other vessels enter the zones set.

o) The display unit shall be of table top mounting type providing clear and clutter free picture in all weather conditions and suitable for bright daylight and night viewing. It shall indicate clearly the important parameters such as radar targets, range marker, bearing line, heading marker, range rings, guard zone and background.

p) On the viewing side of the display unit, the following controls shall be provided:

   (i) Power ON/OFF
   (ii) Standby/Transmit
   (iii) Automatic adjustment of gain, sea clutter and tune keeps targets clearly in view

(iv) True motion display the Vessel's movements relative to fixed targets
(v) Bearing cursor rotation
(vi) Electronic bearing line (EBL)
(vii) Variable range marker (VRM)
(viii) Range scale selection
(ix) Display brilliance & illumination
(x) Selection of background colour and target colour
(xi) Tuning
(xii) Heading marker ON/OFF

13.6.2 Performance Requirements

a) The marine radar shall perform at least or better than the following requirements in this Paragraph.

b) Processor unit:

(i)	Presentation mode:	Head up, course up, north up and true bearing modes (with inputs of compass and speed data)
(ii)	Range scale:	0.125 nm to 24 nm
(iii)	Range units:	Selectable from nautical miles, kilometres, and kilo yards
(iv)	Minimum range:	30 m or less
(v)	Range ring accuracy:	1.5% or less of the maximum range of the scale in use; or 30 m, whichever is the greater
(vi)	Radar bearing accuracy:	1.5 degree or less
(vii)	Display language:	English Bilingual (English and Chinese) is preferred.
(viii)	Other:	With adjustable electronic bearing lines and variable range markers features
(ix)	Operating temperature:	-15℃ to +55℃ or better
(x)	Relative humidity:	90% or better

c) Display Unit:

(i)	Display:	Flat panel colour LCD
(ii)	Screen size:	15 inches (381 mm) or larger

(iii)	Resolution:	1280 x 1024 pixels or better
(iv)	Brightness:	700 nits

d) Transceiver:

(i)	Operating frequency:	9410±30 MHz (X–band)
(ii)	Peak power output:	At least 6 kW (Please note that this specification about peak power assumes a traditional radar (magnetron radar), rather than a solid state radar.)
(iii)	Pulse length:	Equipped with long, medium and short pulse modes for close, medium and long range operation
(iv)	Overall noise figure:	6 dB or better

e) Antenna:

(i)	Operating frequency:	9410±30 MHz (X–band)
(ii)	Aerial type:	Open array radar antenna
(iii)	Horizontal beam width:	2.0 degrees or less
(iv)	Vertical beam width:	26.0 degrees or less
(v)	Polarization:	Horizontal
(vi)	Rotation speed:	Not less than 24 rpm within satisfactory operation at relative wind speed up to 70 knots. Manual and automatic selection of antenna rotation speed such as 24 rpm, 36 rpm and 48 rpm shall be available according to detection range.
(vii)	Operating temperature:	-15℃ to +55℃ or better;
(viii)	Relative humidity:	90% or better
(ix)	Waterproofing:	IPX6

f) Heading Marker, Bearing Measurement and Display

(i) The thickness of heading marker shall not be greater than 0.5 degree with an accuracy of not greater than 1 degree.

(ii) Arrangements shall be provided for bearing measurement with an accuracy of better than degree. Bearing discrimination shall be better than 2.0 degrees.

(iii) ARPA (Automatic Radar Plotting Aid) Requirement

(iv)	Target acquisition:	10 targets (manual)

(v)	Tracking:	Automatic
(vi)	ARPA range scales:	From 0.75 to 12 nautical miles or better
(vii)	Readout of selected target:	Range, bearing, course, speed, CPA (Closest Point of Approach), TCPA (Time to Closest Point of Approach)
(viii)	Target vector:	Relative, true
(ix)	Intercept mode:	Automatically calculate intercept course and Time to Go (TTG) to tracked target
(x)	Adjustable warning limit:	warming for CPA to a desired adjustable limit

g) The crew operator shall be able to select the following modes of presentation at the radar display:

(i) radar image only,
(ii) plotter image only, or
(iii) plotter image overlaid with radar image.

13.7 Navigation Electronic Chart Display and Information System (ECDIS)

13.7.1 The ECDIS shall show the radar, AIS, depth of water by echo sounder and ENC information in one picture.

13.7.2 General Requirements

a) One (1) set of Electronic Chart Display and Information System (ECDIS) shall provide the following functions:

(i) Navigational calculation
(ii) Chart updating
(iii) Piloting
(iv) Voyage monitoring
(v) Create User Charts and Route Plan

b) One (1) set of ECDIS with DGPS receiver and echo sounder shall be installed. It shall consist of three (3) DGPS display control units, a remote GPS antenna and differential beacon receiver, colour chart plotter with electronic chart cartridges for Hong Kong Waters, and echo sounder.

c) The information received by the DGPS receiver shall be input to the marine radar and display on the marine radar and the screen of colour plotter. The output of the receiver shall give the Vessel position in a format compatible to marine radar in the "American Standard for Interfacing Marine Electronic Navigational Devices" NMEA 0183 or NMEA 2000 format. However, connection of the radar system to the other systems supplied under this Contract via other standard or proprietary interface types equivalent to NMEA 0183 or NMEA 2000 is acceptable.

d) One (1) screen monitor of size not less than 19 inches shall be provided. The screen monitors must fulfil the following features:

(i) 1000 nits Brightness;

(ii) 610 mm active viewing area;

(iii) HDMI, DVI and composite inputs with a pre-installed cable to the Server Rack for transmission of hydrographic survey information as secondary input;

(iv) On-class menu keys;

(v) Can be operated as components including but not limited to radar, chart plotter, depth sounder and alarm.

e) The GPSD/GPS/plotter system shall be provided with "speed logs and electronic compass interface" or "gyro and its interface" to support the "dead reckoning" mode operation, if GPS satellite signal is absent for a period greater than 10 minutes.

f) The system shall be equipped with navigational sea charts in details covering the entire Hong Kong Waters.

g) The information received by the AIS shall be able to display on the screen monitors of ECDIS.

h) Complete interface kit shall be provided to interface with the colour chart plotter for the radar, echo sounder and GPS/DGPS. The colour chart plotter shall accept and display information given by the radar, echo sounder and GPS/DGPS receiver.

i) The processor unit of the ECDIS shall accept and display information given by the ENE: Radars, VHF, AIS transponder, DGPS and control console. The processor unit shall have high-performance quad-core processor for rapid, responsive operation of the multiple touch screen monitor.

j) One (1) laptop computer with additional LCD display shall be separately installed. The Contractor shall confirm the installation location with the user. This laptop computer shall fulfill the following requirements:

(i) Operating system:	Window 11 Professional (Chinese) or better
(ii) CPU:	Intel Core i7(Gen 12 or newer) Processor 2.6GHz or better
(iii) RAM:	8 GB 4800MHz DDR5 or better
(iv) Display card:	Up to 1920 x 1080 HDMI and provide the dual displays function which provide the display signal to the monitor of ECDIS
(v) Monitor:	15.6 inches or better
(vi) HDD type:	512 GB SSD
(vii) HD:	500 GB or above
(viii) Interface:	USB (3.1) x 2, USB (Type C) x 1, Bluetooth (receive NMEA Data from AIS and DGPS, connect the printer, multi-card reader and USB device)

(ix)	Accessories:	Multi-card reader (SD / MMC+ / miniSD, Micro SD, Compact Flash I / II, MS PRO / MS PRO Duo)
(x)	Software:	Orca Master (ECS Software), Microsoft Office Standard 2019 or the latest version
(xi)	Printer:	Multi-functional laser printer (copy, print and scan) connected to personal computer through USB, the print & copy speed at least 35 pages per minute and support auto double-sided printing, copying, and scanning. It is desirable that the dimensions (width, depth and height) of the printer is 494 mm x 430 mm x 448 mm
(xii)	Display:	LCD Monitor 32 inches or better

k) ECDIS display shall be used for the display of radar, radar tracked target information, AIS and other appropriate data layers to assist in route monitoring.

l) ECDIS shall provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment.

m) ECDIS is capable of reading and loading IHO S-57 (Version 3.1) ENC data file and update the same where necessary. Also it is able to handle the different chart format such as S-57 digital charts, SevenCs directENC charts, SevenCs Bathmetic ENCs, ARCS charts, VMAP/DNC charts, AML charts, BSB charts, WMS charts and Geo TIFF.

n) The chart information to be used in ECDIS shall be the latest edition, can be corrected by official updates (S-57 digital charts, SevenCs directENC charts, SevenCs Bathmetic ENCs) by the MD with records of update shown on the ECDIS.

o) ECDIS shall enable the mariner to execute in a convenient and timely manner all route planning, route monitoring and positioning currently performed on paper charts. It shall be capable of continuously plotting the ship's position.

p) The ECDIS shall be capable of displaying both English and Chinese characters of the ENC.

q) ECDIS shall store 12 hours history voyage record and can be reproduced on the ECDIS.

13.7.3 Performance requirements

a) Navigational Features

(i)	Total waypoints:	2000 or more
(ii)	Routes:	50 route plans or more
(iii)	Alarms:	Including but not limited to, proximity alert, cross-track error, and arrival /anchor watch

b) Environment

(i)	Operating temperature:	10°C to +50°C
(ii)	Storage temperature:	20°C to +60°C

c) Electrical and Physical

(i)	Power source:	12 - 24V DC (external)
(ii)	Display (screen type):	24 inches or greater diagonal high resolution colour display resolution 1280 x 1024 pixels or better for 4:3 aspect ratio
(iii)	Waterproof rating:	IPX6 or greater

d) GPS Receiver

(i)	GPS receiver type:	Equipped with 8 channel parallel receiver or better
(ii)	Frequency range (GPS):	1575.42±1MHz (C/A code), L1
(iii)	Sensitivity (GPS):	-130 dBm or better
(iv)	Dynamic range (GPS):	25 dB or better
(v)	Warm start fix time:	Less than 30 seconds
(vi)	Cold start fix time:	Less than 3 minutes
(vii)	Position accuracy:	no greater than 15 m
(viii)	Tracking velocity:	999 knots

e) Differential Beacon Receiver

(i)	Frequency range:	283.5-325 kHz
(ii)	Frequency step:	500 Hz
(iii)	Position accuracy:	No greater than 5 m

f) Data Display

(i)	Lat/Lon:	N or S plus 7 digits E or W plus 8 digits
(ii)	Speed and course:	0.1Kt/h or 0.1Km/h resolution digit 1-degree resolution
(iii)	Cross track error:	Graphic or direction indication
(iv)	Bearing:	3 digits, 1-degree resolution
(v)	Range:	4 digits, 0.01-nm resolution
(vi)	CDI:	Active perspective view, selectable scale (0.1, 0.3 or 0.5nm)
(vii)	Time:	Selectable as GMT or local mode

(viii)	Mapping:	Resident world map in memory (reversible video)
(ix)	Language for system:	English operation and display Bilingual (English and Chinese)

13.8 Back up for ENC or ECDIS (paper nautical charts)

13.8.1 The Contractor shall supply the back up for ENC or ECDIS (paper nautical charts).

13.9 Echo sounder

13.9.1 The Contractor shall supply and install an Echo Sounder System with the sonar unit securely installed on the body of the vessel. The Echo Sounder shall be as follows this chapter.

13.9.2 The equipment shall consist of a transducer and a digital depth indictor front panel which is flushed mounted at the steering console and capable of displaying depth information in feet, fathoms and meters.

13.9.3 The measured depth shall be between 0m and 150m with at least three (3) selectable ranges to indicate shallow, mid and deep ranges. The unit of measurement shall be selected at the front panel of the equipment.

13.9.4 Shallow water audible and visual alarms shall be provided when entering an area with a depth shallower than the pre-set depth. Setting of the alarm depth shall be capable on the front panel of the equipment.

13.9.5 The measuring accuracy of depth reading shall be better than + 5% of full scale range.

13.9.6 The peak to peak transmitting pulse power of the transducer shall not be less than 200 Watts and the nominal operating frequency shall be 200 kHz.

13.9.7 There shall be an isolating switch to switch off the recorder in case of shortage of recording paper but the equipment for sensing and indicating the depth shall still be operating and functioning as in normal working condition.

13.9.8 The transducer shall not interfere or be interfered with by other equipment on the vessel.

13.9.9 The echo sounder supplied shall be completely compatible with all systems using the NMEA 0183 or 2000 standard and be capable of interfacing with the navigational radar, ECDIS, compass, DGPS and other equipment as necessary.

13.9.10 Echo sounder display shall be:

a) 10.4” colour LCD with adjustable backlight and full dimming capability with day/night pre-sets;

b) Either 24 V DC or 220-240V AC Power Supply;

c) Provide data Output in NMEA 0183;

d) Provide output for external VGA;

e) Provide output for printer; and

f) Type approved in accordance with IMO relevant Requirements.

13.10 International Maritime Mobile (IMM) VHF Radio with GMDSS

13.10.1 The Contractor shall supply one (1) console mounted International Maritime Mobile (IMM) VHF radio equipped with GMDSS functionality.

13.10.2 The IMM VHF radio shall be located nearby the Coxswain seat. Its exact position shall be determined and agreed by the GNC during the design of the wheelhouse.

13.10.3 General Requirements:

a) The IMM VHF radio shall meet the licensing requirements of the Office of the Communications Authority of Hong Kong (OFCA).

b) The radio shall be fully compatible with the Global Maritime Distress Safety System (GMDSS) with a Class A Digital Selective Calling (DSC) transceiver fully compliant with the International Maritime Organization (IMO) GMDSS carriage requirements.

c) The radio shall be equipped with all the international maritime VHF channels with a fist microphone and press-to-talk switch or telephone handset, mic/handset hanger, mounting bracket and loud speaker.

d) The radio shall have a dual watch mode selection switch, incorporating Channel 16 with any other selected channel.

e) The following functions shall be available on the front panel of the radio:

(i) Power ON/OFF;
(ii) Transmit indicator, volume and squelch controls;
(iii) Socket for plug for microphone and external speaker;
(iv) Quick selector for Channel 16;
(v) Channel selector and indicator;
(vi) Independent dual watch mode selection switch; and
(vii) Transmission power selector for HIGH and LOW Power (25 W / 1 W).

f) The operating temperature range of the radio shall be -5°C to +55°C or better.

g) The water ingress protection for the radio shall be IP X7, IP56 or better.

h) The radio shall include an exterior antenna, integrated microphone, loudspeaker, control knobs/keys, display screen, and all connectors and accessories to provide the functionality required.

13.10.4 Performance Requirements

a) Transmitter Characteristics

(i) Frequency Range: 156.000MHz to 157.425MHz, or better

(ii)	Frequency Deviation:	Frequency modulation with maximum frequency deviation of +5 kHz
(iii)	Spurious and Harmonics:	-70dB or better
(iv)	RF Output Power:	Transmission power selector for: (a) High at twenty-five (25) watts nominal and (b) Low at one (1) watt nominal.

b) Receiver Characteristics

(i)	Frequency Range:	156.000 MHz to 163.425 MHz or better
(ii)	Sensitivity:	Less than -119dBm for 20 dB SINAD or equivalent
(iii)	Adjacent Channel Selectivity:	65dB or better
(iv)	Spurious Image Rejection:	65dB or better
(v)	Intermodulation:	65dB or better
(vi)	Audio Output:	Not less than 1watt at rated output with less than 10% distortion.

c) Aerial and Feeder

(i) The aerial provided shall be a marine type aerial with at least 3 dBi gain, vertically polarised, omni-directional and suitable for mounting on the launch.
(ii) The V.S.W.R. of the aerial installed shall be less than 1.5: 1.
(iii) The aerial feeder shall be RG58U type or equivalent.
(iv) Coaxial cable lightning suppresser with appropriate earthing connection shall be provided for protecting the radio equipment. All outdoor connector joints shall be properly covered by waterproof tape or material.

d) Loudspeaker:

(i) 6W or above.

13.11 Marine Band Hand-held Waterproof Radio Transceiver

13.11.1 General Requirements

a) The Contractor shall provide one (1) GMDSS IMM VHF waterproof handheld transceivers.

b) Each portable IMM VHF transceiver shall be of proprietary make and completed with two (2) sets of rechargeable lithium batteries, batteries charger, helical antenna with V.S.W.R. not exceeding 1.5:1 and carrying case (with shoulder strap or belt clip). The batteries shall be of a lifetime of at least four 4 years.

c) The operation period of each fully charged battery shall not be less than eight (8) hours per charge (10% transmit, 10% receive, 80% stand-by). The charger shall be designed for 220V AC input power supply and equipped with a BS 1363 type 13A power plug.

13.11.2 The portable transceiver shall, as a minimum, be capable of transmitting and receiving on all 55 International Maritime VHF channels, together with the private maritime VHF single frequency channels 96 (157.925 MHz) and / or 99 (157.975 MHz) and shall comply with the following:

a) The transceiver shall be of robust, waterproof, light weight design and made with shock proof material suitable for hand held radio communications both on the Vessel and ashore.

b) The transceiver shall be fully solid state and of software programmable carrier frequency type. Add-on crystal for carrier frequency will not be acceptable.

c) The unit shall be a type approved model accepted by OFCA for maritime frequency band application.

13.11.3 Performance Requirements

a) The transceiver shall, as a minimum, incorporate the following controls / switches / functions:

(i) Power on / off button;
(ii) Volume control;
(iii) High / low transmitting power switch;
(iv) Press to talk switch;
(v) Built-in microphone and loudspeaker;
(vi) Channel selector operating channel display; and
(vii) Sockets for external microphone, press to talk and loudspeaker.

b) The transceiver shall comply with the following:

(i)	Operating frequency range:	International Maritime VHF Band
(ii)	No. of Operating Channels:	99 (programmable)
(iii)	Channel spacing:	25 kHz
(iv)	Frequency stability:	± 8 ppm between 0 and 50 ℃
(v)	Housing IP Category:	IP 57

13.12 Automatic Identification System (AIS) transponder (Include the receiver and transmitter modules)

13.12.1 General Requirements

a) The equipment shall receive information from AIS-equipped vessels.

b) The equipment shall be a Class A universal AIS complying with IMO MSC.74 (69) Annex 3, IMO MSC.191(79), ITU-R M.1371, ITU-R M.493, ITU-R M.825 (DSC), IEC 61993-2, IEC60945, IEC 61162-1/2, IEC 62288.

c) The AIS transponder (receiver module) shall be capable of receiving AIS information from AIS equipped vessels that includes: dynamic data (vessel position, coordinated universal time (UTC), course over ground (COG), speed over ground (SOG), rate of

turn (ROT), heading), static data (maritime mobile service identity (MMSI), vessel name, type of ship, call sign, length and beam, heading, destination, latitude and longitude, location of position-fixing antenna on the ship), short safety-related messages and other navigational data.

d) The AIS transponder (receiver module) supplied shall be equipped with interface connecting to display including the display of the radar system. The AIS shall allow the radar and ECDIS to display AIS information given by the AIS receiver.

e) The AIS signal must feed in to the Serial port, USB port, Bluetooth of EDCIS and provide 12 hours history record to ECDIS

f) The AIS supplied shall be compatible with all systems using NMEA 2000 standard and be capable of interfacing with the navigation radar, ECDIS, compass, and DGPS.

g) It shall be possible to edit AIS message information relating to navigation and ship information.

h) The AIS shall be easy to identify other ship's status by providing electronic chart data.

i) The AIS shall have a self-restoring function to enhance stability.

j) The AIS shall have a user-friendly one touch keypad (or equivalent).

13.12.2 Each set of AIS shall include:

a) A display with minimum dimensions of 250 mm x 130 mm;

b) An AIS transponder unit;

c) A VHF antenna;

d) A GPS antenna; and

e) Installation/operation handbook.

13.12.3 The AIS shall be capable of the following performance requirements:

a) General Requirements

(i)	Power Supply:	24V DC
(ii)	Default Frequencies:	
	1. AIS1 (CH 87B):	161.975MHz
	2. AIS2 (CH 88B):	162.025MHz
(iii)	DSC (CH70) :	156.525MHz
(iv)	Frequency Range:	155-163MHz

13.12.4 AIS Transmitter

a) Power Output: 12.5W or 1.0W (δ1.5dB)

13.13 Radar Transponder

13.13.1 The Contractor shall provide two (2) sets SART Radar transponder. A radar transponder gives the location for any nearby vessel and aircraft with X-band radar. Easy mounting in bulkhead bracket onboard the vessel, easy to release and activate in an emergency situation.

13.13.2 General requirements:

a)	Frequency range:	9,200 MHz to 9,500 MHz
b)	Polarization:	Horizontal
c)	Form of sweep:	Saw tooth
d)	Fast return:	0.4μS ± 0.1 μs
e)	Sweep rate:	7.5μS ± 1μs
f)	Pulse emission / number of sweep:	100 μs nominal / 12 sweeps
g)	Antenna beam width:	Vertical beam At least ±12.5° Azimuthal beam Omni directional within 2dB
h)	Effective isotropic radiated power (EIRP):	More than 400 mW
i)	Effective receiver sensitivity:	Better than -50 dBm
j)	Recovery time following excitation:	Within 10μs
k)	Delay time (radar signal / SART transmission):	0.5 μs or less

13.13.3 Environmental Condition

a)	Battery:	Lithium battery (primary):
b)	Nominal voltage:	7.2 V, Capacity 3.6 AH
c)	Operation life time:	96 hours in stand-by mode, and then at least Eight (8) hours in response mode
d)	Useful life time:	Four (4) years after plant delivery
e)	Temperature range(storage):	-30 ºC to +65 ºC
f)	Temperature range(operation):	20 ºC to +55 ºC

13.14 Satellite Emergency Position Indicating Radio Beacon (“EPIRB”)

13.14.1 The Contractor shall provide one (1) set of maritime type Satellite EPIRB (406 MHz) will be stowed on upper deck.

13.14.2 The equipment shall be complied with IMO Resolution MSC.471(101) and IMO A.662(16).

13.15 Voyage Data Recorder

13.15.1 A VDR conforming to the specifications listed in IMO IEC 61996-1 shall be fitted to the Vessel for the purposes of post incident review.

13.15.2 The VDR shall satisfy the following performance requirements:

a) Data collection unit (DCU)

(i) Recording period:	720 hours or better
(ii) Recorded media:	Removable CF Solid State Drive
(iii) Built in UPS:	Two (2) hours or above
(iv) Number of audio interface input:	Ten (10) or above
(v) Number of serial data input:	Twelve (12) or above
(vi) Number of Ethernet data input:	Seven (7) or above
(vii) Interface:	Support NMEA 0183 or NMEA 2000 (Ethernet base)
(viii)Remote Alarm Display Panel:	4.3 inches colour LCD or better

13.15.3 The Contractor shall record all necessary items to VDR in accordance with the requirements of IMO IEC 61996-1 standard in the version as at the delivery of the Vessel unless the standard specify that version of such standard as at the keel laying date of the Vessel shall apply in relation to the relevant requirements specified therein and include at least the following:

a) Bridge microphones;

b) VHF;

c) Radar;

d) DGPS;

e) Echo sounder;

f) AIS;

g) Wind sensor;

h) Fire detection and alarm system;

i) Navigation & signal lights panel; and

j) Bilge alarm system.

13.15.4 The Contractor shall provide a laptop computer with installed playback software for playing back the recorded files from the VDR. Extraction of data from the VDR shall be possible via USB or equivalent.

13.16 CCTV System

13.16.1 The Contractor shall supply and install a CCTV System to provide a 360 view of the exterior of the vessel to assist with navigation and in particular berthing of the vessel as well as the rear and front deck for view of operations being carried out at those locations. Interior views to include the Unmanned Machine Spaces.

13.16.2 The CCTV system shall be provided with the following major equipment:

a) IP based, high definition cameras;

b) Recording / processing devices including network video recorder ("NVR"), workstation computer; and

c) And Uninterruptible Power Supply ("UPS").

13.16.3 The locations of the CCTV cameras shall be determined with the GNC

13.16.4 Unless otherwise specified, all CCTV cameras shall comply with the following technical requirements:

a) All cameras shall be IP based, high definition camera (1920 x 1080p), water-proof, vandal-resistant type, Infrared Cut Filter (ICR) day and night dome pan-tilt-zoom cameras. They shall be marine type and shall be suitable for operation in a rough sea environment. Ingress protection: Outside door shall be IP56 or better, inside of up-deck may be IP20 or higher IP value, and under-deck may be IP44 or better.

b) All cameras shall have an image stabilization function to accommodate the rough sea conditions.

c) All cameras shall be capable of covering diagonal view by wide angle lens or standard lens according to the actual condition.

d) CCTV images shall be displayed relevant multi-function display on the Wheelhouse Control Station. Exterior CCTV views of the port / starboard / aft shall be permanently displayed on the overhead monitors. Interior CCTV images of the UMS shall be displayed at the Engineering Officer's Console.

e) An Uninterruptible Power System (UPS) shall be designed, supplied and installed to sustain the operation of the CCTV system for a minimum of thirty (30) minutes.

f) The CCTV system shall be equipped with a control panel or virtual control panel, installed in the Wheelhouse to allow the operator to control pan-tilt-zoom of the selected camera. These requirements will be discussed further during the design phase.

g) All cameras shall be powered by Power over Ethernet (PoE) as part of the CCTV system.

13.16.5 The CCTV system shall consist of sufficient channels covering and including but not limited to the following areas:

a) one (1) camera on the port side, viewing aft from the wheelhouse area for viewing crane operations;

b) one (1) camera on the starboard side, viewing aft from the approximately the wheelhouse area for viewing crane operations;

c) one (1) camera facing the aft deck;

d) one (1) camera facing forward to view operations on the bow;

e) one (1) camera facing aft for navigation purposes;

f) one (1) camera facing forward for navigation purposes, just for record not need on monitor;

g) At least two (2) cameras in each the engine room;

h) At least one (1) camera in each steering gear room; and

i) At least one (1) camera in the wheelhouse.

13.16.6 Camera shall be a pan-tilt-zoom camera with a wide field of view of at least 120° and with Infra-Red (IR) Light Emitted Diodes (LEDs) enabling operation in poorly illuminated areas or conditions. The camera shall be installed in the location that covers the area in front of the Vessel.

13.16.7 The control and monitoring of the CCTV system shall be from the wheelhouse.

13.16.8 The image of each camera shall be superimposed with the camera identity, location, time and date.

13.16.9 Video captured by all cameras shall be fed to the NVR via main-stream for recording. The NVR shall provide sufficient disk space for archive of 30 days video image for all cameras of 1920x1080 resolution at 25 frames per second.

13.16.10 LCD monitor with screen size not less than 21 inches diagonal measurement shall be provided for display of video image. The configuration of the System shall support smooth liveview of up to 16 cameras to be displayed to the monitor simultaneously.

13.17 Electric horn conforming to IMO requirement

13.17.1 One (1) set of maritime type electric horn shall be fitted on the radar mast.

13.17.2 One (1) set of horn controller shall be fitted on navigation watching console capable of operating horns.

13.17.3 One (1) set of horn push button shall be fitted on appropriate location.

13.17.4 The electric horn shall be marine grade and weatherproofed to IP56.

13.17.5 The equipment shall be fed from the AC 220V and DC 24V emergency supply system and sound pressure level at least 100 dB at 10 m.

13.18 Integrated Navigation System

13.18.1 The Contractor shall supply and install an Integrated Navigation System (“INS”) to allow the operator in the Wheelhouse, to switch and view the screen most appropriate to the given operation that they are carrying out. The INS shall provide the Vessel operator with a user interface to be used in normal operation providing access to all data or video supplied from the navigation equipment, unless otherwise stated.

13.18.2 Three (3) 26" or larger IMO compliant multifunctional displays, acceptable to the GNC, shall be located in the Wheelhouse Control Station and Wet Laboratory and Monitor room for displaying Conning and Navigation Information, main engine, etc.. The display INS to be fitted within a console which shall be angled such that the view on the display is not compromised by glare. The displays/ monitors shall have the following minimum specifications:

a) General requirement:

(i)	26 inch viewable image size, Widescreen,Aspect Ratio 16:9;	
(ii)	Native Resolution:	1280 x 1024 pixels or better
(iii)	Contrast ratio standard:	1000:1 (typical)
(iv)	Light Intensity Standard:	350 cd/m² (typical)
(v)	Viewing Angle Standard:	±85 ° (typical) (up/down/left/right)
(vi)	Multi-touch screen:	Yes
(vii)	This display shall be 100% dimming to meet the requirements of night navigation.	

b) Special function requirement:

(i) view navigation radar screen;
(ii) view navigation ECDIS screen;
(iii) Vessel location
(iv) Vessel heading;
(v) Real time water depth;
(vi) Wind Speed and direction
(vii) Air temperature, rainfall, tidal stream speed and direction (subject to the sensors equipped on board), and HKO warnings in the monitoring room.
(viii) Mode of Propulsion;
(ix) Propeller RPM / Load;
(x) Rate of turn indicator;
(xi) Steering angle;
(xii) Fuel consumption;
(xiii) Hong Kong Observatory warning

c) Other information deemed necessary by GNC or proposed by the Contractor.

13.19 Wired Intercom System

13.19.1 General requirement:

a) The intercom system shall consist of at least two (2) master stations and eight (8) slave stations.

b) All stations (both master and slaves) shall be able to communicate with each other. In addition the master station shall be able to give an emergency call-out to all the slave stations simultaneously.

c) Weatherproof type enclosure shall be provided for all the stations.

d) Incoming calls shall be signalled by audible tone.

e) Incoming calls shall be signalled by visual means with integral flashing indicator.

13.19.2 Specific requirement:

a) The locations of master and slave stations of the intercom system shall be determined in the kick-off meeting after Contract is awarded.

b) All stations shall be provided with handset type intercom units with weatherproof type enclosure except the location on weather deck, where headset type unit shall be provided.

13.20 Installation Requirements

13.20.1 General

a) The control panel of all equipment shall be installed and flush-mounted in the coxswain operation area unless otherwise specified. The mounting screw shall be detachable from the front of the equipment and the equipment shall be taken out at the front for further checking or replacement. The Contractor shall submit a layout plan showing the exact locations of the Equipment before installation.

b) Equipment supplied shall be completed with all standard and/or maker recommended accessories as required for normal operation.

c) The equipment supplied shall be completed with all the auxiliary items required for normal operation including connectors, circuit breakers, power sockets, interface device, plugs and cables with conduits. Additional power conditioners, filtering devices, power stabiliser or regulator shall be provided and installed at no extra cost if required.

d) RF connectors of suitable impedance shall be provided and used for connections of the RF cables, antennae and radio equipment. Connectors between the feeder cables and antennae shall be protected by weatherproof material to avoid water seepage.

e) All wiring shall be finished in a neat and appropriate manner approved by the Government.

f) Adequate measures to prevent interference amongst the equipment shall be taken, which include but not limited to the following:

(i) Separate screened conduits or trunkings shall be provided.

(ii) Rules, regulations and recommended practices regarding screening of electric wiring must be observed.

(iii) Receiving apparatus and other electronic equipment which may be affected by radio frequency induced voltages must be effectively earthed, screened and protected against such voltages.

(iv) Lightning protection devices shall be fitted.

13.20.2 All siting installation and cabling work shall be undertaken to the highest standard to ensure:

a) satisfactory performance of the Equipment;

b) protection from mechanical and water damages;

c) ease of accessibility for maintenance and repair, and

d) manufacturers' recommendations shall be strictly observed.

13.20.3 The power, signal and control cables connecting to the flush-mounted equipment shall be long enough to let the equipment wholly rest on a secure surface with valid cable connections for fault finding and equipment testing. These extended cables shall be properly managed and resided inside the console.

13.20.4 Induced mutual interference shall be within an appropriate level which would not affect normal operation.

13.20.5 Installation location

a) Installation location of the equipment shall be easily accessible for inspection and maintenance. Exact location shall be subject to the approval of the Government.

b) Installation location of the equipment shall not cause interference with other Equipment including any emitted interference.

13.20.6 Material and Workmanship

a) Material and Equipment shall be of high quality, and shall comply with, where applicable, the appropriate British Standards and Code of Practice, together with any amendments made thereto, suitable for installation in the Vessel.

b) All the designs shall be subject to the approval of the Government and the respective works shall be carried out in a first class workman-like manner.

c) The Government reserves the right to reject any part of the installation not compliant with the Offered Specifications including these Technical Specifications. The Contractor shall carry out the necessary remedial work or replacement at its own cost and expense and without delay.

d) The Contractor shall provide all installation materials including but not limited to cables, casing and mounting accessories which are durable and fire retarding. Where it is impracticable for signal cables for data to be run inside conduits, PVC insulated and sheathed with armoured cable shall be used.

13.20.7 Equipment Fixing and Interconnection

a) All switches, connectors, jacks and receptacles shall be clearly, logically and permanently marked during installation. All wires and cables shall be identified at

every termination and connection point with permanent type markers suitable for installation in the Vessel.

b) Interconnection of various items of Equipment shall be mechanically and electrically connected by multi-pin connectors or terminals.

c) All cables shall be joined by properly designed connectors or inside joint boxes. Where terminal blocks are used for connection cables, the tip of each conductor shall be crimped with a suitable terminal pin before it is inserted into the terminal block.

d) The Contractor shall be responsible for providing and installing properly rated power cables from the power points to its own equipment.

13.20.8 Electricity

a) Except for AC operated equipment that is deployed with the approval of GNC, the power supply of the ENE shall be compatible with the Vessel's DC electrical system.

b) The equipment shall be protected by appropriately rated fuses. The fuses shall be contained in independent fuse holders which are easily accessible.

13.20.9 Cables

a) All exposed cables and wiring shall be sheathed or protected by metal conduits.

b) Watertight cable glands shall be provided by way of watertight bulkhead or deck penetration.

c) Signal wiring shall be separated from power supply cables and housed in separate screened conduits or cable trunks.

d) Cables and wirings shall run behind the compartment lining. Where electric cables are necessary to be fitted on the decorative surface of bulkheads, they shall be enclosed in proper metal conduits.

13.20.10 Labelling and Marking

a) Each cable shall be clearly labelled and carry its own unique identification code.

b) Polarity of power cables shall be labelled.

13.21 Acceptance Test

13.21.1 The acceptance tests for each unit of each item of ENE shall comprise the following:

a) A bench acceptance test which includes functional tests and detailed measurements of the performance of each unit of each item of ENE Equipment to verify that each unit of each item of ENE Equipment complies with all Offered Specifications including the specifications as set out in this Chapter shall be performed by the manufacturer of the ENE and recorded in a test report to be certified by the manufacturer.

b) On-site commissioning test shall be carried out by the Contractor in the presence of the EMSD representatives after completion of the installation of each unit of each item of ENE Equipment. The overall installation standard and operational features of each unit

of each item of ENE Equipment shall be evaluated. The test shall be carried out at the same time as the Official Sea Trial.

13.21.2 The Contractor shall submit a test plan for the on-site commissioning tests of the ENE at least one month prior to the on-site commissioning test date to the Government for approval. The bench acceptance test reports certified by the manufacturers for all ENE shall be provided to GNC and EMSD at the same time as the test plan for the on-site commissioning tests if not already provided.

13.21.3 The Contractor shall provide all the necessary test equipment and tools for carrying out all tests at no extra cost to Government.

13.21.4 At least one (1) month before the end of the Warranty Period, the Contractor shall arrange and perform confirmation test in the presence of the representatives from EMSD. Should any defects be found during the confirmation test, the Contractor shall fix the defects as soon as possible and in any event no later than the time prescribed by the EMSD representatives.

13.21.5 Without prejudice to other rights and claims of the Government (including the continued retention of the Retention Money in the amount as specified in Schedule 3 of Part V), the Warranty Period shall be extended correspondingly for so long as the defects are not fixed by the Contractor.

13.21.6 For defects found during the confirmation test, the Equipment or its parts shall be repaired or replaced, and the Warranty Period of the Equipment shall be extended for one more year.

13.22 Documentation for the Proposed ENE Equipment

13.22.1 The Contractor shall supply the following documentation:

a) Technical and proposed equipment information including integrated system equipment schematic diagram of all this general electronic equipment and sufficiently detailed to enable a technical appraisal of the ENE required in this Chapter to be made.

b) Lists of equipment as required in this Chapter.

13.22.2 The Contractor shall upon delivery of the Vessel as part of the Delivery Acceptance, supply three sets of Operation Manuals, Service Manuals and integrated system/equipment schematic diagram in English or Chinese (at least two (2) sets of which shall be original), giving full details on:

a) Operations and working principals;

b) Equipment functional description;

c) Equipment specifications;

d) Schematic block diagrams and circuit diagrams with sufficient information and details for Equipment maintenance and repairing;

e) Calibration procedures;

f) Equipment (adjustment/mounting procedure) and parameter settings;

g) Part list with part numbers and locations (the adjustment/calibration tools/kit/program shall also be included);

h) Maintenance and troubleshooting instructions;

i) Equipment interfacing with wiring diagram with clear signal labelling;

j) Software operation manual for equipment driven by application software;

k) As fitted conduit/trunking route diagrams for the electronic equipment installed on board for the purpose of future maintenance; and

l) The design conduit/trunking route diagrams submitted to GNC and EMSD for approval during construction stage.

13.22.3 In addition, the Contractor shall submit a list to show the unit price and the installation cost for each proposed Equipment and the accessories and recommended maintenance spares for the first year following the Warranty Period. The name of the manufacturer and model/type shall also be included in the above list for MD and EMSD's consideration/evaluation.

Chapter 14 Hybrid System

14.1 General Provisions

14.1.1 The objectives of the hybrid system is to provide for Zero and Low emission requirement of the vessel in certain scenarios for operation as below.

14.1.2 Power Management is incorporated into the system to achieve energy saving and environmental protection target and meantime to satisfy the operation need of the vessel.

14.1.3 The propulsion system on board is to be supplied independently by two (2) power input, i.e. diesel engine and electrical input. And the two system are able to have two (2) power input running in parallel to provide different combination to cope with different scenarios.

14.1.4 When running under diesel mode, the vessel shall be propelled by two (2) separate propellers driving system including main engines and reduction gear boxes. And the reduction gear box would have two (2) input to allow intake from either diesel engines or Electric Motor-generator (E-motor).

14.1.5 Regarding the electrical propulsion system, the power is supplied by energy storage system (ESS) and onto two (2) separate Electric Motor-generator (E-motor) with variable frequency control. The output of the Electric Motor-generator (E-motor) motor would be fed to the reduction gear box (PTI) for the driving of the vessel propeller system.

14.1.6 Moreover, the E-motor could also provide power (PTO) for Vessel house loads and/or to charge the Energy Storage System (ESS) with battery for economic cruising or provide for the electric loading on board.

14.1.7 Automatic coordination of power supply and demand shall be undertaken by power management system.

14.1.8 Zero Emission Mode:

The vessel shall meet the following endurance conditions criteria whilst operating safely in Zero Emissions Mode under weather conditions equivalent to WMO Sea State 5:

(i) 6.0 hours at 0.0 knot (vessel drifting)

This operation profile shall require Main diesel engines and generators engine all to be stopped. And the power supply is fed from the Energy Storage System (ESS) of which the capacity shall be sufficient to provide power supply to run and operate the following equipment and system normally for the duration of 6 hours.

a) All navigation and communication equipment in normal running condition;

b) Normal hotel load and all on-board system and equipment including HVAC System, fresh and sea-water system shall run and operate as normal excluding the usage of bow thruster;

c) The E-motor would be kept stand-by and ready to be put into for operation if necessary; and

d) All scientific instrumentation as required.

(ii) 2.5 hours at 5.0 knots

This operation profile shall require Main diesel engine and generator engine all to be stopped. The vessel shall be propelled by the two E-motors. And the Energy Storage System (ESS) shall be sufficient to provide power supply to run the following equipment and system to run and operate normally for the full duration of 2.5 hours.

a) All navigation and communication equipment in normal running condition;

b) Normal hotel load and all on-board system and equipment including HVAC System, fresh and sea-water system etc. excluding the usage of bow thruster;

c) The E-motor would be running for vessel propulsion;

d) Vessel navigation and manoeuvring system (e.g. steering system) in normal running condition; and

e) All scientific instrumentation required.

(iii) Nearshore Survey mode – 2.5 hours

The vessel shall run between 2 - 5.0 knots for 2.5 hours. The propulsion power shall only be provided by the energy storage battery system. During that time, the E-motor shall be clutched in whilst on board equipment and system is the same as stated in Paragraph 14.1.8(ii).

14.1.9 Class notation shall be assigned to the system. And RO requirement for the system shall be fully complied with.

14.1.10 The system shall be with power management so as to:

(i) Optimize vessel fuel efficiency, using main engines, batteries or generator subject to operation and applied propulsion and house load; and

(ii) Improve generator engine and main engine performance.

14.1.11 The reliability of the system is of great importance for consideration. Design and arrangement shall ensure single failure of any key component, e.g. engine, inverter etc., shall not cause the whole vessel to black out or failure to operate.

14.1.12 Basic requirement shall follow with RO requirement wherever applicable. For example, voltage dip, harmonic distortion and critical protection and testing requirement for the whole system and key components shall follow with the RO requirement whereas applicable. The operating voltage (either AC or DC) shall be below 1000V.

14.1.13 The enclosure protection for semi-conductor converter shall be commensurate with its working environment and equipment arrangement. That shall be subject to RO and GNC approval.

14.1.14 The Contractor shall note that the Vessel is for use in Hong Kong and it is desirable that the hybrid system offered by the Contractor is supported and serviced in Hong Kong including after sales technical service and availability of spare parts.

14.1.15 The Vessel shall be equipped and fitted with all equipment described in this Chapter 9 & 10 each complying with the specifications set out in this Chapter of Part VII for such equipment. The provided Spare Parts shall be of the same model as supplied for the Vessel and shall equally comply with all specifications set out in this Chapter of Part VII.

14.1.16 The hybrid equipment, associated cooling pipework, cabling and fittings shall be of a design and construction adequate for the service which they are intended and shall be so installed and protected with danger to persons onboard reduced to as low as reasonably practicable, due regard being paid to moving parts, hot surfaces and other hazards. The design shall have due regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

14.1.17 Sufficient space and headroom in the vicinity of the hybrid equipment for local operation, inspection and routine maintenance shall be provided.

14.1.18 The hybrid installation in the Vessel shall be suitable for operation as an unmanned machinery space. The control and monitoring shall be centralized in the Wheelhouse Engine Remote Control Console and the Engine Room Control Console.

14.2 General Requirement

14.2.1 The propulsion system shall be designed and installed as a hybrid power train. The propulsion system shall be installed as a parallel hybrid power train consisting of the following: **[E]**

a) Diesel main engine(s).

b) Reduction gearboxes with independent Power Take In ("PTI")/Power Take Off ("PTO").

c) Hybrid Electric Machine (Electric motor-generator) fitted to gearbox PTI/PTO.

14.2.2 The parallel hybrid drive train system described in Paragraph 14.2.1 shall allow the Vessel to be propelled using power either from the diesel main engine propulsion system or the electric propulsion system. Also the Vessel shall be propelled by both diesel and electric power at the same time. **[E]**

14.2.3 A Power Management System (PMS) shall be fitted which can automatically determine the most efficient power source subject to the applied load.

14.2.4 Energy Storage System ("ESS") shall be fitted onboard. It shall be sufficient to propel the Vessel independently, without diesel main engine or generator, as stated in Clause 14.1.8 above. Typical house loads shall include air-conditioning but exclude the usage of bow thruster. **[E]**

14.2.5 The integrated hybrid system shall include but not be limited to:

a) Diesel main engines

b) Gearbox with PTI/PTO

c) Flexible couplings

d) Diesel generator(s)

e) Hybrid Electric machine (namely Motor-generator which is capable to serve as generator or motor in the hybrid arrangement depending on the selected PTI/PTO mode)

f) Cooling system

g) Energy Storage System (ESS) including Battery Management System (BMS)

h) Battery chargers

i) DC switchboards

j) Power Management System

k) Semi-conductor Converter (including AC/DC Converter, DC/AC Inverter, DC/DC Converter, DC link wherever applicable, variable frequency drive (VFD), Active Front End Drive (AFE) and/or other equivalent means wherever applicable)

l) Remote Control and Monitor System

14.2.6 The electrical arrangement of the Hybrid system shall comprise DC and AC system. The incoming diesel generator shall supply power to DC switchboard via AC/DC converter. Energy Storage System (ESS) shall also connect to the DC switchboard. In turn, the DC switchboard shall supply power to AC equipment via DC/AC inverter, variable frequency drive (VFD) and Active Front End Drive (AFE). Also DC switchboard shall supply power to an AC switchboard for house load and small AC equipment.

14.2.7 The Hybrid system shall be designed to avoid excessive temperature of components (i.e. motor, clutch reduction gear, semi-conductor converter). Impact loading to Motor-generator and associated shafting, improper load sharing, interruption of power transmission is not allowed during change over from different mode. Alarm shall be provided for lengthy switching over time. Frequent start stop or clutching in and out operation for position keeping shall be avoided.

14.2.8 The switchboards shall be so arranged that short circuit or faults in the DC side shall not induce, or shall be protected from, excessive current or voltage in the AC side. The DC switchboard shall have, but not be limited to, the following protections:

a) Overcurrent and short-circuit protection

b) Under voltage & overvoltage protection

c) Ground fault insulation alarm and monitor

d) The DC busbar shall be separated into different sections with power electronic protection devices fitted between sections. This is to avoid a complete shut down due to a single electrical failure.

e) The protection arrangement shall be arranged to trip the defective circuit without undue interruption of the normal supply to essential service.

14.2.9 The Hybrid system shall be designed to avoid voltage spike, over-voltage and over-current of its component, i.e. Semi-conductor Converter, and also the system.

14.3 Vessel Operational Modes

14.3.1 The vessel shall be designed and built in order to be able to operate in the following modes:

a) Diesel Mode

(i) Operate conventionally using main diesel engines only to propel the vessel, with no additional power being supplied to or from the PTI/PTO;

(ii) Electric motor/generators are deactivated or passive to prevent interferences; and

(iii) All required house loads shall be supplied by the generator(s).

b) Electric Mode

(i) Propel the vessel via PTI (alone), taking power from either the generator(s) or the Energy Storage System (ESS);

(ii) Propulsion diesel engines shall be cut-off completely; and

(iii) Automatic coordination of electric power supply by power management system.

c) Charge/ Auxiliary Power Supply Mode

(i) With the diesel main engines running, electric power is taken from the gearbox PTO with electric motor/generator to provide power for Vessel house loads and/or to charge the ESS;

(ii) Economic cruising by using power reserve from the propulsion diesel engines to support hotel loads and/or ESS charging;

(iii) Automatic load control of complete propulsion system; and

(iv) Automatic coordination of electric power supply by power management system.

d) Boost Mode

(i) Both main diesel engines are running, with boost input via the gearbox PTI with electric motor/generator. Propulsion is achieved using power from the diesel Engines and the PTI which is supplied from either the ESS or the generator;

(ii) Fully automatic synchronization and load control of the complete propulsion system; and

(iii) Automatic coordination of electric power supply by power management system.

14.4 Reduction Gearbox with PTI/PTO

14.4.1 Reduction gearbox is detailed in Chapter 9 of Part VII.

14.4.2 The gearbox shall have a PTO/PTI flange on the aft face of the gearbox body. This is to be suitably sized for the hybrid electric machine detailed in Section 14.5 of Part VII. An integrated PTO/PTI clutch shall be fitted.

14.5 Hybrid Electric Machine (namely Motor-generator)

14.5.1 The Motor-generator is the key component of the hybrid system and it shall be proprietary make.

14.5.2 The Motor-generator shall be of permanent magnet type.

14.5.3 The Motor-generator can be used as either a motor for propulsion or as a generator for driving power of other Motor-generator, auxiliary house loads and/or battery charging.

14.5.3 High winding temperature alarm shall be provided.

14.5.4 The E-Motor shall be interfaced with vessel position keeping system. Besides properly interface arrangement, the motor and associated arrangement shall also be fit for this intended purpose (frequent start-stop operation without any overheat or adverse effect upon vessel electrical system).

14.5.5 Single-phase protection shall be provided.

14.6 Energy Storage System (ESS) with Batteries

14.6.1 The energy storage system with batteries shall be compact and of modular type.

14.6.2 At least two (2) strings of battery modules shall be provided.

14.6.3 The battery pack consists of a battery module. The design of battery modules is to make sure that, when thermal runaway occurs to any battery cell of the battery module, it is not to trigger thermal runaway of other battery cells; or, if a battery pack consists of two or more battery modules, the design is at least to ensure that when thermal runaway occurs to a battery cell, this may spread only within the module to which this cell belongs, but will not spread to other modules.

14.6.4 Each battery set includes a slave BMS which transfers all information to the main BMS via a bus system. The main BMS monitors and balances the battery set continuously.

14.6.5 It shall be able to support instantaneous charge/discharge. It is also capable to act as a buffer for all transient loading.

14.6.6 It shall be sized to propel the vessel independently, without diesel engine or generator providing power for equipment and system the vessel except any usage of bow thruster as stated in paragraph 14.1 of Part VII.

14.6.7 The energy storage system/batteries shall be located in a dedicated space(s) within the vessel. The space(s) shall be protected by structural fire protection, fire detection and fire suppression in accordance with RO Requirements to the satisfaction of the GNC.

14.6.8 The protection of the battery enclosure shall be commensurate with the cooling arrangement.

14.6.9 Ventilation shall be provided to the space in accordance with RO Requirement to the satisfaction of the hybrid system supplier/integrator and the GNC.

14.6.10 The location and arrangement of battery room shall comply with RO requirement and accepted by GNC.

14.6.11 Isolator shall be provided in the battery output circuit to allow normal maintenance work to be carried out.

14.6.12 Whilst the battery is connected to busbar via inverter, the inverter shall be equipped with arrangement to avoid the damage of the battery due to any electrical fault on busbar.

14.6.13 The battery system shall be equipped with battery management system (BMS) in order to monitor the working condition of the battery. The operating temperature shall be properly monitored to ensure a safe working condition. BMS and/or PMS shall ensure safety with excessive charge and discharge current due to too high or too low battery voltage. Alarm shall also be provided for battery charging failure and for operation of any battery protective devices. Safety valve shall be provided for gas release where applicable. The charge-up of the battery shall not be more than 1C rating.

14.6.14 Alarm shall be provided for:

a) Battery high temperature;

b) Over voltage and under voltage;

c) High hybrid battery room temperature;

d) Hybrid battery room ventilation failure; and

e) Over charge or discharge of battery.

14.6.15 The selection and arrangement of batteries shall take safety as prime concern. That includes, but is not limited to, the follows: **[E]**

a) the location shall be protected from collision; and

b) the battery modular shall minimize the extent of damages.

14.7 Remote Control and Monitor System

14.7.1 Remote Control and Monitor System comprises two (2) independent system for each propulsion shafting

14.7.2 The complete system shall be capable to perform the function listed in Paragraph 14.3 of Part VII.

14.7.3 The system shall be of a redundant nature (i.e. failure of one system shall be automatic switching to the other system).

14.7.4 The system shall have direct coordinating field bus interface to the other shaft to achieve single lever control function.

14.7.5 The system shall have direct coordinating field bus interface to the other sub-system e.g. position keeping system.

14.7.6 The system shall provide proper load and torque sharing between diesel main engine and motor-generator.

14.7.7 The system shall enable smooth cutting-in and off of the diesel main engine and motor-generator whereas applicable including the activation of any safety trip of the concerned system.

14.8 Power Management System

14.8.1 The system shall be a Supervisory Control and Data Acquisition system (SCADA) is a control system architecture that uses computers with complete redundancy for high reliability.

14.8.2 The power management system (PMS) shall take care of change over, cutting-in and cutting-out of different power source according to the load profile once an optimal operating mode is selected without any intervention from the vessel operator. Nevertheless, there shall be “Overriding” or “By-pass” switch for the vessel operator to override the control of PMS. This is to operate the diesel Propulsion System and the Electric System separately under an emergency situation or when deemed necessary.

14.8.3 The power management system shall control and manage the available power and convert power as required according to the applied load profile, including the house load.

14.9 Semi-conductor Converter

14.9.1 Semi-conductor Converters shall include AC/DC Converter, DC/AC Inverter, DC/DC Converter, DC link, variable frequency drive (VFD), Active Front End Drive (AFE) and/or other equivalent means wherever applicable)

14.9.2 DC link shall be provided to reduce the total harmonic distortion and stabilize the voltage wherever necessary.

14.9.3 Semi-conductor Converter shall undergo shop test and high voltage test as required by RO and manufacturer before putting into use on board.

14.9.4 Semi-conductor Converter for power supply shall be subject to complete function tests with intended loading on board.

14.9.5 Functional test for semi-conductor Converter for motor drives shall be performed with all relevant ship systems simultaneously in operation and in all characteristic load conditions.

14.9.6 Where forced cooling is provided, the converter cannot remain loaded unless effective cooling is provided. Alarms for loss of flow (including primary and secondary coolants) shall be provided. Piping shall be arranged to prevent harmful effect due to leakage or condensation and shall be preferably in the lower part of the assembly.

14.9.7 The semi-conductor converter shall be equipped with overvoltage protection.

14.9.8 The semi-conductor converter shall be equipped with over-current protection to avoid damages due to over-current arise and/or over-load from any situations.

14.10 Variable Frequency Drive (VFD)

14.10.1 The protection arrangement shall be as stated in paragraph 14.9 of this Part VII.

14.10.2 The VFD has the maximum and minimum frequency limiting function, which makes output-frequency operated within the specified range. The protection to the VFD and E-Motor shall provide the following:

a) Stall prevention

b) Overcurrent and Short-circuit protection

c) Under voltage & over voltage protection

d) Ground fault protection

e) Power supply phase failure protection

f) Motor thermal protection through sensing of the motor winding temperature

14.10.3 Except with Active Front End Drive, means shall be provided to avoid any increases of DC bus voltage due to energy fed back into VFD.

14.11 Associated liquid Cooling System

14.11.1 Where forced liquid cooling system is applied, 100% redundancy shall be reserved to ensure the continuous functioning of the system irrespective of any breakdown of any component of the system.

14.11.2 Parameters (i.e. coolant pressure, coolant flow rate, coolant temperature, etc.) of the system shall be properly monitored to ensure correct function. Alarm shall be provided for any deviation of these parameters from the set value.

14.12 Failure Mode and Effect Analysis

14.12.1 Failure Mode and Effect Analysis shall be carried out to identify the failure modes and their effect for the complete hybrid system which includes but is not limited to the follows:

a) Propulsion, Electrical and Battery Systems with all system components;

b) Power Management System; and

c) Battery Management System.

14.12.2 A practical, realistic and documented assessment of the failure characteristics of the Hybrid System and its components shall be undertaken with the aim of defining and studying the important failure conditions and their effects. The corresponding Failure Mode and Element Analysis shall be performed by experienced personnel. For failure modes causing hazardous effects, corrective measures shall be identified. A test program shall be drawn to confirm the conclusions of FMEA and carried out in the technical acceptance test. The report shall be approved by RO and submitted to GNC for approval.

14.13 Operation and Maintenance Manual

14.13.1 The contractor shall provide the operation and maintenance manual for routine operation and maintenance of the Hybrid System. The manual shall include:

a) Design philosophy

b) Schematic and line diagram of individual system

c) Information of key components

d) Operations and precautions

e) Maintenance information

f) Maintenance schedule

Chapter 15 Special Equipment

15.1 Water Current Profiler

15.1.1 The contractor shall provide an Acoustic Doppler Current Profiler.

The Acoustic Doppler Current Profiler (ADCP) installed shall have the following specifications:

a) Able to make real-time measurements.

b) Able to acoustically detect profile velocity of not less than 5 m/s with accuracy not less than ± 0.25% and resolution not less than 1 mm/s

c) Able to acoustically detect profile velocity with not less than 128 cells which each cell size can be up to 0.05 m

d) Able to acoustically detect profile flow direction of 360˚ with accuracy not less than ± 2˚ and resolution not less than 0.01˚

e) Able to acoustically detect water depth of no less than 30 m with accuracy not less than ± 1% or ± 1 cm and resolution not less than 1 mm.

f) Have operating temperature range of not less than 0 to 40˚C

g) Able to deliver data of full section velocity, full section flow direction and depth of sea at a frequency of not less than every 2 mins.

h) To be installed and delivered with data display unit with corresponding data processing software incorporated.

15.2 Meteorological System

15.2.1 The contractor shall provide Meteorological system equipment (which can measure real- time wind direction, wind speed air temperature, rainfall, solar radiation and UV radiation to be mounted at the top of a mast.)

The Meteorological System installed shall have the following specifications:

a) Able to make real-time measurements.

b) Able to operate in the temperature range not less than 0 to 60°C.

c) Able to detect wind speed of not less than 60 m/s with accuracy not less than ± 5% and resolution of 0.01 m/s.

d) Able to detect wind direction of 360˚ with accuracy not less than 5˚ and resolution of not less than 1˚.

e) Able to detect air pressure of a range 300 to 1100 hPa with accuracy not less than ± 0.5 hPa.

f) Able to detect air temperature of a range 0 to 60˚C with accuracy of not less than ± 0.3˚C and resolution of 0.1˚C.

g) Able to detect rainfall in the range not less than 0 to 300 mm/h with accuracy of not less than 3%.

h) Able to detect solar radiation of wavelength range not less than 100 to 3000 nm, output range not less than 0 to 1600 W/m2 with resolution of not less than 1 W/m2.

i) Able to deliver data of at a frequency of not less than every 2 mins.

j) To be installed and delivered with data display unit with corresponding data processing software incorporated.

15.3 Ferry Box system

15.3.1 There is on board Ferrybox system which is supplied by EPD. The system is an automated, flow-through system designed to continuously monitor physical, chemical, and biological parameters in surface seawater, with data logged and transmitted in near real-time for environmental monitoring and research. The system is built for unattended operation, featuring automated cleaning to prevent biofouling and ensure data quality.

15.3.2 The Contractor shall provide the power supply, sea water and other concerned arrangement to accommodate the system. Details shall be discussed in the kick-off meeting.

The FerryBox system shall measure the following criteria:

a) Conductivity

b) Temperature

c) Salinity

d) Oxygen concentration and saturation

e) Total chlorophyll

f) Turbidity

g) pH, Intake temperature

h) Dissolved nutrients (NOx, NO2, PO4, NH4, silicate)

i) Phycocyanin,

j) Phycoerythrin

k) CDOM/FDOM

l) COD eq.,

m) TOD eq.

n) BOD eq

15.3.3 The FerryBox intake system shall be connected to an inlet/sea chest mounted in the tank compartment,

15.3.4 The analysis unit(s) are to be installed in the Workshop for sampler, with a deck drain situated beneath the unit in case of leaks.

15.3.5 Where required, any pumps or filters required by the system are to be mounted to allow for ease of inspection/maintenance.

15.4 Aft deck rosette transportation system

15.4.1 A rosette sampler moving system shall be provided, utilising recessed rails or similar in the aft deck, to allow for the rosette sampler (see annex 9 for details) or other items to be moved from the Workshop to the aft deck to a suitable location for crane operations.

15.4.2 The maximum load of the carriage system shall be 250kg, with a maximum payload dimension of 1300 mm (diameter) x 1700mm (height).

15.4.3 The layout of the system shall allow for the rosette to be lifted and operated by either the port or the starboard crane and moved back to inside the Workshop and secured. The layout shall be approved by the GNC.

15.4.4 The system shall allow for the carriage unit to be locked in various locations, as agreed with the GNC.

15.4.5 The system can be manually or electrically powered. In the case of the carriage being electrically powered then a manual override in case of a system failure shall be provided.

Chapter 16 Services Support

16.1 General Requirements

16.1.1 In determining the appropriate design for the Vessel, all of the following factors shall equally be taken into account without one outweighing another.

a) Vessel performance (e.g. engine rating, size, etc.);

b) Initial cost;

c) On-going cost (e.g. maintenance cost, fuel consumption, spare parts, etc.);

d) Reliability (frequency and time to repair breakdown);

e) Time between maintenance periods;

f) Time to undertake scheduled maintenance (downtime);

g) All machineries and equipment installed in the Vessel shall be serviceable in the HKSAR; and

h) Maintainability - the Vessel shall be easy to maintain by ensuring that there shall be:

(i) Good access to all installed items for monitoring, service and overhaul; and

(ii) Ease access to in-situ service and maintenance in the HKSAR.

16.2 Information to be Provided Prior to and at Delivery Acceptance

16.2.1 Information shall be provided prior to Delivery Acceptance:

16.2.2 Detailed inventory list for the whole Vessel to be submitted to the Government for approval.

16.2.3 The Inventory List shall cover all discrete items down to major component/unit level. Full details of each item includes:

a) Item number;

b) Description;

c) Type/model;

d) Quantity;

e) Manufacturer;

f) Manufacturer’s reference number;

g) Location in Vessel;

h) Local agent/supplier address, telephone and fax numbers;

i) Order time;

j) Self-life; and

k) Unit cost.

FOUR (4) paper copies and ONE soft copy of the Inventory List shall be provided to GNC.

16.2.4 "As Fitted" Plans and Drawings including those as listed in (but not limited to) Annex 7 of the TS, and any other relevant information as required by GNC and including those specified below shall be supplied either before or upon Delivery Acceptance of the Vessel.

16.2.5 Not less than four (4) weeks before the Delivery Acceptance of the Vessel, the Contractor shall provide a list of all "As Fitted" Plans and Drawings to GNC for acceptance. FOUR (4) hard copies of final version of the "As Fitted" Plans and Drawings and ONE soft copy in Compact Disk (CD-ROM) shall be provided by the contractor to GNC upon delivery of the Vessel to the Government Dockyard.

16.2.6 At Delivery Acceptance, the Contractor shall provide to GNC all the necessary service and repair manuals, operational guides, spare parts information of all engines, machinery equipment, electrical equipment, steering, windlass, electronics and navigational lights and lightings and the outfitting items of the Vessel.

16.2.7 In addition to the abovementioned items, upon Delivery Acceptance, the Contractor shall also supply the following:

16.2.8 FOUR (4) copies of ship equipment list for all bought-in machineries and electrical equipment. The list shall include:

a) Description;

b) Type/model;

c) Makers part number or equivalent;

d) Location;

e) Quantity;

f) Supplier or agent's name and contact address;

g) Order time;

h) Shelf life; and

i) Unit cost.

16.2.9 FOUR (4) copies (at least one (1) original) of maker operation, maintenance and workshop manuals for all machineries / equipment in English.

16.2.10 FOUR (4) paper copies and ONE (1) soft copy in CD-ROM as per the Vessel delivered of "Docking Plan" which shall include the profile, plan and sections shall be prepared by the Contractor.

16.2.11 FOUR (4) copies of On Board Operator's Manual (English and Chinese) covering:

a) Daily user check and operation procedure;

b) Operating detail of each system; and

c) Emergency operation procedure.

(The precise format and detail required shall have to be subject to the GNC's approval when the configuration of the Vessel and outfitting is decided.)

16.2.12 The first draft of the On Board Operator's Manual (in both English and Chinese) shall be submitted to GNC for approval one (1) month before documentation acceptance.

16.2.13 The documentation for all Equipment, spare parts and stores, special tools and test equipment shall be provided at the Delivery Acceptance of the Vessel.

16.2.14 Spare Parts and Consumable Parts for the Main Engines shall comply with Paragraph 16.2.15 and 16.2.16 of Technical Specification, Part VII.

16.2.15 All items of Spare Parts and Consumable Parts for the main engines shall be delivered to the Government Dockyard as per the requirements stipulated in Schedule 2, Delivery Schedule of Part V.

16.2.16 All items supplied shall be identical in make, quantity and size to the parts currently in use. All items shall be properly documented, preserved and packed.

16.2.17 Tools & Test Equipment for Electronics

16.2.18 All test and tool equipment for the electronics equipment of the Vessel shall be directly to EMSD.

16.2.19 All items shall be properly documented, preserved and packed.

16.2.20 Photographs

a) The contractor shall provide the following upon Delivery Acceptance:

b) As-Fitted Photographs

c) Two (2) sets of colour prints (130 mm x 90 mm) from different aspects to give an overall picture of the various parts/areas of the Vessel shall be provided upon Delivery Acceptance.

d) Each print shall be enclosed in a suitable album and labelled showing the position of the content.

16.2.21 Official Photographs

a) Four (4) framed colour photographs of picture size not less than 350 mm x 270 mm and frame size not less than 510 mm x 400 mm showing the profile of the Vessel in Hong Kong Waters shall be provided upon Delivery Acceptance.

b) Four (4) 200 mm x 150 mm colour photographs with specifications of vessel particulars showing the profile of the Vessel in HKSAR Waters shall be provided upon Delivery Acceptance.

c) Four (4) 150 mm x 100 mm colour photographs showing the profile of the Vessel in Hong Kong Waters shall be provided upon Delivery Acceptance.

16.2.22 Softcopy of Photographs

a) All photographs as required in the section 16.2 of Technical Specification, Part VII shall be taken by way of digital camera in JPEG format at a resolution of not less than 5.0 Mega pixel. The photographs shall be stored in Compact Disk (CD-ROM) and forwarded to GNC at the time of Delivery Acceptance.

16.2.23 Certificates and Reports

Copies of the following documents (one (1) original with two (2) copies and one (1) softcopy stored in CD-ROM), filed in clear folders, shall be forwarded to GNC at the time of Delivery Acceptance:

a) Associated test certificates;

b) Test performance certificates of equipment (e.g. electronics, switchboards, etc.);

c) Main engines performance test certificates issued by the engine manufacturer;

d) Complete record of the trial commissioning tests of the Technical Acceptance;

e) Original copy of the warranty certificates of all machineries, equipment and apparatus of the Vessel (valid for 12 months from the date of Acceptance Certificate of the Vessel);

f) Certificates of light and sound signalling equipment;

g) Builder certificates;

h) Certificates of building material;

i) Deviation card for compass (after adjustment in the HKSAR);

j) Undertaking duly signed and sealed by the Contractor's (or its sub-contractor's) shipyard for providing Warranty Services in relation to all aspects of the Vessel during the Warranty Period in the HKSAR as stipulated in Annex 1 and Annex 9 of this Part;

k) Certificate of Class with such class notations as specified in Schedule 9 to be issued by the RO; and

l) Any other certificates as appropriate.

16.2.24 Ship Model

a) The Contractor shall provide two (2) ship models (scale 1:50) for display and training purpose.

b) The purpose of the ship model is to provide a reasonable realistic appreciation to the viewer (who cannot see the actual vessel) about the shape, scale, construction of the Vessel and the machinery installations and fittings therein. Hence the model shall include the position and look of the major external fittings including but not limited to the skeg, appendages, shafts, propeller (propulsion units), rudders, mast, mast fittings and navigation lights and any other external above and under water items; and the Vessel shall be made to an overall exact scale standard relevant to model making. The price for such model shall be INCLUDED in the Total Purchase Price of the Vessel in the Tender Documents.

Chapter 17 Training

17.1 Training on Electronics Navigational Equipment (ENE)

17.1.1 General Requirements

a) All training courses shall be held in Hong Kong.

b) The Contractor shall provide appropriate classroom as well as on board training to the operational and technical staff to familiarise officers with the operation and maintenance of the ENE being supplied and installed. The trainer shall be able to communicate with the local trainees effectively, better to use Cantonese if possible, but not must.

c) It is anticipated that two (2) distinct types of training shall be required, namely:

(i) Operator Training

(ii) Equipment Maintenance Training

d) The Contractor shall submit a detailed course syllabus and a schedule for conducting the training course after installation of ENE onboard. The training proposal shall include details of the depth and duration of the training course, qualifications of the instructor and the qualification requirements of the trainees.

e) Each trainee shall receive one (1) copy of comprehensive training documents before the start of each course.

f) Training manual in both Traditional Chinese and English shall be provided and submitted to MD and EMSD for approval at least one (1) month prior to commencement of the aforementioned two (2) types of training respectively.

17.1.2 Operator Training Course

a) This course shall provide training for trainers in Cantonese.

b) The course shall provide a full knowledge and appreciation of the day-to-day operation of all ENE. This shall include hands-on demonstrations and operation of all ENE including the necessary routine cleansing requirement.

c) The course shall be held immediately before the commissioning of the ENE on the Vessel.

d) A total of up to 15 trainees will attend the course. The training course shall accommodate the specified number of trainees.

17.1.3 Equipment Maintenance Training Course

a) The equipment maintenance training course shall enable the maintenance staff to:

(i) acquire full knowledge and appreciation of all aspects of the design considerations, day-to-day operation, inter-connected system operation, fault breakdown, routine maintenance and fault finding/ repairing procedures of the ENE being offered; and

(ii) effectively maintain the ENE. This shall include practical demonstrations and tests.

b) The maintenance training shall include, but not limited to the following items:

(i) Introduction of the ENE locations;

(ii) ENE operational, working principle and functional descriptions;

(iii) ENE block and schematic functional descriptions;

(iv) ENE adjustment/calibration procedure and parameter settings;

(v) ENE construction and mounting;

(vi) ENE interfacing and signal interfacing;

(vii) Preventive maintenance and trouble-shooting

c) The course shall enable technical staff to effectively maintain the ENE.

d) The course shall be held immediately after the commissioning of the ENE on the Vessel.

e) A total of up to 15 trainees will attend the course. The training course shall accommodate the specified number of trainees.

17.2 Training on Operation and Maintenance of the Vessel

17.2.1 In addition to the training to be provided for the ENE, the Contractor shall provide training in relation to the operation of the Vessel for the operational staff of the user department, training in relation to maintenance of engine and equipment on board for the technical staff of the user department and for the Maintenance and Support Section of Government Dockyard.

17.2.2 In order to ensure the navigational work-up team of the MD acquires full knowledge and appreciation of all aspects of the manoeuvrability, vessel handling, turning characteristics, engines, etc., the Contractor shall provide an appropriate familiarization training course for 25 officers of the MD in the HKSAR upon the Delivery Acceptance of the Vessel. Supportive training of ship operation will be carried out on board for two (2) weeks after the Delivery Acceptance of the Vessel. An operation training programme comprising familiarization training and supportive training shall be proposed for consideration by GNC which shall include details of depth and duration of the training course. The training instructors must possess suitable qualifications acceptable to MD. A certificate shall also be issued to the trainees by the training instructor or his organisation upon completion of the training course for proof of competence and satisfactory completion of the course.

17.2.3 In order to ensure the engineering work-up team and the front-line maintenance teams of the MD and the maintenance personnel of the Government Dockyard acquire full knowledge and appreciation of all aspects of the designs, day to day operation, breakdown, routine maintenance and fault diagnosis of the engine/electrical distribution system, hull structural repair, etc., the Contractor shall therefore provide appropriate train-the-trainer courses for a total of 25 engine operators and 10 maintenance personnel from the Government Dockyard in the HKSAR or overseas at the delivery of the Vessel. A certificate shall also be issued to the trainees by the training instructor or his organisation upon completion of the training course for proof of competence and satisfactory completion of the course.

17.2.4 All facilities, venue, and materials necessary for the above-mentioned training courses shall be provided by the Contractor unless otherwise specified. The training shall also be conducted in Cantonese with relevant training materials to be supplied by the Contractor. The training materials in both Traditional Chinese and English shall be provided at least one (1) month prior to commencement of the training, in both paper and CD-ROM format. The training video and manuals for major operations shall be provided onboard.

Chapter 18 Abbreviations

A	Ampere
ABS	American Bureau of Shipping
AC	Alternating Current
AFFF	Aqueous Film-Forming Foam
AIS	Automatic Identification System
AML	Additional Military Layers
ARCS	Admiralty Raster Chart Service
ARPA	Automatic Radar Plotting Aid
ASCII	American Standard Code for Information Interchange
ASTM	American Society for Testing and Materials
ASWF	American Standard Window Film
AUX	Auxiliary
AV	Audio Video
AVLS	Automated Vehicle Location System
AWS	American Welding Society
BER	Bit Error Rate
BMS	Battery Management System
BNC	Bayonet Neill-Concelman
BS	British Standards
BSB	data encoded in the BSB format
CCD	Charge-coupled device
CCTV	Close Circuit Television
CD	Compact Disc
CDI	Course Deviation Indicator
cd/m^2	candela per square metre

CD-ROM	Compact Disc Read-Only Memory
CFC	Chlorofluorocarbon
CH	Channel
cm	Centimetre
CMR	Compact Measurement Record
CO_2	Carbon Dioxide
COG	Course Over Ground
CPA	Closest Point of Approach
CPU	Central Processing Unit
CRT	Cathode ray tube
c/w	come with
CWA	Chemical Warfare Agent
dB	Decibel
dB(A)	A-weighted decibel
dBi	decibel isotropic
dBm	Decibel-milliwatts
DC	Direct Current
DDR	Double Data Rate
deg	Degree
DGNSS	Differential Global Navigation Satellite System
DGPS	Differential Global Positioning System
dia.	Diameter
DNC	Digital Nautical Chart
DPDT	Double-pole, double-throw
DSC	Digital Selective Calling
DTM	Digital Terrain Model
DTRS	Digital Trunk Radio System
DVD	Digital Versatile Disc

DVI	Digital Video Interface
DVR	Digital video recorder
E.C.C.	Engine Control Console
ECDIS	Electronic Chart Display and Information System
ECS	Electronic Chart System
EFFS	External Fire-Fighting System
EFCP	External Fire-Fighting Control Panel
EGNOS	European Geostationary Navigation Overlay Service
EIAPP	Engine International Air Pollution Prevention
ENC	Electronic Navigational Charts
ENE	Electronic Navigational Equipment
E/R C.C.	Engine Room Control Console
FSK	Frequency-shift keying
FTP	Fire Test Procedures
FO	Fuel oil
FOV	Field of View
g	Gravity
GB	Gigabyte
Geo	TIFF Format File
GHz	Gigahertz
GLONASS	Global Navigation Satellite System
GM	Metacentric Height
GMDSS	Global Maritime Distress Safety System
GMSK	Gaussian Minimum Shift Keying
GMT	Greenwich Mean Time
GPS	Global Positioning System
GRP	Glass-reinforced plastic
GSOF	General Serial Output Format

GZ	Righting Lever
HazMat	Hazardous Material
HEPA	High-efficiency particulate arrestance
HCFC	Chlorodifluoromethane
HD	Hard Disk
HDCP	High -bandwidth Digital Content Protection
HDD	Hard Disk Drive
HDMI	High Definition Multimedia Interface
HPS	Harbour Patrol Section
HSC	High-speed Craft
HVAC	Heating, ventilation and air conditioning
Hz	Hertz
IBSS	International Bibliography of the Social Sciences
ICLL	International Convention on Load Lines
IEC	International Electrotechnical Commission
IEEE	Institution of Electrical and Electronic Incorporated Engineers
ICR	Information Collection Request
IHO	International Hydrographic Organization
IMD	Intermodulation Distortion
IMM	International Maritime Mobile
IMO	International Maritime Organisation
INS	Inertial Navigation System
IP	Ingress Protection
IPX	Internetwork Packet Exchange
IR	Infrared
IS	Intact Stability
IS CODE	International Code on Intact Stability
ISO	International Organization for Standardization

ITU-R	International Telecommunication Union – Radiocommunication Sector
ITC	International Tonnage Certificate
K	Kilo
kΩ	Kilo Ohm
kg	Kilogram
kHz	Kilohertz
km	Kilometre
km/h	Kilometre per hour
kn	Knots
kW	Kilowatt
L/min	litre per minute
LAN	Local Area Network
LO	Lube oil
LCD	Liquid Crystal Display
LCG	Longitudinal Centre of Gravity
LED	Light-emitting Diode
L/s	Litre per second
LSA	Lifesaving Appliances
m	Metre
m/s	Metre per Second
m^2	Square Metre
m^3	Cubic Metre
M/E	Main engines
MARPOL	The International Convention for the Prevention of Pollution from Ships
MARPA	Mini-automatic Radar Plotting Aid
MCR	Maximum Continuous Rating
MEI	MEI Corporation
MEPC	The Marine Environment Protection Committee

MFD	Multi-function Display
MHz	Megahertz
min	minimum
max	maximum
m/min	Metre per minute
MJ/m^2	Megajoule per Square Metre
MKD	Minimum Keyboard Display
mm	Millimetre
MMC	Multi Media Card
MMSI	Maritime mobile service identity
mph	Mile per hour
MS PRO	Memory Stick PRO
MS PRO	Duo Memory Stick PRO Duo
MSC	Maritime Safety Committee
MSK	Minimum Shift Keying
mV	Milli Voltage
NAVSEA	Naval Sea Systems Command
NDT	Non-Destructive Test
NIR	Non-Ionizing Radiation
NFPA	National Fire Protection Association
NMEA	National Marine Electronics Association
ns	Nanosecond
nm	Nautical Miles
NTRIP	Networked Transport of RTCM via Internet Protocol
NUC	Not Under Command
OBE	On-board electronics
OSHA	Occupational Safety and Health Administration
OSDS	Oil Spill Detection System

P&S	Port and Starboard
Pa	Pascal
PAL	Phase Alternating Line
ppm	Part per Million
p.s.i.	Pounds per square inch
PTO	Power take off
PVC	Polyvinyl Chloride
QZSS	Quasi-Zenith Satellite System
RAM	Random Access Memory
RCA	Radio Corporation of America
RGB	Red Green Blue
RF	Radio Frequency
RG58U	RG58U Type Coaxial Cable
RH	Relative Humidity
RMS	Root Mean Squared
RO	Recognised Organisation
ROT	rate of turn
RPM	revolutions per minute
RT	Radioactive Test
RTCM	Radio Technical Commission for Maritime Services
SART	Search and Rescue Transponder
SATA	Serial Advanced Technology Attachment
SBAS	Satellite-based augmentation systems
SD	Secure Digital
SENC	System Electronic Navigation Chart
SINAD	Signal-to-noise and Distortion Ratio
SOG	speed over ground
SOLAS	Safety of Life at Sea

SPL	Sound Pressure Level
SSD	Solid-state Drive
STANAG	NATO Standardization Agreement
SVP	Sound Velocity Profiler
TCG	Transverse Centre of Gravity
TCPA	Time of Closest Point of Approach
TFT	Thin-Film Transistor
TIFF	Tagged Image File Format
TMR	TOPEX/Poseidon Microwave Radiometer
TNC	Threaded Neill-Concelman connector
TS	Technical Specifications
UHF	Ultra High Frequency
UPS	Uninterruptible Power System
USB	Universal Serial Bus
UTC	coordinated universal time
uV	nano voltage
UV	Ultraviolet
V	Volt
VAC	Voltage of Alternating Current
VCG	Vertical Centre of Gravity
VDC	Voltage of Direct Current
VDR	Voyage Data Recorder
VGA	Video Graphics Array
VHF	Very High Frequency
VMAP	Vector Map
VRS	Virtual Reference Station
V.S.W.R.	Voltage Standing Wave Ratio
VTC	Vessel Traffic Centre

VTS	Vessel Traffic Services
W	Watt
WMS	Web Map Service
W/H E.C.C.	Wheelhouse Engine Control Console
XGA	Extended Graphics Array

Part VII - Annex 1 - Warranty Services and Guarantee Slipping

1. Warranty Services

1.1 The Contractor shall provide Warranty Services in relation to all aspects of the Vessel during the Warranty Period, including Guarantee Slipping as stipulated in this Annex. Both the Warranty Services and Guarantee Slipping shall be carried out locally in Hong Kong. If the Contractor appoints an authorised agent to perform the Warranty Services, the Contractor shall ensure that the authorised agent appointed will perform the Warranty Services and Guarantee Slipping in full compliance with the requirements of the Contract including those as set out in this Annex 1.

1.2 The Government reserves all rights and claims against the Contractor in the event that any warranty claim has not been handled in accordance with the terms of the Contract.

1.3 For the Equipment in respect of which the manufacturer/supplier does not offer a one-year free warranty on such equipment, the Contractor shall provide the Warranty Services throughout the Warranty Period at the Contractor's own cost. For other loose equipment and installations, such as life-saving and firefighting equipment, etc., which are required to be serviced, inspected or renewed annually, the Contractor shall provide the servicing, inspection and renewal as per the manufacturer's requirements of that equipment or installation in the Warranty Period applicable to such items.

1.4 During the Warranty Period, when the Vessel is handed over for the Warranty Services and/or Guarantee Slipping, the Contractor shall be responsible for the due return of the Vessel in good order. Should there be any loss or damage of the Vessel or any Warranty Item (as defined in Paragraph 1.5 below) caused by any reason whatsoever while the Vessel is in the possession or control of the Contractor (including even when the Vessel is at the Government Dockyard or a maintenance base of the user department) or at the shipyard of the Contractor or an authorised agent appointed by it, the Contractor shall pay for the cost for the loss or damage plus 20% as and for liquidated damages but not as a penalty. Throughout the Warranty Period, notwithstanding anything to the contrary in the Contract, the Vessel and all Warranty Items are deemed to be at the Contractor's risks, and the Contractor shall insure and keep insured, at his own expense, a property insurance with the Government to be named as the sole payee, for an indemnity amount of not less than the purchase price of the Vessel plus 20% to protect the Government property against all risks. The Certificate of Insurance and evidence showing that the premium has been paid shall be available for inspection in advance. The Contractor shall provide this insurance policy before the commencement of the Warranty Services and/or Guarantee Slipping. Any excess payable under the insurance policy shall be borne by the Contractor.

1.5 Total Vessel Warranty

It is required that the Vessel is covered by free of charge Warranty Services for one year after the date of the issue of the Acceptance Certificate in respect of the Vessel. The Warranty Services shall cover the entire Vessel and all its Equipment (including all major Equipment specified in Schedules 6 and 7 in Part V and electronic navigational equipment), fittings and outfit (including spare parts, and documentation) (collectively, "Warranty Items") against defects of design, construction, workmanship or materials and against any non-compliance with any of the Product Warranties. The Warranty Services may be backed up by the Contractor using individual equipment suppliers/manufacturers' warranties but the Contractor shall remain solely liable to MD as a primary obligor to provide the Warranty Services. Notwithstanding and without prejudice to the Contract on warranty obligations for the total Vessel, any individual equipment supplier/manufacturer's warranty extending beyond the one year total Vessel warranty must be assigned to the Government as appropriate.

1.6 Procedures for Warranty Claim

Without prejudice to the provisions of the Contract, a detailed procedure for dealing with warranty claims must be proposed by the Contractor and agreed by MD before the issuance of the Acceptance Certificate of the Vessel. This shall be based on the following principles:

1.6.1 Any notification of claimed defect shall be sent from MD to the Contractor through a defined route.

1.6.2 There shall be a joint inspection to examine the defect and the Contractor shall propose the appropriate and necessary remedial action to the satisfaction of MD.

1.6.3 The Contractor shall undertake on-site Warranty Services (including provision of all replacement Warranty Items, spare parts, labour, materials, test equipment, and transportation) wherever, at the option of the Government, the Vessel is berthed in the Government Dockyard or maintenance bases of the user department. Taking the Vessel to the shipyard of the Contractor should be avoided unless absolutely necessary.

1.6.4 Rectification of defects must have a minimum effect on the operation of the Vessel by the provision of on loan equipment if the anticipated repair time exceeds the time frame as specified in Paragraph 1.7.1 below.

1.7 Throughout the Warranty Period, the Contractor shall be responsible for the provision of free of charge corrective maintenance and rectification of all defects in all and any of the Warranty Items including repair and replacement as necessary. This shall, at no cost to the Government, include Warranty Services to be performed by the Contractor described in the following sub-paragraphs:

1.7.1 To attend to the Vessel for inspection and repair within two (2) working days of receiving the report of a fault ("fault report") and to take immediate action to rectify the defect after inspection. Unless otherwise agreed by the Government, all corrective maintenance and rectification must be effected within three (3) working days after the fault report is first issued. The MD must be informed of what corrective maintenance and rectification actions have been taken within five (5) working days of receiving the relevant fault report.

1.7.2 To provide all necessary transport, replacement Equipment, spare parts, labour and materials, tools and testing instruments required for the corrective maintenance and rectification.

1.7.3 Any replacement item or part to be used shall originate from the manufacturer of the original Warranty Item to be repaired and must be able to be found in the latest spare parts list issued by such manufacturer. Alternative components shall not be used without the prior approval in writing of the MD.

If the Contractor fails to respond to any reported warranty claims within two (2) working days, the MD may invoke the necessary action for arranging corrective maintenance and rectification of the defect either on its own or by deploying a third party contractor as deemed appropriate with a view to minimising any downtime incurred. In such case, the Contractor shall compensate the Government for the full cost of such repairs plus 10% as and for liquidated damages but not as a penalty no later than 10 working days after a written demand has been served on the Contractor by MD.

1.8 Extension of Warranty

1.8.1 The Warranty Period for any Warranty Item shall be suspended whilst and if the Contractor fails to repair and correct satisfactorily the defects in such Warranty Item within seven working days counting from the date when the relevant fault report was first issued.

1.8.2 Warranty Items which are electronic equipment sub-assemblies, modules or components and which are replaced during the Warranty Period shall have a new warranty period of one year commencing from the date of replacement.

1.8.3 In relation to a Warranty Item, references to Warranty Period shall be construed to include such extended warranty period as mentioned in Paragraph 1.8.1 and/or 1.8.2 above, depending on whichever is applicable.

1.8.4 Equipment which is found to be defective during the trials at the Guarantee Slipping as mentioned in Paragraph 2.2.5 below shall have an extension of warranty of one year.

1.9 Recurrent Defects

During the Warranty Period, should a second and similar defect arise in relation to a Warranty Item, this shall be construed as conclusive evidence of the Warranty Item's unsuitability for the purpose intended, and the Contractor shall take immediate steps to conduct a thorough investigation jointly with MD at the Contractor's expense, to ascertain the reasons for any such defect and shall forthwith at the MD's option and the Contractor's expense, procure and deliver another replacement Warranty Item with a new design suitable for the purpose intended to replace the original defective Warranty Item.

1.10 In the event that the Contractor proposes to modify any Warranty Item or any part of the Vessel in order to repair or replace the same or another Warranty Item, the Contractor shall obtain the Government's advance written consent to the proposed modification.

1.11 Throughout the Warranty Period, the Contractor shall maintain an inventory of spare parts, which shall be the same items as listed in Schedules 6 and 7 in Part V and in the same quantity in the shipyard of the Contractor which the Contractor shall use for performing the Warranty Services. The Government will not provide its own inventory of the Spare Parts to the Contractor for the provision of the Warranty Services.

1.12 Updated/Upgraded Information

It is expected that during the Warranty Period certain Warranty Items may be modified or changed. All documentation affected by this change must be updated to reflect the new situation. All the support documentation such as the Vessel inventory list, job information and maintenance scheduling in relation to these modifications and changes shall be provided at the expiry of the Warranty Period.

1.13 Warranty of Electronic Navigational Equipment

Please refer to the Chapter 13 of the TS.

2. Guarantee Slipping

2.1 As stated in the section "Warranty" above, Guarantee Slipping shall be carried out at the end of the original Warranty Period regardless of any subsequent extension in relation to any Warranty Item under the terms of the Contract.

2.2 At the Guarantee Slipping, the Contractor shall carry out the following work and provide all necessary materials, spare parts, labour and equipment in order to carry out such work:

2.2.1 Pre-guarantee slipping inspection and trial

(a) Joint inspection with trial to confirm the list of guarantee slipping items; and

(b) Collect vessel performance information beforehand for comparing when guarantee slipping completion

2.2.2 Engines and Gearboxes

(a) Renew the lubricating oil and replace the filters for the main engines and gearboxes and top up the engine coolant as per the manufacturer's recommendations;

(b) Clean all the engine air filters and change the filter elements;

(c) Change all fuel/water separators elements and fuel filters for all engines;

(d) Clean the coolers of the engines and gearboxes and renew all zinc anodes if provided;

(e) Check all the engines' belts and adjust or renew if necessary;

(f) Check tappet clearances for the inlet and exhaust valves, ignition timing and idle speed and adjust if necessary;

(g) Conduct function tests for the engines' protection system and their associated sensors, gauges and other measuring devices;

(h) Disconnect and remove all engines and gearboxes sea water pipes (suction & discharge) for inspection, and clear off marine growth and obstructive materials in all pipes and fittings;

(i) Repair all damages and leakages in the metal and fibreglass pipelines; and

(j) Any other work required or recommended by the engine manufacturer.

All of the work listed at Paragraphs 2.2.2(a) to (j) shall be carried out by the manufacturer's authorised agent/dealer. All the work procedures and the spare parts used shall comply with the manufacturer's specifications and requirements.

2.2.3 Hull and Deck Items (where applicable)

(a) Paint Under the Water Line

(i) Paint under the water line shall be checked by the paint manufacturer's representative for the effectiveness of one year's protection against marine growth;

(ii) The hull shall be cleaned and readily for inspection of paint damage;

(iii) Damaged paint shall be repaired according to the paint manufacturer's procedures;

(iv) After the repair of the damaged paint as specified at Paragraph 2.2.3(a)(iii), two coats of touch up primer and one coat of touch up shall be applied; and

(v) One touch up anti-fouling paint of finishing coat shall be applied to the damaged paint as specified at Paragraph 2.2.3(a)(iii).

(b) Paint Above the Water Line

(i) Damaged paint on the hull above the water line and deckhouse shall be repaired properly. After repair, two coats of touch up primer and one coat of touch up (finishing) shall be applied;

(ii) Two coats of paint shall be applied on the Vessel's name, draft marks and insignia; and

(iii) One full coat of anti-slip paint shall be applied to the open and side deck.

(c) Inspect and clean and polish propellers.

(d) Inspect, clean and remove obstructed object on the propeller shaft.

(e) Water jet tunnel and impeller(s) inspection and cleaning (if applicable).

(f) Free, clean, grease and recondition all moving parts of the deck fittings, i.e. WT (water tight) hatches, vent covers, rollers and fairleads and anchor chain stoppers, etc.

(g) Renew all zinc anodes on hull, rudder(s) and tail shaft(s).

(h) Life-saving appliances (LSA) and Fire-fighting appliances (FFA) must be serviced and re-certified as required. (Free, clean, grease and recondition all fire control valves, hydrants and bilge suction and control valves)

(i) Free, clean and repaint the anchor chain and swivel set.

2.2.4 Mechanical, Electrical & Air-conditioning

(a) Dismantle all overboard valves for inspection and renew the defective parts;

(b) Check and clean the sea water system (including the grating, sea chest internal, sea suction and strainers) complete with renew their zinc anodes;

(c) Each of the compartment bilge suction to be checked and free of rubbish;

(d) Generator megger test and electrical circuit earth leak test; and

(e) Batteries condition check and switch over test.

2.2.5 The following shall be tested at the dock trial / sea trials as part of the Guarantee Slipping:

(a) Engine control and steering system including emergency/alternative method;

(b) Engine alarm and shut down function (including emergency stopping of engines at wheelhouse);

(c) Hybrid System

(d) Battery Generator

(e) Navigational equipment, lights and sound signals;

(f) Ahead and astern running and crash stop test;

(g) Steering trial;

(h) Speed Measurement;

(i) Bilge system function (including high level bilge alarm system);

(j) Fire pump(s) function (including fire detection system, alarms, ventilation fans /fuel

pump remote shutdown);

(k) The Dock Trial and Sea Trial Safety Checklist items, as listed below;

Dock Trial Check List

General items will be checked during dock trial	
1.	Engines start and stop testing
2.	Engines emergency stop check
3.	Engines speed and clutch unit testing
4.	Engines speed high and low idle speed testing
5.	Engines gauges and alarm check
6.	Propulsion system testing (Diesel and Hybrid)
7.	Anchor windlass testing
8.	Navigation lights testing
9.	Wheelhouse horn and windows screen wipers testing
10.	Fire protection system alarm check
11.	Portable fire extinguishers inspection
12.	Life-saving equipment inspection
13.	Engine room ventilation fans testing
14.	Air compressor and air conditioning system testing
15.	Cabin lights testing
16.	Bilge system in each compartment testing.
17.	Floor plate inspection
18.	Fuel tanks quick closing valves testing
19.	G.S. pumps testing
20.	Bilge pumps testing
21.	A/C cooling water pumps testing
22.	Tailshaft cooling water pumps testing
23.	Fire pumps testing
24.	Fuel oil pumps testing
25.	Sanitary pumps testing
26.	Sewage pumps testing
27.	Fresh water pumps testing
28.	Waste water pumps testing
29.	Steering system power assisted and manual operation testing
30.	Emergency rudder operation check
31.	Rudder indicator check

32	Deck cranes testing

Sea Trial Safety Check List

General items will be checked during sea trial	
1.	Engines start and stop testing
2.	Engines emergency stop check
3.	Engines speed and clutch unit testing
4.	Wheelhouse horn and windows screen wipers testing
5.	Portable fire extinguishers are in place
6.	Life jackets and life buoys are in place
7.	Sea trial navigation flag hoisted
8.	Telecommunication system function check
9.	Approved coxswains are in control
10.	Sufficient fuel oil to perform the full course of sea trial
11.	Water tank is full
12.	Deck cranes testing

(l) Other trials or testing of equipment as required by the Government Representative; and

(m) Any item or component found defective shall be repaired or replaced.

2.3 After Guarantee Slipping, the Contractor shall submit the above works completion report (including engines trial/testing report completed with engines parameters) to the Government Representative.

Milestones		Completion Dates
1	Kick-Off Meeting	To be held within two (2) months after the Contract Date at the Government Dockyard or the Contractor's Shipyard
2	Completion of hull structures	The Contractor shall propose the completion dates of Milestones 2-8 for GNC's approval within two (2) months after the Contract Date.
3	Completion of installation of main machinery system	
4	Completion of installation of electronic navigation equipment	
5	Sea trial	
6	Pre-shipment Construction and Handling Inspection	
7	Shipment to Hong Kong	
8	Official sea trial	The Delivery Date for the Vessel shall be no later than the date set out in Schedule 2 (Delivery Schedule) of Part V
9	Delivery Date	

Item No.	Drawings Approval	Completion Date
1	General Arrangement Plan	All the drawings are required to be submitted in two months after Signing of Articles of Agreement for GNC's approval / reference.
2	Lines Plan	
3	Structural Construction Plan in Mid-Ship bulkhead section	
4	Details of Hybrid System – Main Engines, Diesel Generators, Gear Boxes (PTI/PTO), E-Motors, ESS, PMS, BMS, DC Grid, Electronic Components, etc. (Including design philosophy of PMS)	
5	Construction Profile and Deck Plan	
6	Shell Expansion Plan	
7	Tank Capacity Plan	
8	Engine Mounting Arrangement	
9	Power / Speed Estimation and Curve	
10	Intact and Damaged Stability Plan	
11	Details of Navigational / Communication Equipment	
12	Details of Deck Equipment, Outfitting, Furniture, etc.	
13	Details of Engines' Arrangement	
14	Control Console Arrangement and Schematic Diagram	
15	On board Fire System Diagram / Schematic diagram and layout Plan	
16	Piping Arrangement	
17	Instrumentation and Control System	
18	Calculation of Fuel Capacity	
19	Details of Electrical and Electronic Equipment	
20	Electrical Load Calculations	
21	Schematic Layout of Electrical Circuits	
22	Paint Schedule	
23	Lightning Protection Arrangement	
24	Torsional Vibration Calculation (if applicable)	
25	Others as required	

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Dr Catherine Lam"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
	Hull Structure, Layout and Outfitting Inspection			
H-1	Mould Lofting			
H-2	Construction Materials – Aluminium plate mark checking for hull & superstructure			
	a. Aluminium plate mark checking for hull & superstructure			
	b. Material certificates verification			
H-3	Welding consumables & welders certificates			
H-4	Keel laying for hull			
H-5	Fabrication of hull up to main deck in stages of work, including:			
	a. Alignment			
	b. Edge Preparation			
	c. Welding			
	d. Workmanship			
	e. Compliance with approved plans			
	f. NDT (X-ray) of welds			
	g. Hull internal aluminium work inspection			
	h. Plating thickness gauging			
H-6	Engine bearers fabrication / welding			
H-7	Superstructure scantling & welding checking			
H-8	Welding construction and pressure tests of tanks			
	Fuel oil tank			
	a. Tank construction (internal/external/fitting)			
	b. Tank pressure test			
	Freshwater tank			
	a. Tank construction (internal/external/fitting)			
	b. Tank pressure test			
	Black/Grey water tank			
	a. Tank construction (internal/external/fitting)			
	b. Tank seating construction/securing arrangement			
	Oily Water tank			
	a. Tank construction (internal/external/fitting)			
	b. Tank seating construction/securing arrangement			
H-9	Hose test for hull & superstructure			
H-10	Mock up inspection for the wheelhouse			
H-11	Installation of various outfitting items			
	a. Anchor and chain			
	b. Windlass			
	c. Hand pump			
	d. Hatches			
	e. Doors			
	f. Windows			
	g. Ventilators			
	h. Seating of heavy equipment and masts			
H-12	Function tests of various outfitting items			

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Dr Catherine Lam"				Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected				
H-13	Watertightness or weathertightness of openings				
	a.	Manholes			
	b.	Hatches			
	c.	Doors			
	d.	Windows			
	e.	Ventilator & air pipes			
H-14	Painting inspection of different layers				
H-15	Draught marks and vessel dimensions verifications				
H-16	Arrangement of wheelhouse and accommodation				
H-17	Zinc anodes and lightning system				
	a.	Installation of zinc anodes			
H-18	Inspection of fire, heat and sound insulation				
	a.	Fire insulation			
	b.	Heat insulation			
	c.	Sound insulation			
H-19	Interior furnishings				
	a.	Console area			
	b.	Wheelhouse			
	c.	Passenger space			
	d.	Toilets and pantry			
H-20	Lifesaving appliances and fire fighting appliances				
	a.	Lifesaving appliance			
	b.	Fire fighting appliance			
H21	Inspection of sea chest and grating				
	a.	Sea chest			
	b.	Grating			
H-22	Inclining experiment				
H-23	Sea trials including operation test of outfitting equipment				
H-24	Towing hook static bollard pull test				
H-25	Site towing demonstration trial				
H-26	Cleanliness inspection before acceptance				
H-27	Inventory check in the HKSAR				
H-28	Acceptance and delivery				
H-29	Acceptance of As-Fitted drawings and Engines/Equipment Manuals and documentations.				
	Machinery and Electrical Installation				
EM- 1	General inspection on installation of machinery:				
(a)	General inspection on installation of main engines				
(b)	General inspection on installation of generator sets				
(c)	General inspection on installation of auxiliary machinery				
(d)	General inspection on installation of gearbox and shafting				
(e)	General inspection on installation of hydraulic system				
(f)	General inspection on installation of deck cranes				
(g)	General inspection on installation of fire pump				

Part VII - Annex 4 - Main Items Inspection Timetable				
VESSEL NAME : "Dr Catherine Lam"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
(h)	Propeller taper bedding test			
(i)	Coupling taper bedding test			
(j)	Coupling and rudder bolts fitting			
(k)	General inspection on installation of power distribution system			
EM- 2	Main engines:			
(a)	Test of engine safety devices and alarms			
(b)	Test of emergency stop			
(c)	Inspection of exhaust pipe before lagging			
EM- 3	Hydraulic test of sea valve			
EM- 4	Inspection of sea water suction strainer			
EM- 5	Freshwater system:			
(a)	General inspection & dimension checking of freshwater system			
(b)	Freshwater tank low level alarm test			
(c)	Freshwater tank final cleaning/internal inspection before filling			
(d)	Freshwater tank high level alarm test			
(e)	Freshwater tank content gauge calibration and test			
(f)	Inspection of piping penetration of bulkhead and deck			
(g)	Hydraulic test of freshwater piping			
(h)	Functional test of freshwater system			
EM- 6	Fuel oil system:			
(a)	General inspection & dimension checking of fuel oil system			
(b)	Fuel oil tank low level alarm test			
(c)	Fuel oil tank final cleaning/internal inspection before filling			
(d)	Fuel oil tank high level alarm test			
(e)	Fuel oil tank content gauge calibration and test			
(f)	Inspection of piping penetration of bulkhead and deck			
(g)	Hydraulic test of fuel oil piping			
EM- 7	Bilge system:			
(a)	General inspection & dimension checking of bilge system			
(b)	Bilge tank high and low level alarms test			
(c)	Inspection of piping penetration of bulkhead and deck			
(d)	Hydraulic test of piping			
(e)	Functional test of bilge system			
EM- 8	Sanitary system:			
(a)	General inspection & dimension checking of sanitary system			
(b)	Inspection of piping penetration of bulkhead and deck			
(c)	Hydraulic test of piping			

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Dr Catherine Lam"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
(d)	Functional test of sanitary system			
EM- 9	Fire fighting system:			
(a)	General inspection & dimension checking of fire line system (including the emergency fire line system)			
(b)	Inspection of piping penetration of bulkhead and deck			
(c)	Hydraulic test of fire line			
(d)	Function test of fire line (including emergency fire line)			
EM- 10	Fire extinguishing system:			
(a)	General inspection & dimension checking of (gas) fire extinguishing system			
(b)	Hydraulic & blow test of gas fire extinguishing piping			
(c)	Test of (gas) fixed fire extinguishing alarm system			
(d)	Test of fire detection (smoke & heat detectors) alarm system			
EM- 11	Functional test of drainage system			
EM- 12	Hydraulic system (including deck cranes)			
(a)	General inspection & dimension checking of hydraulic system			
(b)	Inspection of piping penetration of bulkhead and deck			
(c)	Hydraulic test of piping			
(d)	Functional test of hydraulic system			
EM- 13	E/R ventilation system:			
(a)	Inspection of E/R ventilation fans installation			
(b)	Function test of start/stop at remote and local control for E/R ventilation fans			
EM- 14	Air conditioning system:			
(a)	General inspection of air-conditioning system			
(b)	Inspection and hydraulic test of cooling water system			
(c)	Function test of air-conditioning system			
(d)	Air conditioning full load test during sea trial			
EM- 15	Batteries:			
(a)	Inspection of battery connectors and housing boxes			
(b)	Inspection of battery charger			
(c)	Operational test of battery charger Test of main engines and generator consecutive starting by each group of battery (start/stop at remote and local control)			
EM- 16	Electrical installation:			
(a)	Inspection of lightning conductor			
(b)	General inspection of cable layout & checking of cable sizes			
(c)	Inspection of cable penetrations of bulkhead and deck			

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Dr Catherine Lam"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
(d)	Inspection of transformers			
(e)	Inspection of tally plates			
EM- 17	Main switchboard & panels:			
(a)	Main switchboard & panels - high voltage injection test			
(b)	Cable size checking of electrical switchboard installations			
(c)	Inspection of AC distribution panel			
(d)	Inspection of DC distribution panel			
(e)	Megger test of the electrical system			
(f)	Earthing test of the electrical system			
EM- 18	Control Console:			
(a)	Inspection of wheelhouse control console			
(b)	Functional test of wheelhouse console controls			
(c)	Inspection of navigation equipment control panel			
EM- 19	Lighting:			
(a)	Inspection and and functional test of general lighting			
(b)	Inspection and and functional test of emergency lighting			
(c)	Inspection and and functional test of floodlight installation			
(d)	Inspection and functional test of searchlight installation			
EM- 20	Navigational Lights and Signals			
(a)	Inspection and functional test of navigational lights			
(b)	Test of horn/whistle			
EM- 21	Shafting (tailshaft and coupling) system:			
(a)	Marking/Stamping and material check			
(b)	Dimension check and taper bedding test			
(c)	Shaft line checking of stern/shaft bracket and alignment of main engines and tailshafts			
EM- 22	Test of window wipers			
EM- 23	Bollard pull test			
EM- 24	Electronic equipment tested by EMSD			
EM- 25	Test of noise level during sea trial			
EM-26	Test of Bow thruster			
(a)	Electrical circuit protection testing			
(b)	Positioning keeping interface testing as recommended by supplier			
(c)	Function test of the system and its associated equipment			
(d)	Manoeuvrability and performance test			

Part VII - Annex 4 - Main Items Inspection Timetable				
VESSEL NAME : "Dr Catherine Lam"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
EM-27	(a) Official Speed Trial			
	(b) Other Official Sea Trials			
EM-28	Test of Hybrid System			
	(a) Software Test			
	(b) Function Test of the whole system			
	(c) FMEA Verification Test			
	(d) Integration and Interface Test with various system			
	(e) All test as listed out in EM-17 whereas applicable			

Note:
The inspection items are preliminary and not exhaustive, any items found necessary to be included at a later stage will be added to this list.

Part VII - Annex 5 - Official Sea Trial, Endurance and Performance Tests

Official Sea Trial, Endurance and Performance Tests							
Date of Test:				Place of Test:			
Vessel's Identification:				Vessel's Name:			
Conditions at Endurance and Performance Test (Official Sea Trial)							
Person on board	**15**			Dummy Weight	82.5 kg per person		
Fuel (Diesel)	**Not less than 50% of Fuel and Water Tank**			Other Equipment	20kg for each persons on board		
Sea Conditions	**Calm sea with wind speed below 6 knots / maximum wave height of less than 0.5 m / Sea Water Depth not less than 5 meters**						
Engines:	'P'	'S'	Centreline (if applicable)	Propulsion:	'P'	'S'	Centreline (if applicable)
Maker				Maker			
Type				Type			
Serial Number				Diameter (if applicable)			
Rated Power				Pitch (if applicable)			
Rated Speed				Direction of Rotation			

1) Official Speed Trial

Conditions at Speed-Trial		
1	Person on board	15 Persons (at 82.5 kg per person and 20 kg personal effect)
2	Fuel oil tanks	not less than 50% fuel tank capacity
3	Fresh water tank	not less than 50% tank capacity
4	Grey water tank	not less than 50% tank capacity
5	Black / Grey water tank	not less than 50% tank capacity

2) Endurance and Performance Test

Conditions at Endurance and Performance Test		
1	Person on board	15 Persons (at 82.5 kg per person and 20 kg personal effect)
2	Fuel oil tanks	not less than 50% fuel tank capacity
3	Fresh water tank	not less than 50% tank capacity
4	Grey water tank	not less than 50% tank capacity
5	Black / Grey water tank	not less than 50% tank capacity

3) Hybrid (Electric) Propulsion Test

Conditions at Hybrid Propulsion Test		
1	Person on board	15 Persons (at 82.5 kg per person and 20 kg personal effect)
2	Fuel oil tanks	not less than 50% fuel tank capacity
3	Fresh water tank	not less than 50% tank capacity
4	Grey water tank	not less than 50% tank capacity
5	Black / Grey water tank	not less than 50% tank capacity

4) Manoeuvrability Test

Conditions at Forward Turning Circle Test		
1	Person on board	15 Persons (at 82.5 kg per person and 20 kg personal effect)
2	Fuel oil tanks	not less than 50% fuel tank capacity
3	Fresh water tank	not less than 50% tank capacity
4	Grey water tank	not less than 50% tank capacity
5	Black / Grey water tank	not less than 50% tank capacity

5) Crash Stop Test / Astern Running Test / Emergency Steering Test

Conditions at Crash Stop Test / Astern Running Test / Emergency Steering Test		
1	Person on board	15 Persons (at 82.5 kg per person and 20 kg personal effect)
2	Fuel oil tanks	not less than 80% fuel tank capacity
3	Fresh water tank	not less than 85% tank capacity
4	Grey water tank	not less than 85% tank capacity
5	Black water tank	not less than 85% tank capacity

Diesel Engine Performance Test

Engine Load	**Engine Speed (rpm)**	**Vessel Speed (Knots)**	**Time (Start)**	**Time (Finish)**	**Fuel Consumption (litres/mintue)**	**Engine Oil Pressure (Bar)**	**Engine (in) CW Temp. (ºC)**	**Others**
__% of rated Power								
50% of Rated Power			Not less 15 minutes					
75% of Rated Power			Not less 20 minutes					
100% of Rated Power (Endurance Test)			Not less 30 minutes					
Remarks:								

Witness by:	MD Representative	Shipyard Representative	User Dept Representative

Course	0	45	90	135	180	225	270	315	360
Time Taken									
Ahead turning to (starboard)									
Course	0	45	90	135	180	225	270	315	360
Time Taken									

Ahead turning to (port)									

Turning diameter: Ahead turning to (starboard)	Ship length
Engine R.P.M. (Starboard)	rpm
Engine R.P.M. (Port)	rpm
Max heeling angle	degree
Turning diameter: Ahead turning to (port)	Ship length
Engine R.P.M. (Starboard)	rpm
Engine R.P.M. (Port)	rpm
Max heeling angle	degree

Part VII - Annex 6 – Definitions of Wave and Sea

Beaufort scale number	Description	Wind speed	Wave height	Sea conditions	Land conditions
0	Calm	< 1 km/h (< 0.3 m/s) < 1 mph < 1 knot < 0.3 m/s	0 m 0 ft	Flat.	Calm. Smoke rises vertically.
1	Light air	1.1–5.5 km/h (0.3–2 m/s) 1–3 mph 1–3 knot 0.3–1.5 m/s	0–0.2 m 0–1 ft	Ripples without crests.	Smoke drift indicates wind direction. Leaves and wind vanes are stationary.
2	Light breeze	5.6–11 km/h (2–3 m/s) 4–7 mph 4–6 knot 1.6–3.4 m/s	0.2–0.5 m 1–2 ft	Small wavelets. Crests of glassy appearance, not breaking	Wind felt on exposed skin. Leaves rustle. Wind vanes begin to move.
3	Gentle breeze	12–19 km/h (3–5 m/s) 8–12 mph 7–10 knot 3.5–5.4 m/s	0.5–1 m 2–3.5 ft	Large wavelets. Crests begin to break; scattered whitecaps	Leaves and small twigs constantly moving, light flags extended.
4	Moderate breeze	20–28 km/h (6–8 m/s) 13–17 mph 11–16 knot 5.5–7.9 m/s	1–2 m 3.5–6 ft	Small waves with breaking crests. Fairly frequent whitecaps.	Dust and loose paper raised. Small branches begin to move.
5	Fresh breeze	29–38 km/h (8.1-10.6 m/s) 18–24 mph 17–21 knot 8.0–10.7 m/s	2–3 m 6–9 ft	Moderate waves of some length. Many whitecaps. Small amounts of spray.	Branches of a moderate size move. Small trees in leaf begin to sway.
6	Strong breeze	39–49 km/h (10.8-13.6 m/s) 25–30 mph 22–27 knot 10.8–13.8 m/s	3–4 m 9–13 ft	Long waves begin to form. White foam crests are very frequent. Some airborne spray is present.	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic bins tip over.
7	High wind, moderate gale, near gale	50–61 km/h (13.9-16.9 m/s) 31–38 mph 28–33 knot 13.9–17.1 m/s	4–5.5 m 13–19 ft	Sea heaps up. Some foam from breaking waves is blown into streaks along wind direction. Moderate amounts of airborne spray.	Whole trees in motion. Effort needed to walk against the wind.
8	Gale, fresh gale	62–74 km/h (17.2-20.6 m/s) 39–46 mph 34–40 knot 17.2–20.7 m/s	5.5–7.5 m 18–25 ft	Moderately high waves with breaking crests forming spindrift. Well-marked streaks of foam are blown along wind direction. Considerable airborne spray.	Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.
9	Strong gale	75–88 km/h (20.8-24.4 m/s) 47–54 mph 41–47 knot 20.8–24.4 m/s	7–10 m 23–32 ft	High waves whose crests sometimes roll over. Dense foam is blown along wind direction. Large amounts of airborne spray may begin to reduce visibility.	Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over.

10	Storm, whole gale	89–102 km/h (24.7-28.3 m/s) 55–63 mph 48–55 knot 24.5–28.4 m/s	9–12.5 m 29–41 ft	Very high waves with overhanging crests. Large patches of foam from wave crests give the sea a white appearance. Considerable tumbling of waves with heavy impact. Large amounts of airborne spray reduce visibility.	Trees are broken off or uprooted, saplings bent and deformed. Poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	Violent storm	103–117 km/h (28.6-32.5 m/s) 64–73 mph 56–63 knot 28.5–32.6 m/s	11.5–16 m 37–52 ft	Exceptionally high waves. Very large patches of foam, driven before the wind, cover much of the sea surface. Very large amounts of airborne spray severely reduce visibility.	Widespread damage to vegetation. Many roofing surfaces are damaged; asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	Hurricane	≥ 118 km/h (≥ 32.8 m/s) ≥ 74 mph ≥ 64 knot ≥ 32.7 m/s	≥ 14 m ≥ 46 ft	Huge waves. Sea is completely white with foam and spray. Air is filled with driving spray, greatly reducing visibility.	Very widespread damage to vegetation. Some windows may break; mobile homes and poorly constructed sheds and barns are damaged. Debris and unsecured objects are hurled about.

World Meteorological Organization (WMO) Sea State Code		
Sea State Code	Wave Height (meters)	Characteristics
0	0	Calm (glassy)
1	0 to 0.1	Calm (rippled)
2	0.1 to 0.5	Smooth (wavelets)
3	0.5 to 1.25	Slight
4	1.25 to 2.5	Moderate
5	2.5 to 4	Rough
6	4 to 6	Very rough
7	6 to 9	High
8	9 to 14	Very high
9	Over 14	Phenomenal

Character of the Sea Swell		
	0. None	
Low	1. Short or average 2. Long	
Moderate	3. Short 4. Average 5. Long	
Heavy	6. Short 7. Average 8. Long	
	9. Confused	

Part VII - Annex 7 - As Fitted Drawings and Documents

As-fitted Drawings and Machinery/Equipment documents and information literature to be delivered to the Government upon Delivery Acceptance

1. As-Fitted Drawings

1.1 Upon delivery of the Vessel, the Contractor shall deliver to the Government four (4) hard copies and two (2) soft-copies in pdf. and dwg. files of the following plans and drawings that contain the technical information of the Vessel and its machinery and equipment as they are when the Vessel is on the day accepted by the MD. These are termed the final version of the "As- Fitted" Plans and Drawings, and they must consist of the following ones as well as any other additional ones that may be required by GNC during the design and construction of the Vessel before the Vessel is accepted by the Government.

1.2 The as–fitted plans and drawings shall be prepared by professional ship draughtsmen and they shall be prepared in a professional manner, scale, size and style normally required of in the ship design and construction business sector. All plans and drawings shall show and be clearly marked for the profile, plan, and section views of the layout, arrangement details, and construction details in a manner required by GNC officer.

1.2.1 General Arrangement Plan
1.2.2 Lines plan and offsets data and table.
1.2.3 Stability information booklet and the inclining experiment report.
1.2.4 Hydrostatics, cross curves and intact and damage stability calculations for all ship loading conditions specified in the Technical Specifications.
1.2.5 Vessel subdivision drawings and stability calculations.
1.2.6 Painting scheme of the whole Vessel.
1.2.7 Vessel draught marking diagram.
1.2.8 Detailed arrangement and layout plan of the wheelhouse, cabins, decks showing the disposition of all main equipment, fittings and fixtures, furniture, doors, windows, hatches, manholes and access openings. The down-flooding openings (points) shall be clearing indicated on the drawings.
1.2.9 Equipment layout diagram.
1.2.10 Hull structural construction and hull scantlings drawings.
1.2.11 Hull shell and frames and the framings arrangement and construction plan.
1.2.12 Hull shell expansion plan.
1.2.13 Keel construction plan.
1.2.14 Steering system and steering arrangement diagrams.
1.2.15 Superstructures and deck structural and construction plan.
1.2.16 Hull watertight bulkheads construction plan.
1.2.17 Superstructures to deck connection detailed construction plan.
1.2.18 Deck edge and bulwark (if any) details and construction plan, including detailed structural arrangement drawings of hull to deck connection.
1.2.19 Detailed cathodic corrosion prevention and arrangement plans and drawings for the Vessel throughout.
1.2.20 Mast structural and construction plan and mast equipment arrangement plan.
1.2.21 Anchoring and mooring arrangement plan.
1.2.22 Piping diagrams for fuel oil, freshwater, lubrication oil, bilge, firefighting, scuppers and drains, sewage system.
1.2.23 Fire prevention, fire control drawings
1.2.24 Drawings of the main switchboard and all other switchboards and the electrical system.
1.2.25 Wheelhouse and cabin sound and heat insulation system diagram.
1.2.26 Main engines, E motor and generator sets arrangement and sitting plans and drawings of their fuel lines and exhaust gas piping and arrangement.
1.2.27 Vessel ventilation drawings for the wheelhouse, cabins and other spaces.
1.2.28 Main fuel oil tank drawing and its associated piping and manifold(s), and filling, overflow and ventilation system.
1.2.29 Freshwater tank and its associated piping arrangement.
1.2.30 Fuel oil tank(s) and its associated piping system.
1.2.31 Drawings for anchor, windlass and the anchoring system.
1.2.32 Lifesaving appliance arrangement plan and fire safety plan.
1.2.33 Distress signals, alarm systems, and internal/external communication arrangement and system plan.
1.2.34 Navigation lights, sound and signal diagrams and any other external lighting arrangement plan.

1.2.35 Vessel overall lighting arrangement and light control plan.
1.2.36 Vessel alarm and signals, internal communication systems and public address systems plan.
1.2.37 General layout and arrangement drawing of the air-conditioning system.
1.2.38 Refrigerant piping layout drawing of the air-conditioning system.
1.2.39 Air-conditioning load calculation.
1.2.40 Shaft line arrangement
1.2.41 Propeller details and drawings
1.2.42 Solar panel arrangement
1.2.45 FMEA Report.

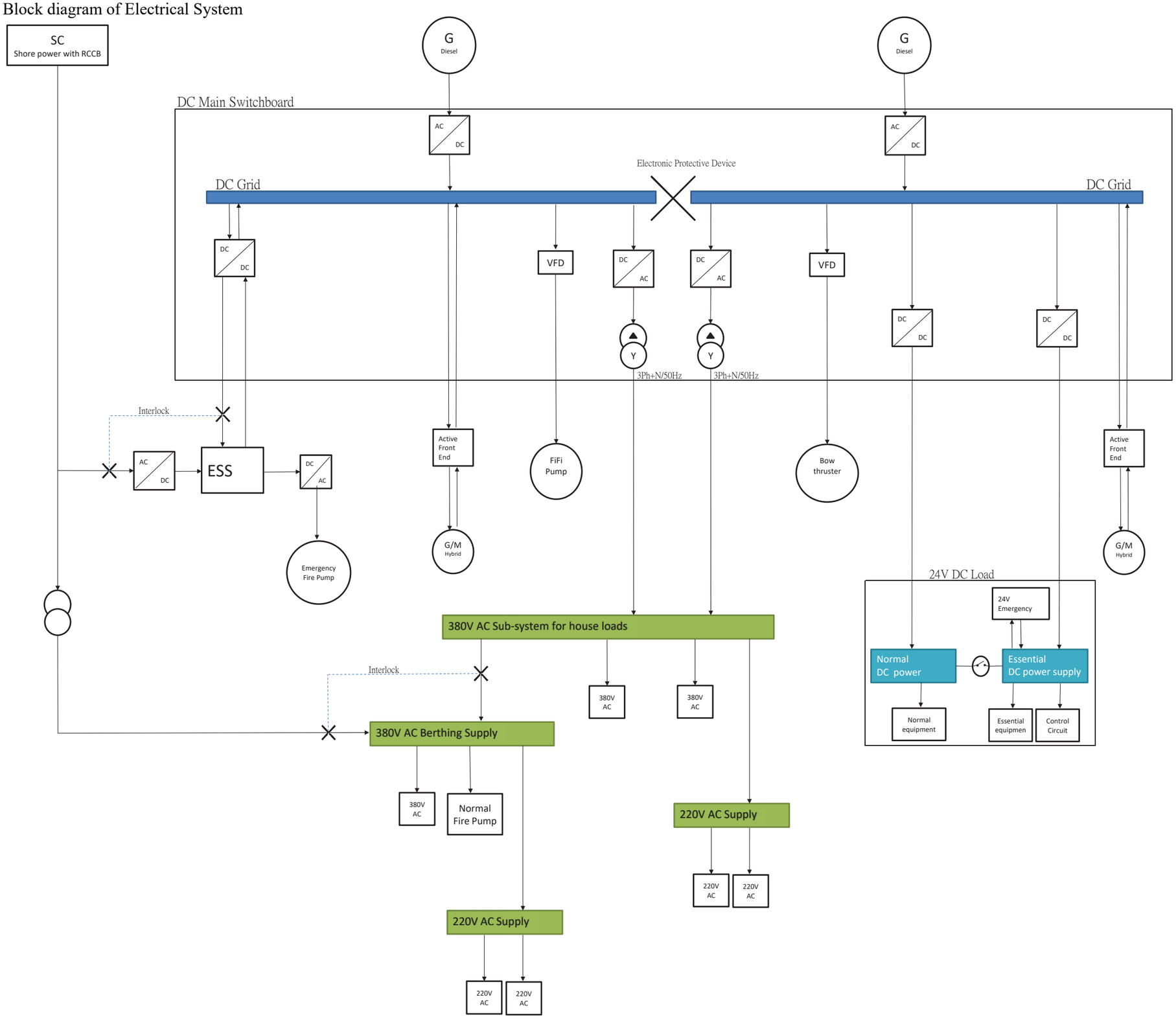
The list is not exhaustive and additional item may be added if required.

1.3 Documents to be provided by the Contractor

1.3.1 In not less than one (1) month before the Delivery Acceptance of the Vessel, the Contractor shall provide for GNC acceptance a list of all documents to be provided.

1.3.2 When the Vessel is delivered to the Government Dockyard the Contractor shall deliver to the Government all the technical information, leaflets, literature, manuals and booklets etc. and whatsoever items that are necessary for the operation, handling, services, maintenance, spare parts, repairs and the technical understanding of any one of all the engines, machinery, motors, pumps, equipment, fittings and outfitting items of the Vessel.

Annex 8 - Conceptual Block diagram of Electrical System



Part VII – Annex 9 – Environmental Protection Equipment Information

Rosette sampler ×1

Van Veen sediment grab ×1

Small sediment grab ×1

Manta trawl net (for microplastics survey) ×1

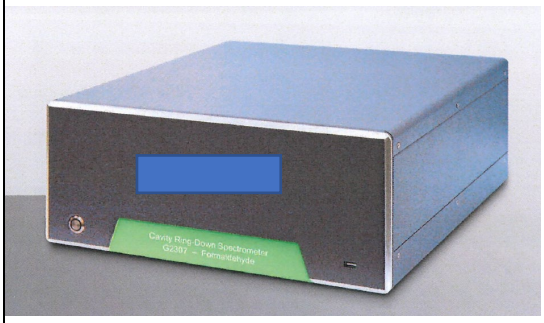
Dimension (approx.)	opening 100 cm × 50 cm, a length of 2 m
Weight (approx.)	50 kg
Data sheet	N/A
Storage location	Workshop for sampler

Deck unit ×1 (for power supply and controlling the rosette sample)

All the following equipment is to be fitted within the Dry Lab on the upper deck, unless stated otherwise.

Equipment	Size	Weight	Electricity requirement	Photo
NOx Analyzer	178 (H) x 432 (W) x 597 (D) mm	18kg	110 W	
O_3 Analyzer	178 (H) x 432 (W) x 597 (D) mm	14kg	112 W	
CO Analyzer	178 (H) x 432 (W) x 597 (D) mm	18kg	160 W	
SO_2 Analyzer	178 (H) x 432 (W) x 597 (D) mm	16.2kg	160 W	
Chemically resistant, compact and oil-free diaphragm vacuum pump	341 (L) x 226 (H) x 160 (W) mm	12.6 kg	270 W	
Sensor-based monitoring station (Gas and $PM_{2.5}$)	42 (L) × 32 (W) × 18 (H) cm (to be mounted on / to wheelhouse roof railings, location to be agreed with GNC),	15 kg	Battery	
Toxic Air Sampler	48 (L) × 43 (W) × 19 (H) cm	40 kg	Max 1100 W	

Equipment	**Size**	**Weight**	**Electricity requirement**	**Photo**
VOC sampling canister (Just need storage space)	15(L) x 15(W) x 20 (H) cm	1kg x 30 pcs	No power needed	
OVOC sampling pump	negligible	1 kg	Battery	
PTR-ToF-MS	480(L) x 615(W) x 1130(H) mm	130kg	800 W	

Equipment	**Size**	**Weight**	**Electricity requirement**	**Photo**
Total Carbon Analyzer	60(D)x48(W)x 42(H) cm *The minimum overall height requirement with standard sampling line system is 1.2 m between the top surface of the instrument and the connection to an external stack.	35 kg	100 W sampling; 600 W analysis	
Formaldehyde Analyzer	Analyzer: 43.2(W)x17.9(H)x44.6(L) cm External pump: 19(W)x10.2(H)x28(L) cm	21.3 kg (6.5kg for external pump)	<260 W for start-up, 110 W (analyzer) + 80 W (pump) at steady state	
Ozone LiDAR	2500 (L) x 1600 (W) x 2400 (H) mm (with environmental enclosure)	500 kg	2000-3000W	 (window opening for LiDAR) 

Equipment	Size	Weight	Electricity requirement	Photo
Wind LiDAR	830 x 1008 x 1365 mm (L x W x H)	350 kg	<1000W	
Aerosol LiDAR	2m x 1m x 1m (H x W x D)	350 kg	<1000W	

Part VII - Annex 10 - Tenderer's Presentation

1. General

1.1 Those Tenderers, who passed the Stage 1 and 2 of the Tender Evaluation Procedures, are required, at the discretion of the Government and at their own costs and expenses, to make a verbal presentation of their proposals to the Government Representatives within twenty-one (21) calendar days upon notice. The presentation shall be conducted by a team of qualified persons who are authorized by the Tenderer. Face-to-face presentation in person is preferred, where should be held at Government premises as designated by the Government Representatives as far as practicable. Presentation by way of video conference may also be considered at the Government's discretion.

1.2 The Tenderer shall introduce, explain and clarify their tender proposals during the presentation. In no circumstances should additional information or new/amended proposal not set out in their tender submissions be accepted. Tender assessment will be made solely based on the Technical Proposal submitted before the Tender Closing Date. The presentation will **not** be taken into account in marking under the Marking Scheme in Annex D to Part II - Conditions of Tender.

1.3 The Tenderer shall focus in presenting the Technical Proposal submitted in respect of its proposed design, philosophy and solutions to be adopted as well as the Excess Proposals therein involving higher standard of specifications and proposed innovative suggestions, if applicable. The scope of presentation shall be strictly based on and within the contents of the Tenderer's Technical Proposal submitted, without any disclosure, clarification or deliberation of the Price Proposal submitted. Organisation introduction and brief of the company profile should be kept to the minimum, which should not be more than five (5) minutes. The length of presentation shall not exceed three (3) hours.

1.4 The presentation shall be followed by a Question and Answer Section for the Government Representatives to make further enquiry about the Tenderer's Technical Proposal and presentation. Such Question and Answer Section should not be construed as any commitment by the Government. Any requests from the Tenderer for the Government to provide additional information about the tender requirements laid down in the Tender Documents or other vessel project plans of the Government will **not** be accepted.

2. Scope of Presentation

2.1 According to the requirements set out in Paragraphs 1.1 to 1.3 above, the presentation shall cover the following topics and follow the numbering sequence below.

(1) Organisation Introduction (not more than five minutes)

(2) Hull

(3) General Arrangement

(4) Fire Safety Equipment

(5) Lifesaving Appliances and Arrangements

(6) Machinery

(7) Electrical System

(8) Operational Systems

(9) Innovation Suggestions