Part VII – Technical Specifications

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Chapter 1 – General Provisions

1.1 Introduction

1.1.1 This document or "Technical Specifications" (TS) sets out the requirements of the Government of the Hong Kong Special Administrative Region of the People's Republic of China ("Government") in relation to in relation to **one (1) Fast Rescue Vessel** ("Vessel") for use by the Fire Services Department ("FSD" 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]; and

(b) Those specifications that are not labelled with [E] shall equally form part of the Contract like the specifications labelled as [E], but the Government will not conduct checks at the tendering stage whether the products offered comply with those specifications not labelled with [E]; and

(c) Desirable Specifications [D].

1.1.3 All this Part VII shall form part of the Contract. As part of the tender evaluation during the tendering stage (viz., completeness check), the Tenderer shall submit all the information in sufficient detail to substantiate that the product and the services offered meet the Essential Requirements as stipulated in Annex C to the Conditions of Tender, failing which its tender will **not** be considered further.

1.1.4 All TS, including all Essential Requirements, those without any label (viz., [E] or [D]) and the Desirable Specifications labelled with [D] (if and to the extent the Contractor has indicated compliance in its tender), shall also form part of the Contract and be of equal materiality and importance upon the award of the Contract. The non-compliance with any specifications set out in these TS shall have the same consequences as specified in the Contract. Save during the tendering stage in the manner as mentioned in Paragraph 1.1.2 (b), no differentiation shall be made based on the classification unless otherwise expressly specified.

1.1.5 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.

1.1.6 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.

1.1.7 As mentioned in the definition of "Vessel" in Clause 1.1 of Part IV, unless otherwise expressly stated, references to "the Vessel" shall mean each of the one (1) Vessel. References to "a Vessel" shall mean any such Vessel. Unless otherwise specified, all requirements specified in this Part VII shall apply to each of the one (1) Vessel1 to be supplied.

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

1.2 Statement of Purposes of the Vessel

1.2.1 This high-speed search and rescue Vessel shall be built to the highest standards, designed for a shallow-draft, operating with a small crew on coastal and offshore operations equipped for multi tasks such as lifesaving, towing, diving, firefighting and treatment of patients on board. The Vessel shall be safe, fit and suitable for the operational purposes for which it is intended, namely to be navigated and operated by the FSD anywhere within Hong Kong Waters, mainly for (a) fire / special services incidents in Eastern Hong Kong Waters; (b) fire/rescue/emergency operations in Marine Parks in Eastern Hong Kong Waters; and (c) maritime incidents in Yan Tian Port and Mirs Bay Port.

1.2.2 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 requirements of this Part VII 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 Vessels for the Government.

1.3.2 GNC may delegate the site 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 Navigational Equipment ("ENE") technical acceptance.

1.4 Shipyard

1.4.1 The Tenderer's shipyard must have the essential shipbuilding and workshop facilities such as lifting gears, aluminium 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 to carry out the design of the Vessel and also carry 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 not less than fifteen (15) years under reasonable maintenance.

1.5.2 It is the SOLE responsibility of the Contractor to supply Vessel which are safe, fit and suitable for the operation of the of the FSD as set out in Paragraph 1.2.1 above and which meet all the relevant regulations and the specifications in this Part VII, 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 The Vessel is required to be issued with a certificate of class (without conditions) with notation by the RO as specified in Schedule 9 of Part V. All plans, particulars and documentations which are required for the classification of the Vessel should be approved by the RO, in addition to those listed in Annex 3 to this Part shall be approved by the RO before submission to MD for endorsement and final approval prior to commencement of work. Any subsequent modifications or additions are to be treated in the same manner. Those drawings which are not required under ship classification approval shall be submitted to MD for approval before work is carried out.

1.5.4 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.

1.5.5 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 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 Chapter, an advance written notice of not less than five (5) working days (if the Vessel are located in Asia), and ten (10) working days (if the Vessel are 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;

(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 the 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. 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 of the Contract 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 MD during the construction of the Vessel. The weekly report shall be submitted before noon of every Monday.

1.6.6 MD 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. The Contractor shall cooperate with the consultant(s) and afford them unhindered access to the Vessel at all times during working hours, and shall furnish them with current copies of all approved drawings, sketches, correspondence, change notices, change orders, test agendas, schedules and other necessary documents where applicable.

1.6.7 After arriving at the site for a survey visit, if MD officers 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 officers and FSD officers during their survey visits and construction progress visits to the Vessel at the shipyard where the Vessel are 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 officers or FSD 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 officers and consultants can be carried out with a maximum of efficiency and a minimum of interference with the Contractor's work.

1.7 Official Sea Trial and Speed Requirements

1.7.1 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, ship handling at sea and performance tests, manoeuvring test, crash stop test, astern running test, emergency steering test, anchoring tests and other tests as stated in this paragraph. This programme must be submitted to MD in not less than 14 working days before the trials commence. The notification for Official Sea Trial shall be included evidence that the Vessel are safe to go to sea for the intended tests and trials specified in the Contract.

1.7.2 As in all other tests and trials to be conducted as part of the Technical Acceptance, the Contractor is required to 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). 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.

1.7.3 The Contractor shall provide to MD officers, 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 officers. The location of each person on board, which can affect the centre of gravity of the vessel under trial, will need to be first agreed by the GNC.

1.7.4 The Contractor shall provide a trial report to GNC after completion of the above tests. The report shall contain information regarding the method of test, engine(s) running condition, sea condition, weather condition and wind condition, vessel loading condition, 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 GNC appointed consultant during the tests; and such information shall be prepared in a format agreed by GNC.

1.7.5 Official Speed Trial

(a) The Official Speed Trial shall be carried out in Hong Kong Waters.

(b) As part of the Technical Acceptance as specified in Paragraph 1.8.1 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 each Vessel (i.e. NOT theoretical) shall be measured during the Official Speed Trial runs to determine if the Contract Speed can be achieved.

(d) The actual mean speed shall be calculated as the arithmetic mean of not less than FOUR continuous runs, i.e. TWO 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 poles or other measuring method acceptable to MD.

(e) The Contract Speed is considered not achieved if the Contract Speed cannot be attained during the Official Speed Trial after a total of FIVE runs in each direction.

(f) The Contract Speed to be achieved by each Vessel in the Official Speed Trial shall be the minimum highest achievable speed of 40 knots as specified in Paragraph 2.5.1 of this Part VII, with the engine power at declared maximum (rated) power and the Vessel

under Official Speed Trial Conditions as stated in Annex 5 to this Part. If the Vessel fails to achieve the minimum highest achievable speed under the aforesaid conditions, the Government will deem that the Vessel has failed to pass the Official Speed Trial and therefore Technical Acceptance.

(g) 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.

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.

(h) All Equipment shall also be in operation during the Official Sea Trial unless explicitly exempted by MD. This Equipment shall have passed the Technical Acceptance. The information including but not limited to the speed, time of the day, engine running conditions and sea condition shall be properly recorded by the Contractor, and signed as witnessed by the GNC surveyor (or the GNC representatives) during the Official Sea Trial and shall form part of the Official Sea Trial Report. A copy of the Official Sea Trial Report as required in Paragraph 1.7.6 below shall be given to GNC before Delivery Acceptance. 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.

1.7.6 The following tests, for each Vessel, 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:

(a) Endurance Test

The Endurance Test shall be carried out for different 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. 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) Manoeuvrability Test

Forward turning circle tests to port and starboard sides shall be carried out with

(i) both engines running, and
(ii) single engine running.

The minimum time for turning to both sides at 15°, 90°, 180°, 270° and 360° shall be recorded.

(c) 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.

(d) Astern Running Test / Emergency Steering Test

The maximum astern running speed achievable by the Vessel shall be determined by the test. Also an emergency steering test shall be carried out to ascertain satisfactory emergency steering operations shall be carried out.

(e) Starting Tests for Main Engines and Electric Generator Engines

(f) Anchoring Test

(g) Noise level measurement:

- The noise level in the Deckhouse shall not exceed 65 dB when the Vessel is operating.

- The noise level in the Accommodation Space shall not exceed 70 dB when the Vessel is operating.

1.8 Acceptance and Delivery

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

(a) Technical Acceptance

(b) Delivery Acceptance

1.8.2 Technical Acceptance

(a) This includes all the hull construction, mechanical and electrical tests and trials as required in this part and those considered necessary by the Government, including equipment tests, anchoring tests, inclining experiment and bottom survey on the slipway in Hong Kong, the Official Speed Trial as mentioned in Paragraph 1.7.5 of this Chapter shall be conducted in Hong Kong Waters, the Endurance Test, Manoeuvrability Test and Crash Stop Test as mentioned in the Paragraphs 1.7.6 (a), (b) and (c), the bench acceptance test and on-site commissioning test for ENE as mentioned in Chapter 8 of this Part and all other verification tests 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.

(b) All electronic items and their installations shall be approved and inspected by EMSD as part of the Technical Acceptance.

(c) The Contractor shall supply all necessary equipment and labour at its own cost for carrying out the tests and trials stated in Paragraph 1.8.2 (a) and (b) above.

(d) If the Vessel cannot pass all of the tests comprised in the Technical Acceptance by the Delivery Date specified in the Contract, the options available to the Government are set out in Clause 12 of the Conditions of Contract and other applicable provisions of the Contract.

1.8.3 Delivery Acceptance

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

(b) Certificate of class (without conditions) for the Vessel with notations as specified in Schedule 9 of Part V shall be issued by the relevant RO as specified in Schedule 9 of Part V before the Acceptance Certificate is 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 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 MD in good and complete condition.

(e) Not later than six weeks before the Delivery Acceptance of the Vessel, the Contractor is required to submit to GNC four 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 MD 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 MD in a satisfactory state. Details of

each inventory item shall include item name, description, type, quantity, manufacture'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 8.1 of Chapter 8, and all items set out in the Inventory List in the form as approved or stipulated by the Government shall be delivered to MD at the Delivery Acceptance of the Vessel. The Contractor must provide 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.

(h) 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 once the Director of Marine has issued the Acceptance Certificate.

1.9 Warranty Services During the Warranty Period

1.9.1 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 Acceptance Certificate of each Vessel, shall be delivered to MD upon Delivery Acceptance.

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

1.9.3 The Contractor is responsible for arranging the Vessel for Guarantee Slipping at the end of the 12-month Warranty Period. In addition to any defects which the Contractor may be required to fix under Clause 18 of the Part IV (Conditions of Contract), 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.

1.10 Support Services

1.10.1 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.

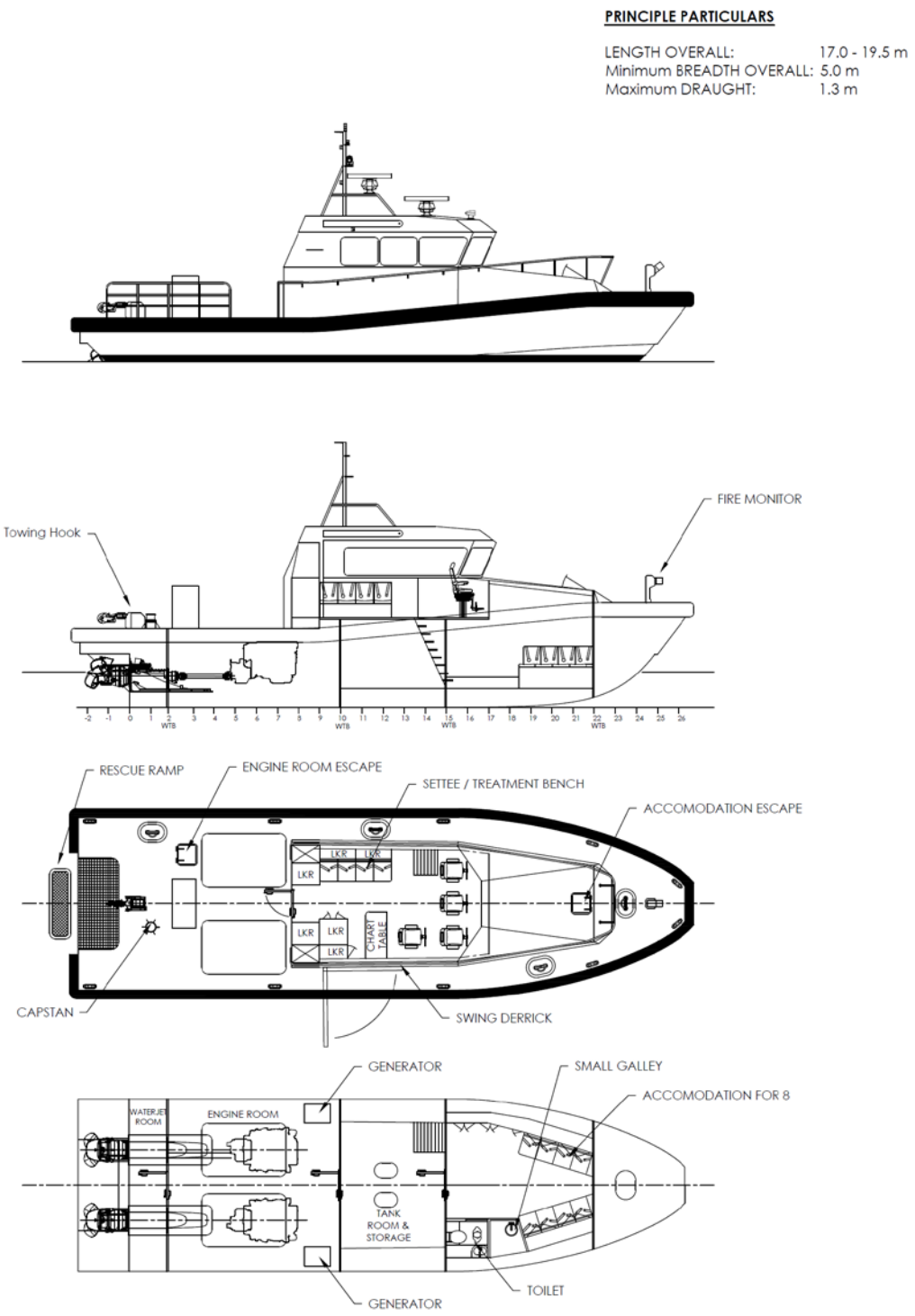
1.10.2 The above applies not only to main engines but also to all other equipment installed in the Vessel. Support and maintenance services must be available (i.e. serviceable) in Hong Kong in respect of all equipment installed in the Vessel and return of the whole or part of the Equipment to the original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

1.11 Asbestos Free

1.11.1 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



2.2 General Provisions

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

2.2.2 The work to be done under this Contract consists of the design, construction, outfit, testing and delivery of the vessel for the Fire Services Department (FSD). Workmanship, functions, characteristics and performance are to be in accordance with these TS, best marine construction practices, and the regulatory standards herein specified or otherwise applicable.

2.2.3 Whilst the Contractor is required to 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 only serves as guidance and is a reference drawing to help to explain the tender requirements.

2.2.4 During the design and construction of the Vessel, the Contractor is required to submit a detailed General Arrangement Plan (GA Plan) for GNC approval and acceptance.

2.2.5 ALL the machinery, equipment and facilities, furniture, fixtures 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.

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 an RO. The Tenderer shall state in Schedule 9 of Part V which RO and its rules and regulations and class notation shall be used in the design and construction of the Vessel. [E]

2.3.2 The Vessel is required to be issued with certificate of class (without conditions) with notation as in Schedule 9 of Part V by the relevant 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 shall be approved by the relevant 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 The Contractor shall design, build and supply the Vessel in full compliance with the requirements given in these TS 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 the TS, the final decision shall rest with GNC.

2.3.4 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 Vessels must comply with the requirements of the RO specified in Schedule 9 or the requirements of any of the RO listed below (where it is expressly specified in this Part VII in relation to a particular requirement, another RO which is any one of the ROs listed in sub-paragraphs (a) to (i) below may be designated for compliance with the relevant requirement), and also the requirements further specified in sub-paragraphs (j) to (m) below:

(a)	American Bureau of Shipping	ABS
(b)	Bureau Veritas	BV
(c)	China Classification Society	CCS
(d)	Det Norske Veritas Germanischer Lloyd	DNVGL
(e)	Korean Register of Shipping	KR
(f)	Lloyd's Register of Shipping	LR

(g) Nippon Kaiji Kyokai NK

(h) Registro Italiano Navale RINA

(i) Russian Maritime Register of Shipping RS

and other entities as specified below:

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

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

(l) 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.

(m) International Regulations for Preventing Collisions at Sea 1972, as amended by International Maritime Organisation (IMO) Resolution A464(XII) of the Inter-governmental Maritime Consultative Organization and Resolutions A.626(15), A.678(16), A.736(18), A.910(22), A.1004(25) and A.1085(28) of the International Maritime Organization, except Rules 39, 40 and 41.

(n) 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 Paragraphs 2.3.4 (a) to (e) above are applicable, then the applicable standards specified by any of the applicable organisations 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

In the event of any inconsistency amongst the above requirements, rules and standards, those mentioned in sub-paragraphs (j) to (m) shall prevail over the requirements of the relevant RO as listed in sub-paragraphs (a) to (i) above.

2.4 Vessel Operating Profile and Environment

Summary of Operational Profile

Description	Value
Maximum (contract) Speed	: 40 kts
Cruising Speed	: 30 kts
Number of hours/year at Maximum speed	: 150 hours
Number of hours/year at Cruising speed	: 850 hours
Number of days/year	: 340 days in service
Endurance:	: 10 hours at Cruising speed

2.4.1 The Vessel shall be able to operate safely within the Hong Kong Waters in weather conditions up to and including the conditions equivalent to Beaufort Wind Force 7. The Vessel shall be designed to be able to withstand conditions of up to Beaufort Wind Force 9 whilst operating at reduced speed whilst returning to port.

2.4.2 Total carrying capacity of the Vessel is sixteen persons including four crew to operate the Vessel. Four dampened seats with drop-down seat cushion shall be provided to all the crew position stated in Paragraph 4.4.1. [E]

2.4.3 The vessel shall have a bollard pull of not less than 6 tonnes.

2.4.4 The Vessel shall be designed to survive a roll over at inversion. See Section 3.3.8 for further details of required criteria.

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

Air	Value	Notes
External air	0 to +40 ºC	(0 - 85% humidity)
Internal air	20 ºC	(70% humidity)
Machinery space	45 ºC	(All equipment at full rated power)

Sea Water	Value	Notes
Maximum temperature	30 ºC	
Minimum temperature	0 ºC	

2.5 Contract Speed

2.5.1 The Contract Speed shall be not less than 40 knots when both of the propulsion engines running with the output power at 100% of Maximum Continuous Rating (MCR) under Official Speed Trial Conditions as stated in Annex 5 to this Part. [E]

2.5.2 The guaranteed speed prescribed above shall be achieved without porpoising, or other dynamic instabilities. The waterjets selected shall match the engine profile.

2.5.3 Two waterjet propulsion units shall be driven by two marine diesel engines, each unit shall be the same manufacturer, same model and deliver same horsepower. [E]

2.5.4 Power to speed estimation for the Contract Speed at its sea trial conditions shall be provided, together with a descriptive account of the philosophy and methodology employed for such speed estimation and evaluation. [E]

2.6 Principal Dimensions

Description	Value	
Length Overall (LOA)	: 17.0 – 19.5 metres (Fenders and waterjet included)	[E]
Breadth Overall	: not less than 5 metres (Fenders included)	[E]
Maximum Draught	: 1.3 metres	[E]

2.7 Material of the Structure

Description	Material	
Hull Structure	: Marine Grade Aluminium Alloy	[E]
Main Deck:	: Marine Grade Aluminium Alloy	[E]
Superstructure	: Marine Grade Aluminium Alloy or FRP composite	[E]

2.8 Markings and Colour Scheme

2.8.1 Markings and colour scheme for the Vessel shall be provided.

2.8.2 All labelling shall be both in Chinese and English and as per applicable rules and regulations. The FSD logo shall also be displayed on both sides of the deckhouse and at location as directed by MD.

2.8.3 The Vessel's name shall be made of cut off aluminium plate, welded to the hull and painted on both sides of the bow and the transom centre to MD and the Fire Service department's satisfaction. Draught marks shall also be marked at both sides of bow and stern in the same manner as the Vessel's name. The full load design draught mark shall be marked at port and starboard amidship. Vessel's identification shall be marked as large as possible at the deckhouse top for helicopter viewing.

2.8.4 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.

2.8.5 Exits shall be identified and labelled. Stowage locations for life jackets and quantities of life jackets contained therein shall be identified.

2.8.6 Safety markings for the prevention of person tripping in the Vessel shall be provided where necessary.

2.9 Tally Plates

2.9.1 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.

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

(a) Equipment in the console;
(b) Electrical and communication equipment;
(c) Air vents and filling pipes for the 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, source of power, fuse rating, voltage and warning and other information as required by MD.

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

2.9.4 List of tally plates shall be provided as directed by MD.

2.10 Other Design Features

2.10.1 Permanent list is not allowed.

2.10.2 The Vessel shall be free of unacceptable structural vibrations.

Chapter 3 - Hull and Deckhouse

3.1 Hull and Deckhouse

3.1.1 The Vessel shall be designed and built with mono-hull form, Inherent Self-Righting capability and is subjected to self-righting test before delivery, for which shall comply with the requirements set out in Paragraph 3.2.7 (Ventilation Openings) and Paragraph 3.3.8 (Self Righting Stability Criteria). [E]

3.1.2 The design stress and load (wave height versus speed); maximum acceleration considered and scantlings calculation including the internal structural members shall be approved by an RO. All materials and build processes for aluminium construction shall comply with an approved standard. Their selection shall recognise the craft through life cycle and service conditions for ease of repair in the event of hull damage.

3.1.3 The hull structure design loads shall be in accordance with the Vessel operational profile and other applicable requirements. Hull construction materials shall be new and of a type which has been certified by an RO or other entities acceptable to GNC for shipbuilding purposes.

3.1.4 The hull and deckhouse structure shall be designed for expected loading, both static and dynamic, encountered in a roll-over scenario.

3.1.5 The Contractor shall carry out quality control throughout the construction of the Vessel by their quality control personnel.

3.1.6 The records of the structural materials used for vessel construction and up-to-date copies shall be provided to GNC before and/or during the construction stage of the Vessel.

3.1.7 Strength shall be maintained by ensuring hull structural continuity of main members including bottom and deck girders and transverse web frames. Where the strength of a main structural member is impaired by cuts or interruptions in continuity, efficient means of compensation shall be fitted. Special care shall be given to reinforcing the hull in way of the fenders and areas likely to experience slamming.

3.1.8 Major penetrations or access openings through the transverse hull bulkheads below the main weather deck level shall be avoided as far as possible. Cable penetrations shall be located as high and as far inboard as possible. Any and all penetrations through bulkheads below the main deck shall be fitted with RO approved devices and be so arranged to ensure the bulkhead to be entirely watertight and strength maintained.

3.1.9 The watertight deckhouse located above the main deck shall, at the outside boundaries, have means of closing the openings, and such means shall be of sufficient strength and be of a design to maintain the watertight integrity in all operational conditions.

3.1.10 Close attention shall be paid to the fabrication and installation of machinery foundations to insure rigidity of the foundations and their structural continuity with adjacent structure.

3.1.11 The keel structure shall be arranged to accommodate Vessel's dry docking and lifting requirements in the Government Dockyard in Hong Kong.

3.1.12 Welding and Fabrication

(a) All welding and fabrication shall be implemented according to the rules of an RO or American Welding Society (AWS) or other international standards acceptable by GNC. Welding scheme shall be approved by the RO before work is carried out.

(b) Welded joints shall be carefully designed and constructed to conform to the latest established standards to prevent fatigue failure. Cutting for edge preparation shall be performed by qualified person to achieve correct angle, shape and smooth finish of the edges. Only qualified welders shall perform the welding work.

(c) Certification of the qualifications of each individual welder and inspector shall be submitted to GNC by the Contractor. Welds installed using unqualified procedures or welding performed by non-certified welders shall be subject to removal by the Contractor at his own expense.

(d) The structural fabrication shall include but not be limited to the following:

(i) Inventory of incoming material, consumables components and machinery;

(ii) Traceability procedures for materials together with traceability identification codes which shall be serial and indexed to the controlled manufacturing procedures;

(iii) Lofting, cutting, fit up, welding, forming and dimensions of structural components, measures shall be taken to avoid deformation of structure during fabrication and welding;

(iv) Welding and inspection procedures identifying clearly the type and extent of Non-Destructive Test (NDT) inspection carried out on the Vessel structure, normally not more than 10% of Ultrasonic Test (UT) and Radioactive Test (RT) is required, GNC may extend the NDT deemed to be necessary subject to the quality of the welding, the Contractor shall submit a NDT inspection plan for GNC approval. NDT shall be carried out by an agent approved by the national authority or RO and the agent shall submit an inspection report to GNC via the Contractor on their findings;

(v) Welding, machining, measuring and inspection equipment maintenance and calibration;

(vi) Machining, finish surfaces, bolting;

(vii) Procedures for non-conformance reporting and rectification of defects;

(viii) Design and manufacturing drawing control and procedures for revisions, updates and reissue of drawings.

3.2 Hull and Deckhouse Structural Requirements

3.2.1 Hull Structure Construction

General Workmanship

(a) Trunks, coamings, and openings where applicable shall have radius corners as large as possible.

(b) Fittings and openings through decks and bulkheads for pipes and cables shall be properly designed to maintain watertight integrity, reduce transmission of heat, and to minimise transfer of machinery vibration and noise to the hull structure.

(c) 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.

(d) Sharp corners shall be avoided.

(e) The superstructure is resiliently fitted for lowest noise level in the wheelhouse and is designed for good 360° visibility.

(f) Due to the high probability of the vessel operating in shallow waters and close to beaches then the stem and bow areas are to be suitably reinforced in case of a grounding situation.

3.2.2 Tightness

(a) Water-tightness test for any exterior fittings in the deckhouse, including the water-tight doors and windows, shall be demonstrated by directing a water stream from a 20mm diameter nozzle at all parts of the exterior including all window, doors and hatches. The nozzle shall be 1.0 metre or less from the fitting being tested, and the water pressure at the nozzle shall be at least 4 bar.

(b) In case there is leakage after the above test is conducted, acceptance of water-tightness test can be conducted in form of structural testing under the conditions in accordance with RO requirements.

(c) Water-tightness test for watertight boundaries and tanks shall be conducted in form of structural testing under the conditions in accordance with RO requirements.

(d) Chalk test shall only be carried out upon the acceptance of GNC or RO if the methods stated above are not applicable.

(e) All structures, fittings and tanks shall withstand the tests described above and any corrective measures to rectify any failure of the tightness acceptance test shall be made good by, and at the expense of, the Contractor.

(f) The vessel watertight integrity is considered paramount for the self-righting capability of Vessel.

3.2.3 Fairness

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 of surfaces which are to be joined.

3.2.4 Decks, Platforms, Flats and Stiffness

(a) All decks, platforms and walking flats shall be sufficiently reinforced to prevent deflection that might be caused by an individual walking or standing on the deck and/or by structural flexure 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, including the expected dynamic hydrostatic loads encountered in a roll over scenario.

(b) The main deck shall be fitted with water-tight hatches for removal of main engines and electric generator(s).

(c) The deck area shall have a camber at 1/50 of half the beam of the deck edge and slope up towards the bow at forward part.

(d) Adequately secured grating shall be provided as required and to GNC's satisfaction. Removable grating shall be provided where required for access to valves, equipment, bilge pickups, and to other systems below.

(e) The superstructure is a self-supporting box design with transverse flat bar stiffeners, transverse web frames and longitudinal girders. The superstructure is elastically mounted to the hull.

(f) Hull above waterline and superstructure: noise damping compound to reduce structure borne noise.

3.2.5 Through-Hull Fittings

(a) Through-hull fittings shall be located in convenient locations for maintenance purposes, as required for equipment listed in this specification. The number of through-hull fittings shall be kept to a minimum.

(b) If required; all through-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.

(c) The hull external shell surface below the waterline where through-hull fittings are located shall be fitted with external fairings/screens to minimise drag.

(d) The hull is designed with longitudinal flat bar stiffeners and transverse web frames and watertight bulkheads giving watertight compartments.

3.2.6 Hull Structural Closures

(a) Inspection hatches shall be provided on each fuel oil tank. The 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.

(b) Access to hull compartments from the main deck shall be provided by flush watertight deck hatches where required.

(c) Flush deck hatches fitted with a gasket shall be provided for engines and equipment removal or maintenance purposes. Soft patches shall be secured properly to GNC's satisfaction.

(d) Flush access to fore peak from main deck shall be provided.

(e) Watertight doors from the accommodation into the Tank Room, from the Tank room to the Engine Room shall be provided.

(f) One deck hatch shall provide access from the main deck to the Engine Room.

(g) Hinged hatch covers shall be provided with means to hold them in the fully opened position.

3.2.7 Ventilation Openings

All ventilation openings, including engine compartment ventilation, other compartments ventilation, fuel oil tank, fresh water tank and exhaust openings, shall be:

(a) Located such that they are not less than 0.2m above the waterline at every angle of heel in any loading conditions or;

(b) Ducted in such a way that they are not less than 0.1m above the waterline at every angle of heel in any loading conditions or;

(c) Equipped with an automatic closing device that does not rely on electronic, manual or any other active control to close and subsequently open.

Each opening, for the sake of water-tight integrity for self-righting purpose, shall be designed to prevent any water ingress before its corresponding down-flooding angle is submerged.

3.2.8 Deckhouse Closures

(a) Watertight door(s) giving access to the deckhouse shall have a coaming as per RO's regulation above the finished main deck surface and a minimum size of 750mm x 2000 mm clear opening. Each door shall have appropriate locking devices.

(b) All access doors and hatches are to be designed for the expected dynamic hydrostatic loads experienced in a roll over scenario. These should be from a proprietary manufacturer with documented loading calculations and water pressure testing evidence.

(c) All doors in the deckhouse shall have clear toughened safety glass windows.

3.2.9 Hull Preservatives and Coverings

(a) Freeboard Area

(i) Exterior surfaces of the Vessel above the boot top (boot topping being the part of the outside shell of the Vessel between the light and loaded draught, that is, that part of the hull which is exposed alternately to wind and water) shall painted and prepared to a satin finish/appearance/texture.

(ii) Wherever paint is used, the Contractor shall propose a suitable paint specification in conjunction with a preferred paint manufacturer for GNC's approval.

(iii) Antifouling paint shall be applied by the Contractor to the paint manufacturer and GNC's satisfaction.

(iv) All coatings shall be applied as specified by the paint manufacturer including temperature and humidity at time of application, coverage/rate, wet and dry film thickness, recoat time and application equipment and rate.

(b) Hull Preservation

(i) The Vessel shall be painted externally with a paint process which can be guaranteed for a minimum of two years' service life by the paint manufacturer. Paint shall be used on all surfaces.

(ii) Painting Schedule shall be proposed by the Contractor in consultation with the paint suppliers/manufacturers and submitted for GNC's agreement and approval.

(iii) All materials used for painting of the Vessel internally and externally shall be agreed by GNC and shall not have adverse effects to the environment and the health of persons on board.

(iv) Painting report for the complete Vessel prepared by the paint manufacturer shall be submitted to GNC.

3.2.10 The items listed below (but not limited to for the purpose) are required to be recorded for the proper supervision of Vessel's construction process:

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

(b) Traceability procedures to be used for the materials, and their traceable identification codes (which shall be serial and indexed to a controlled manufacturing procedures) to be recorded;

(c) Moulding, lofting, cutting, fitting, welding, forming and dimensions control of all the major structural components for fabrication to be recorded;

(d) For relevant vessel structures and components that requires welding; the welding inspection procedures for identifying the type and extent of Non-Destructive Test (NDT) inspections shall be produced and submitted to MD (normally not less than 10% of Ultrasonic Test (UT) and Radioactive Test (RT)). MD may extend the NDT where necessary subject to whether MD is satisfied with the quality of the welding.

(e) Welding and inspection qualification and certification of each personnel;

(f) Records of machining, finishing surfaces, and bolting; and

(g) Procedures for work quality non-conformance reporting and records of rectification of defects.

3.2.11 Construction of deckhouse and hull, including windows, hatches, doors and openings shall be designed to withstand a 360 degree roll and effectively resist ingress of water when submerged during capsize. Design pressures used in scantling calculations for superstructures, doors, hatches and windows shall be at least equivalent to maximum static water pressure encountered during a 360 degree roll.

3.2.12 Deck and deck house shall not create wells that retain large quantities of water during normal operation or in the event of a capsize and recovery. Bulwarks around the aft deck are to be avoided. Foredeck bulwarks shall have freeing capacity exceeding class requirements.

3.3 Stability and Subdivision

3.3.1 The Preliminary Lines Plan and the preliminary stability information, including damaged stability for each compartment and taking into account of wind force effect, of the Vessel shall be submitted with the tender. All calculations and drawings must be in metric units. The calculations shall be carried out by using a proven computer system, with evidence (viz. recognised by a government authority or an RO). [E]

3.3.2 The Vessel is required to comply with the intact and damaged stability requirements stated in this Part.

3.3.3 Inclining Experiment:

(a) An inclining experiment shall be carried out according to the guidance of Annex I of IMO Resolution MSC.267(85)-2008 Intact Stability Code as amended in conducting such an inclining experiment, to determine the lightship weight and the position of the centre of gravity of Vessel.

(b) Before conducting the inclining experiment, the "Scheme of Inclining Experiment" shall be approved by the RO and submit to MD for reference. The Scheme shall include:

(i) the Vessel's intended loading condition during the inclining experiment;
(ii) the proposed locations and movements of the inclining weights;
(iii) the calculation of the estimated heel of the Vessel before and during the inclining experiment;
(iv) the proposed number, location and lengths of pendulums used; or other methods of measuring heel angles; and
(v) the list of data to be measured (i.e. draughts, specific gravity of floating water, etc.).

(c) The lightship weight and centres of gravity shall be calculated and presented in the Inclining Experiment Report. The GM of the Vessel after each and every shift of inclining weight shall be preliminarily determined. Free surface effects of all liquids on board shall be taken into account in all calculations.

(d) The inclining experiment shall be witnessed and conducted to the satisfaction of MD and RO.

(e) The Inclining Experiment Report shall be produced and has obtained the RO's approval before submitting to MD for further comments. The report 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. The Vessel must not carry any operational limitations with respect to its stability capability within the operational requirements stipulated in the TS. No Official Speed Trials shall be conducted until MD, based on the information given in the Inclining Experiment Report, agrees it is safe to carry out such tests and trials.

3.3.4 Stability Information Booklet

(a) The Vessel shall comply with the stability criteria mentioned in this Part or other applicable IMO regulations (International Code on Intact Stability, 2008 - 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:

(i) vessel particulars, sketch of general arrangement drawing showing different compartments and tank positions, hydrostatic curves, and cross curves;

(ii) tank calibration/sounding tables, fuel oil tank, fresh water tank, etc. These tables shall consist of the locations of tanks (in terms of frame numbers), levels from tank bottom, capacity, VCG/LCG/TCG and 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;

(iii) stability calculations for each loading condition which shall include a profile drawing of the Vessel and items of deadweight, lightship, displacement, drafts, trim, VCG, GM(solid & fluid), LCG, down-flooding angle, maximum static stability - GC curves, etc.;

(iv) any other information as reasonably required by the RO and/or GNC; and

(v) the Inclining Experiment Report approved by the RO.

3.3.5 In the preliminary Stability Information Booklet and in the final stability calculations, the estimated and the final (obtained after conducting an inclining experiment) lightship data shall be used respectively. Both the preliminary and final Stability Information Booklet shall include the following loading conditions (and any other conditions as may be required by MD during the construction of the Vessel) and their stability results shall be presented as per the IMO Code on Intact Stability.

	Loading Conditions	**Fuel Oil (%)**	**Freshwater (%)**	**No of Crew**
1	Full Load Departure	98	100	16
2	Full Load Arrival	20	20	16
3	Light Load Departure	98	100	4
4	Light Load Arrival	20	20	4

(a) The maximum free surface moments shall be used for calculating the stability of the Vessel in all the above conditions.

(b) The weight of each person is assumed to be 75 kg with effects of 10 kg.

(c) The VCG of each person shall be assumed as 1,000 mm above the deck they are likely situated. LCG of each person shall be in their most likely position on board.

(d) The wind moments in various loading conditions due to Beaufort Wind Force Scale 9 shall also be considered in the stability calculations.

(e) The Stability Information Booklet shall be approved by the RO before submitting to MD for comments. The Contractor shall supply to MD four copies of Stability Information Booklet (as built), which must be given to MD at Delivery Acceptance.

3.3.6 Intact Stability Criteria

Stability and freeboard will be considered satisfactory if the following criteria are complied with, after taking into account of free surface effects and wind speed at Beaufort Wind Force Scale 9, for loaded conditions as specified above.

(a) The maximum righting lever (GZ) occurs at an angle of heel of not less than 25 degrees;

(b) The GZ shall be at least 200 mm an angle of heel equal to or greater than 30 degrees;

(c) The area under the GZ curve shall not be less than:

(i) 0.055 metre-radian up to an angle of heel of 30 degrees;

(ii) 0.090 metre-radian up to an angle of heel of 40 degrees or the angle at which the lower edges of any openings in the hull, deck, deckhouses, being openings which cannot be closed watertight, are immersed if that angle be less;

(iii) 0.030 metre-radian between 30 and 40 degrees or such lesser heeling angles referred to in (2) above;

(d) The initial transverse metacentric height shall not be less than 0.15 metre.

3.3.7 Damage Stability Criteria

Transverse bulkheads shall be arranged to maintain the stability of the Vessel when flooding of any one under-deck compartment occurs. The residual stability of the Vessel, after taking into account of free surface effects and wind speed at Beaufort Wind Force Scale 9, shall comply with Section 2, Criteria for residual stability after damage of Annex 8 of High Speed Craft Code in all loading conditions as stipulated in paragraph 3.3.5.

3.3.8 Self-Righting Stability Criteria

The Vessel shall be designed to comply with the following self-righting stability criteria:
The stability calculation shall show positive righting arm under curve (GZ curve) from 0 - 180° under all the loading conditions specified in Paragraph 3.3.5. Each GZ curve shall be considered satisfactory only if it shows the following characteristics:

(a) If required due to asymmetry, then GZ curves of both port and starboard rotation are to be presented.

(b) The GZ curve shall also comply with the intact stability criteria as stipulated in paragraphs 3.3.5 and 3.3.6 with no wind heeling lever applied.

3.3.9 Self-Righting Operational Requirements

The Vessel shall be designed to comply with the following Roll Over Operational Requirements:

(a) The Vessel shall be able to survive an inversion/roll over to 180°, including a roll over where the Vessel rolls through 360°.

(b) The self-righting system of the Vessel must be integral within the design and structure of the Vessel and shall not use either additional buoyancy bags or movable ballast to provide the righting moment whilst inverted.

(c) The Vessel shall be able to safely return to a safe haven/port after such event as a minimum, using the Vessel's own propulsion and steering systems.

(d) All systems and equipment (mechanical and electronic) shall be designed and installed such that the above criteria are fulfilled. The following must be fully operational after an inversion and the contractor shall provide a report on the expected state of all systems on the vessel after an inversion, including the time to restart any systems which are shut down during an inversion:-

(i) Main Propulsion Engines;

(ii) Gearboxes;

(iii) Waterjets;
(iv) Windscreen wipers;
(v) VHF radio;
(vi) GPS system;
(vii) AIS system;
(viii) All safety equipment aboard the Vessel; and
(ix) All the mechanical and electrical systems which are required to allow the above to operate fully.

(e) The Contractor shall provide previous experience in the design of self-righting vessels, the stability and self-righting criteria used in the design and supply details of the closing systems and mechanisms for all openings and vents which may be submerged in the event of an inversion.

(f) All ventilation openings are required for the Vessel to operate according to Paragraph 3.2.7.

(g) In case the ventilation openings are shown to show limited leakage during an inversion, they shall be positioned such that this does not cause damage to any machinery or equipment and will not impair the Vessel's stability after an inversion.

(h) The contractor shall make all possible efforts to ensure that damage to any other systems or equipment on the vessel is minimised and shall provide a report on the possible damage expected to other systems as a consequence of an inversion.

3.3.10 Roll Over Test Requirements

Tenderer shall submit a list of Procedure and Safety Precaution for Roll Over test, which shall include the following, to RO and GNC at least 14 working days in advance of the Roll Over Test:

(a) The means of recording the test;
(b) The proposed location of the test,;
(c) The pulling arrangement in details, which shall include all equipment and methodology involved in the test;
(d) The stowage of all portable items and equipment inside the vessel;
(e) All the closing of all water-tight/ weather-tight appliances;
(f) All means of closing appliance to prevent water ingress into the hull, and the method to drain out the water in each appliance, if any;
(g) Checking the ingress of water after the test;
(h) Checking the damage of hull and outfit, if any, after the test;
(i) Checking the functionality of all equipment powered by main engines, generators and DC power supply after the test;
(j) Safety Precaution when the Roll Over test is undertaken; and
(k) The uninstalled items which are prone to be damaged after Roll Over test.

The Roll Over Test shall be conducted under loading condition 3 or 4 as stipulated in Paragraph 3.3.5, whichever is the worse condition of self-righting stability as calculated and stipulated in Paragraph 3.3.8. Normal vessel operation shall be resumed after the Roll Over Test is conducted. Like all other tests and trials to be conducted as part of the Technical Acceptance, the Contractor is required to carry out the roll over test at its own expense (including the expense of fuel, lubrication oil, crew and other necessary expenses), in the presence of MD and FSD officers (see Section 1.6.9 for expenses for Government Staff).

Chapter 4 - General Arrangement

4.1 Compartmentation and General Arrangement

4.1.1 Arrangement on Main Deck and Underdeck

(a) The Guidance General Arrangement Plan (GA Plan) in Section 2.1 to this Part only shows a desirable layout of the accommodation and compartment arrangement of the Vessel.

(b) The Tenderer shall submit the General Arrangement Plan for Government considerations at the tendering stage. During the design and construction of the Vessel, the Contractor is required to submit a detailed General Arrangement Plan for MD approval and acceptance. The General Arrangement Plan to be submitted shall incorporate all Design Refinements and Elaborations.

(c) The Tenderer should note that the Guidance General Arrangement Plan given in Section 2.1 to the TS only serves as a guidance and is a reference drawing to help to explain the tender requirements.

(d) Nevertheless it is a contractual requirement that all the furniture, equipment and facilities, fixtures 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.

(e) The above mentioned guidance GA Plan shows the:

(i) Main deck superstructure, incorporating the Wheelhouse and

(ii) The hull, subdivided into 5 watertight compartments, namely: Forepeak space; Accommodation Space; Tank Room; Engine Room; and Waterjet Room.

4.2 General Provisions

4.2.1 Furniture, Hardware and Equipment

(a) All controls, electrical equipment, high-temperature parts and pipelines, rotating assemblies or any other items in cabins and compartments shall be properly placed not to cause injury.

(b) Equipment on board shall be fitted properly to avoid injury to persons at all times either during normal or failure-mode operation, especially when the Vessel moves off quickly or during emergency crash stops, vessel inversion and during ship manoeuvres.

(c) Built-in furniture shall be adequately secured against ship impacts in case of roll over, ship collision or bad weather and sea conditions. All furniture shall be strongly secured against 180 degrees of inclination in all directions when all seats are occupied by seated persons. All furniture and seats shall be lightweight, tough and robust. Upholstery such as seat cushion, back rests and settees shall be fire self-extinguishing, e.g. urethane foam to BS 3379 or equivalent, and be of thickness not less than 100 mm.

(d) All hardware including screws, hooks, hasps, hinges, handles, sliding bolts, etc. shall be made of brass with chrome plated finish, or in stainless steel.

(e) All fittings and hardware fitted on board the Vessel (such as coat hooks, ceiling lights, bulkhead mounted lights, and etc.) shall be of a high quality chrome finish. They shall be properly fitted in the accommodation spaces and any other spaces as appropriate and as directed by GNC officers.

(f) Colour and decoration schemes (or a furnishing sample board showing materials and colour to be used) for furniture and fittings shall be submitted to MD for approval before installation/fitting.

4.2.2 Insulation and Lining

(a) Insulation:

(i) Boundaries and ceilings around the inside of the deckhouse shall be insulated against heat and change of weather temperature, to be fitted with glass-fibre wool of appropriate thickness or equal; and be lined with protective/decorative panel linings of hard wearing surface.

(ii) Engine room bulkheads and deckhead shall be effectively fire and sound insulated with asbestos-free materials of adequate thickness, pinned and wire-mesh secured, and lined with incombustible sheathing in accordance with RO Requirements and acceptable to GNC officers.

(iii) The Contractor shall make all reasonable efforts to minimise noise and vibration in the Vessel.

(b) Lining:

(a) Panels for walls, ceilings and their joint materials shall be readily removable and shall be submitted for MD approval before installation. The joining method shall provide long-lasting firm and strong attachments between the adjoining members and parts against excessive vibration, and withstand temperature changes and wear and tear within the life expectancy of the Vessel. The panels shall be fitted to avoid noise generation due to its own vibration or in resonance response to the overall vibratory mode of the Vessel. This requirement applies to all operational speeds of the Vessel. Colour of the lining material shall also be agreed by MD.

4.2.3 Access, Doors, Ladders and Hatches

(a) Design of all outfitting including, but not limited to, doors, hatches, ladders, ventilation heads, etc. shall be of a Type Approved by an RO for this type of vessel, or other entities acceptable to MD. These shall require MD acceptance and approval before installation.

(b) Detailed specifications of these items shall be provided. They shall include the structural arrangement, scantlings, material and welding procedures. These shall be in accordance with RO Requirements or other international standards acceptable to MD.

(c) The coaming heights of access hatches shall be a minimum of 300 mm. Where the use of a hatch is not practical, a flush RO approved type watertight manhole shall be used. However, the relevant design and arrangement shall be submitted to MD for approval.

(d) Where the hatches and doors are used for the purpose of escape, they shall be operable from both sides. All hatches and doors shall be fitted with a hold back device. Watertight hatches for access to the watertight compartments below the main deck level shall be type approved by RO and positioned to RO and MD's satisfaction.

(a) Watertight and weather-tight deck hatches should be of hinged type as far as practical. [D]

(e) Doors in deckhouse shall be fitted with manual means of locking; and shall be able to be quick opened from both inside and outside of compartment. The door to aft deck to be outwardly opening water-tight type and shall be fitted with hooks or other means to hold them in the fully open position if required. Three sets of keys shall be provided for doors.

(f) Vertical ladders, if provided, shall be constructed with non-slip purpose with suitable step space intervals, adequate footsteps and handholds for safe access to the compartments and locations of equipment etc.

(g) The engine room and all internal cabin spaces shall be provided with two means of access/escape.

4.2.4 Ventilation

(a) The requirements for ventilators and the ventilation system shall comply with RO Requirements, Paragraph 3.2.7 and be acceptable to GNC officers.

(b) Air pipes shall be fitted to all tanks, void spaces, and all spaces and compartments which are not fitted with other types of ventilation arrangement.

(c) The lower edge of openings in all exterior air pipes and trunks shall be at least 650 mm above the Main Deck.

(d) All ventilators shall be provided with weather-tight covers.

4.3 Deckhouse

4.3.1 The outside configuration of the deckhouse shall be of a design that reduces air resistance, to deflect rain and seawater during heavy weather; and to provide practically all-round visibility at the steering/helm position of the console area. The deckhouse shall be designed and arranged so as to protect the occupants from weather and sea conditions, and aim to minimise risk of injury. Natural light shall be allowed in the deckhouse.

4.3.2 Deckhouse shall be protected from gas or vapour fumes from machinery, engine exhaust gas and smells from the fuel system.

4.3.3 The deckhouse shall be designed with a steering control station for two-man operation comprising controls and instruments for navigation, manoeuvring, communication and machinery operation. Deckhouse includes console, space and seating.

4.3.4 Contractor shall build a mock-up of the deckhouse including the equipment arrangement, seats and other fittings as required under these TS. The mock up should be inspected and agreed by the MD officers.

4.3.5 The Deckhouse control station shall be situated in a forward position in the Deckhouse. Controls for the steering 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.

4.3.6 The equipment and means for navigation, manoeuvring, 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 be able to use the equipment and controls while they are seated.

4.3.7 Instruments, instrument panels and controls shall be permanently mounted in the consoles, taking into account operational, maintenance and environmental needs.

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

4.3.9 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.

4.3.10 The instrument panels for the emergency controls and the monitoring of the fire-fighting systems shall be in a separate position, and shall be in clearly defined locations agreed by GNC officers.

4.3.11 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.

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

4.3.13 The following controls, displays and equipment are required to be incorporated into the Wheelhouse control station so that all relevant controls can be reached from a fixed working position (e.g. sitting, standing or both):

(a) Main engine and generator;

(b) Electronic and navigation equipment;

(c) Fire detection; and

(d) Communication.

4.3.14 Visibility

(a) The visibility from the deckhouse shall not be obstructed. Windows shall allow for 360 degree vision as far as practical and to GNC's satisfaction.

(b) Side mirrors shall be provided at locations to allow the coxswain to safely manoeuvre the craft to a berth and have a clear rear view during operation.

(c) Vision blind spots or sectors shall be as few and small as possible, and in any case they must not adversely affect the keeping of a safe look-out from the helm position in the Wheelhouse.

(d) All equipment fitted in the vicinity of the control console should not obstruct the view of the coxswain and the commander. [D]

4.3.15 Windows

(a) All windows fitted to the vessel shall be capable of withstanding the expected dynamic hydrostatic loads encountered due to a roll over at their fitted locations.

(b) Frames at the front 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 workstation.

(c) All steering position windows to be provided with sunscreens of the readily adjustable type. Forward facing windows shall be inclined forward and provide visibility free of any glare under all operating condition. The deckhouse 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°.

(d) Throughout the Vessel polarised and tinted windows shall not be fitted. All windows shall be manufactured from clear toughened safety glass and secured to the structure and of a type suitable and safe for marine use. A basic layout of the windows is shown in the conceptual general arrangement. Details of all windows shall be submitted to MD for approval and window glass thickness shall be verified in accordance with the submitted information before installation. Water tightness test shall be carried out after windows installation.

(e) At all times, regardless of the weather conditions, all deckhouse front windows shall provide a clear view without obstruction.

(f) The height of the lower edge of the deckhouse front windows shall be, where practical, kept as low as possible for a better view forward. Care should be given to ensure the lower edge will not present an obstruction to the forward view.

(g) The following items/requirements shall be provided:

(i) Marine type wide span and large area wipers (covering not less than 60% of the window glass plane area) with DC electrically operated fresh water window washing systems shall be fitted for all the deckhouse front windows as well as the forward section of the port and starboard side windows. Heavy-duty marine type wipers shall be provided. They shall have an interval operating function with electrical fresh water window/wiper washing systems. These wipers shall be capable of operating independently of each other.

(ii) The windows noted above shall also be fitted with internal blower demister units, to allow the quick removal of condensation. These shall be controlled from the deckhouse control station.

(iii) Two (2) sets of spare wiper blades shall be provided for each window wiper installed for the Vessel.

(iv) Retractable transparent solar blind (American Standard Window Film ASWF, Sunny-Kool or equivalent) shall be installed inside of all deckhouse front windows.

(v) Retractable 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.

4.3.16 Lighting

(a) Adequate lighting intensity and lighting arrangement, as well as any necessary lighting segregation by means of blinds or through the use of other means, shall be provided inside the deckhouse space to enable the operating personnel to perform their task at all times and places. Only limited (and suitably reduced) illumination of the essential gauges, instruments and controls for monitoring likely system fault situations is allowed.

(b) Care shall be taken to avoid large shadows as well as glare and stray image reflections in the operating area environment. High contrast in brightness between work area and surroundings shall be avoided. Non-reflective or matt surfaces shall be used to reduce indirect glare to a minimum.

(c) A suitable degree of flexibility within the lighting system shall be available to enable the operating personnel to adjust lighting intensity and direction in different areas of the compartment, and such arrangements shall also be available for individual instruments and controls.

4.3.17 The following fittings and equipment shall be provided in the deckhouse:

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

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

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

(d) One shelves for the stowage of log books and files;

(e) One marine chart table with lamp and dimmer over, with 4 drawers below for storing of nautical charts;

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

(g) One electric powered marine wall-mounted clock;

(h) Cup holders for coxswain and the commander;

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

(j) Coat-hooks where required; and

(k) A number of storage lockers.

4.3.18 Surface finishing and interior linings of the deckhouse should be of a matt non-reflecting finish to facilitate night operation. [D]

4.3.19 Pillars shall not be fitted inside the deckhouse.

4.3.20 All interior decks of the deckhouse, accommodation space and tank room shall be covered with non-skid, wear resistant and fire retardant vinyl PVC sheets that are acceptable to GNC officers. Colour of the floor covering shall be agreed by MD.

4.4 Seating and Attachment System

4.4.1 Four (4) shock absorption (low frequency and heavy duty dampers) seats with a turntable (0° to 180°), adjustable seat height, fore and aft adjustment (160 mm), adjustable back rest, foot step and inertia reel four-point seat belt (suitable to hold the user safely when inverted) shall be provided. Three (3) shall be fitted aft of the main console for the coxswains and the commander and one (1) in the wheelhouse in a suitable location for FSD crew.

4.4.2 Four (4) other seating locations (combined to form a settee/treatment bench arrangement) with four point retractable safety belts shall be provided for 4 crew/persons within the wheelhouse.

4.4.3 The seats shall be designed to protect the operator from injury and optimise the body posture to mitigate the potentially harmful forces that occur during the Vessel operations, such as mechanical suspension with two double acting hydraulic damper.

4.4.4 Seating and arm rests shall provide with support for spinal neutral alignment and postural stability for each person up to the crew limit and also to prevent them from falling out of the seat in case of a roll over or being thrown on deck (such as inertia reel four-point seat belt).

4.4.5 Basic Requirements of the Seats:

(a) Material of the Structure: Steel and/or marine grade Aluminium Alloy.

(b) Materials of Upholstery: Seat cushions, back rests and settees shall be reinforced nylon laminated neoprene/PVC.

(c) Tension Thrust: Seats with the safety belts should be able to withstand no less than 2,250 newtons. [D]

(d) Seats with the safety belts shall be classification society approval type. Relevant certificates shall be submitted to GNC.

4.4.6 Two further settees, with capacity of 8 crew/persons should be provided within the accommodation space. These settees must be fitted with four point retractable safety belts.

4.4.7 The space under any settee should provide storage. This storage must be capable of safely holding its contents in the case of a roll over scenario.

4.4.8 All equipment, machinery, outfitting, interior linings and panels, flooring, upholstery or other items shall be fixed in such a way that they remain in place during roll over. Doors and hatches to storage spaces shall be provided with locks to keep loose items inside the storage compartment.

4.5 Consoles

4.5.1 The layout of control console shall be submitted for MD approval before the completion date stipulated in Annex 5 to this Part.

4.5.2 Console

(a) The coxswain controls and displays shall easily be reached by a normal Asian stature in his/her fixed position standing without needing to extend arms and field of view of coxswain.

(b) The controls or displays of following equipment shall be installed in the Console and located in front of coxswain and commander in natural positions, with the highest priority devices being located in prime positions. Controls shall ideally be positioned between elbow and shoulder height. Instrument panels and display screens shall be ergonomically positioned for operator comfort without any impediment to his visibility.

(i) Steering control wheel shall be provided with non-slip steering wheel;

(ii) Propulsion engines throttle control head shall be provided on the right hand side of the steering wheel;

(iii) Engine monitoring panel;

(iv) Propulsion / fire pump/ electric generator engines start / stop control;

(v) Bow thruster control panel, including control joystick (if fitted)

(vi) Loudhailer control unit & microphone;

(vii) Compass;

(viii) Electric horn;

(ix) Siren and flashing beacon control panel;

(x) Navigation lights, search lights and flood lights switch panel;

(xi) GPS receiver;

(xii) Radar/chart plotter control and displays;

(xiii) UHF mobile transceiver;

(xiv) Receiver and transceiver radio for FSD;

(xv) Echo sounder display; and

(xvi) Any other displays or controls as required.

4.5.3 All indication lights, illumination of instrumentation gauges and panel lighting within the console area shall be fitted with dimmers for day and night operation.

4.5.4 One magnetic compass shall be installed directly in front of the coxswain.

4.5.5 The control consoles shall have sufficient legroom.

4.6 Forepeak

4.6.1 The Forepeak space shall be watertight and located at the foremost end of the hull, separated with a watertight collision bulkhead.

4.6.2 A flush watertight hatch cover shall be provided on the main deck for access to the forepeak space. Access ladder shall be provided.

4.6.3 Sparred wooden shelves and perforated marine plywood flooring shall be provided for storing the anchor chains.

4.6.4 Sparred wooden shelves for stowage of mooring ropes and equipment shall be provided inside this compartment.

4.6.5 Racks for shapes shall be provided inside the forepeak space.

4.6.6 One manhole grating shall be provided for each size of watertight manhole access.

4.7 Accommodation Space

4.7.1 The Accommodation space is to contain the following, not withstanding any requirements in other sections of this TS:-

(a) Seating for 8 persons on settees or similar;
(b) Enclosed WC compartment;
(c) A small galley;
(d) Direct access to the Deckhouse and to the Tank Room ;
(e) Escape route out to the exterior of the vessel, not via the Deckhouse; and
(f) Lockers and stowage.

4.7.2 All equipment and furniture shall be capable of withstanding an inversion, all equipment shall be securely mounted and all lockers and stowage will have suitable retaining devices to ensure that the contents are securely contained in the event of an inversion.

4.7.3 Each seating position is to have a four point retractable safety belt, suitable to hold the person in the event of an inversion.

4.7.4 The WC compartment is to contain the following:-

(a) One deep bowl water closet with flushing system
(b) One stainless steel wash basin with a spring loaded cold freshwater supply tap;
(c) One water delivery point under basin with a plastic hose for toilet cleaning;
(d) One cabinet with mirror with vanity lights
(e) One electric exhaust fan;
(f) Sufficient lighting;
(g) 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 grey/black water collection tank; and
(h) Stainless steel hand rails as appropriate to allow safe use of the facilities while at sea

4.7.5 Toilet room shall be well ventilated. The exhaust air shall be routed to outside.

4.7.6 Sewage flushed from toilet shall be stored in the grey/black water tank

4.7.7 The Galley shall contain the following: -

(a) 1 x Microwave oven;
(b) 1 x Refrigerator with positive latches;
(c) 1 x Hot water dispenser;
(d) 1 x Stainless Steel kitchen sink with hot and cold potable water supplied via a mixer tap; and
(e) 1 x Galley units should be made with at least one drawers unit.

4.7.8 The accommodation shall ventilated by the HVAC system board.

4.7.9 The accommodation shall be well lit, with standing headroom ($\geq$ 1.90m) wherever possible.

4.8 Tank Room

4.8.1 The Tank Room shall contain the following:

(a) The main fuel tanks for the Vessel;
(b) The main electrical switchboards for the vessel;
(c) Storage racks and lockers; and
(d) Any other equipment or tankage as required.

4.8.2 The Tank Room shall be accessed via a watertight door from the accommodation space.

4.8.3 The Tank Room shall be accessed via a watertight door from the Engine Room.

4.8.4 The Tank Room is to be well lit, with attention paid to ensure that the installed lighting is adequate for regular maintenance work on the machinery and equipment situated in the space

4.8.5 The floor of this compartment shall be covered with unpainted aluminium chequer plate properly secured with fixing screw for crew's safe operational use.

4.8.6 Aluminium chequer plates adjacent to valves, shafts, etc., shall be easily removable for ease of maintenance. Hinged access plates shall be fitted in way of valves. Suitable arrangements shall be provided for hinged plates to avoid/minimize rattling noise.

4.8.7 Fuel tank ventilation openings are to be fitted with non-return valves or other means to prevent the inflow of seawater and outflow of fuel oil.

4.9 Engine Room

4.9.1 The Engine Room Compartment shall be designed with ample space to accommodate the machinery and its associated equipment. Special attention must be paid to the design of the Engine Room layout, and its main deck area above, for main engines and machinery maintenance and repair. The design of Engine Room layout shall be approved by GNC officers.

4.9.2 The Engine Room Compartment shall be designed for unattended engine room operation, protected by a fixed CO2 flooding system and monitored by a CCTV system

4.9.3 The machinery, associated piping system and fittings relating to the main engines and electrical generator sets shall be of a design and construction adequate for the service for which they are intended for 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.

4.9.4 There shall be no exposed surface exhibiting temperature higher than 60 degrees. Where required adequate insulation and protection is to be provided.

4.9.5 The Engine Room is to be well lit, with attention paid to ensure that the installed lighting is adequate for regular maintenance work on the machinery and equipment situated in the space.

4.9.6 The floor of this compartment shall be covered with unpainted aluminium chequer plate properly secured with fixing screw for crew's safe operational use.

4.9.7 Aluminium chequer plates adjacent to valves, shafts, etc., shall be easily removable for ease of maintenance. Hinged access plates shall be fitted in way of valves. Suitable arrangements shall be provided for hinged plates to avoid/minimize rattling noise.

4.10 Waterjet Compartment

4.10.1 The layout of the Waterjet Compartment shall be arranged for easy and convenient installing, operating and access for maintenance and repairs to the waterjet system.

4.10.2 The Waterjet Compartment is to be well lit and suitably ventilated, with attention paid to ensure that the installed lighting is adequate for regular maintenance work on the machinery and equipment situated in the space.

4.10.3 The floor of this compartment shall be covered with unpainted aluminium chequer plate properly secured with fixing screw for crew's safe operational use.

4.10.4 Aluminium chequer plates adjacent to valves, shafts, etc., shall be easily removable for ease of maintenance. Hinged access plates shall be fitted in way of valves. Suitable arrangements shall be provided for hinged plates to avoid/minimize rattling noise.

4.11 Hand Holds and Grab Rails

4.11.1 Sufficient internal and external hand holds and guard rails shall be fitted on the Vessel.

4.11.2 Guard rails on the main deck outside the housing must be non-reflective and fabricated to suit for a marine environment, i.e. aluminium alloy/marine grade stainless steel 316 or other appropriate non-corroding material.

4.11.3 All hand rails shall be strongly secured to the deckhouse side or deck to provide support for persons on board, to prevent them from falling or being thrown on deck or overboard in deteriorated weather and sea conditions, the design to consider the circumstances when all persons on board are lined up together on one side of the deck in case of an emergency situation at sea.

4.11.4 The Contractor should note that to allow use of some of the deck equipment that some of the handrails may need to be collapsible.

4.11.5 The design and arrangement of all on board fittings, including guard railings, their position, fitting arrangement, etc. shall be made acceptable to and approved by MD before fitting.

4.12 Mast

4.12.1 Due to the roll over capability of the vessel, the mast is to be designed such that in the event of a roll over, it is either strong enough to withstand the expected dynamic loads or it is designed to crumple/detach in such a way as to minimise damage to deckhouse/vessel.

4.12.2 As the navigation mast is especially vulnerable, it may be considered to make it breakable from the vessel structure on purpose controlling the damage and survivability of the boat. Critical antennas shall be mounted redundantly and clear from the navigation mast so that basic functionality is ensured. This however means that the mast and all mast mounted equipment will be lost in the event of a capsize. It should therefore be considered what equipment may be installed in the mast and lost after capsize.

4.12.3 All drawings shall be submitted to GNC for approval before construction.

4.13 Exterior Deck

4.13.1 External deck spaces shall include:

(a) Clean and simple fore deck and aft deck areas for efficient boarding and return operation.

(b) Walk around deck facility which provides easy access to fore deck or aft deck. There shall be no steps along the length of the exterior deck between the fore deck and aft deck. The walking area on deck shall be well illuminated in dark environments.

(c) The minimum width of the clear walk round path of the vessel is 600mm.

(d) The fore deck geometry of the Vessel shall be carefully designed to facilitate safe boarding/landing to MD's satisfaction. Adequate hand rails shall be provided to assist the operators to move safely around the vessel and access between the Vessel and other vessels.

(e) The fore deck shall exhibit a flush deck fitted with anchoring / mooring equipment and a remote controlled fire monitor.

4.13.2 All exterior deck areas shall be covered by an appropriate anti-slip surface for boarding / landing and deck covering requirements. The anti-slip paint shall not be made of a mix of paint and added grit material ("sand") and shall be to MD's satisfaction.

4.13.3 Notwithstanding requirements specified in other sections, the aft deck shall have the following fittings:

(a) three 24VDC waterproof power socket;
(b) three 220VAC waterproof power socket; and
(c) one waterproof shore connection.

4.14 Fender

4.14.1 A robust and permanent PUR fender system shall be fitted around the extremity of the vessel. No air or inflatable fender will be accepted.

4.14.2 The fender shall be designed to absorb stresses applied to the Vessel whilst mooring or alongside other vessels.

4.14.3 The fender shall be tightly fixed to the hull and flush on the highest deck level.

4.14.4 The collar must be clear of the water when planning with full load and at rest with full fuel and no payload on board.

4.14.5 The fender shall have excellent resistance to impact abrasion and to hot and cold climate extremes, and will not be affected by petrol, diesel, lubricating oil or chemicals.

4.14.6 The dimensions of the fender shall be at least 250mm x 400mm. Details of the design, dimensions and arrangement drawing of the fender shall be submitted to MD for approval prior to construction.

4.14.7 Four loose, portable pneumatic fenders shall be provided. The manufacturer's certificate shall be provided for approval.

4.15 Anchoring, Mooring and Towing

4.15.1 Anchor

(a) At least one high holding power type anchor approved by an 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.
(b) The Vessel shall be provided with adequate and safe means for releasing the anchor and its cable and warp.
(c) The means of release shall be capable of safe operation even when the anchor cable or warp is under load.
(d) Adequate means and arrangements shall be provided to secure the anchor under all operational conditions.
(e) A minimum 10 metres shackle of stainless steel chain and 100 metres of nylon line shall be provided. A hatch shall be fitted on the deck leading down to nylon lines locker. All equipment to be sized as per RO Requirements.
(f) The anchor shall be handled by use of an electric or hydraulic windlass and associated fittings.

4.15.2 Windlass

(a) A hydraulic windlass with its associated gypsy and warping drum, cable stopper, hawse pipe, bollards and fairleads shall be provided to give an easy run for anchor chain cables and mooring lines. The windlass shall be fitted with an emergency manual operating mechanism.
(b) The windlass shall be capable of lifting one anchor with sufficient length of chain, at a speed of at least 15 metres/minute.
(c) Control of the windlass shall be located in the vicinity of the windlass through a starter control unit enclosed in the watertight cabinet and the wheelhouse control console.
(d) Emergency stop button for the windlass shall be provided at deckhouse control station and locally.
(e) Windlass cover shall be provided.

4.15.3 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).

4.15.4 Where necessary, suitable fairleads, bitts and mooring ropes shall be provided and fitted according to the requirements of an RO or other international standards acceptable to GNC.

4.15.5 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.

4.15.6 Two stainless steel boat hooks with 3-metre staves and stowage arrangement shall be provided.

4.15.7 A minimum 10 deck cleats on deck shall be provided with four nylon 20m long mooring ropes. All appropriately size shall be to GNC's satisfaction.

4.16 Cathodic and Hull Surface Protection

4.16.1 The hull, waterjet and the lighting protection system underwater shall be protected by a cathodic protection system for two years life.

4.16.2 Sufficient number of zinc anodes will be placed on the hull outside and on the waterjets.

4.16.3 The waterjet anodes are to be installed as per the waterjet manufacturer's requirements.

4.17 Lightning Protection

4.17.1 The Vessel shall be fitted with a lightning protection system acceptable to the RO to protect the Vessel, persons on board and the electronic equipment installed.

4.17.2 Methods, protected area and working principles of protection shall be submitted for GNC approval before the installation of the protection system.

4.18 Miscellaneous

4.18.1 Navigational shapes shall be provided and properly stowed in the Vessel.

Chapter 5 - Safety Equipment

5.1 General Provisions

5.1.1 Engine compartments shall be enclosed by fire-resisting divisions complying with the requirements of the International Code for the Application of Fire Test Procedures (FTP Code), as defined in Chapter II-2 of SOLAS.

5.1.2 Fire-resisting bulkheads and decks shall be constructed to resist exposure to the fire as per RO Requirements for that specific location.

5.1.3 The hull, structural stiffeners, bulkheads, decks, deckhouses and pillars shall be constructed of approved non-combustible materials as required in the FTP Code and having adequate structural properties.

5.1.4 The arrangement of pipes, ducts, electrical cables etc., penetrating into engine compartment's 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.

5.1.5 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.

5.1.6 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.

5.1.7 All deck finished materials shall comply with the FTP Code.

5.1.8 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.

5.1.9 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.

5.1.10 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.

5.2 Fire Detection System

5.2.1 An approved automatic fire detection system shall be provided in the Vessel at appropriate locations in accordance with RO Requirements. The fire detection system shall comply with the rules of an RO or international standard acceptable to GNC.

5.2.2 The fire detection panel shall be installed in the wheelhouse.

5.3 The detection system shall initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed in the deckhouse control station.

5.3.1 Fire detectors shall be installed in all compartments. Detection system using only thermal detectors shall not be permitted unless in spaces of restricted height and where their use is especially appropriate.

5.4 Fixed Fire-Extinguishing System for Unattended Engine Compartment

5.4.1 Engine compartment fire extinguishing systems shall be a fixed CO_2 flooding system complying with an RO regulations for engine compartment protection. Activation of the CO_2 system shall cause an audio and visual warning alarm in the deckhouse and the engine compartment. The system shall be approved by an RO or International Standard acceptable to MD.

5.4.2 Engine compartment ventilation systems shall automatically shut down upon activation of the CO_2 flooding systems or manually from controls at the control station.

5.5 Portable Fire Extinguishers

5.5.1 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. In addition, at least one extinguisher suitable for machinery space fires shall be positioned outside each machinery space entrance.

5.5.2 Fire extinguishers shall be Type-Approved by an RO or other international standards acceptable to GNC. Certificates shall be submitted to GNC before Delivery Acceptance.

5.5.3 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.

5.6 Fire Pump for Vessel Internal Purpose

5.6.1 The fire main and fire pump design shall meet RO Requirements.

5.6.2 One electric motor driven fire pump located inside of the machinery space shall be provided to have sufficient capacity to pump seawater with a jet throw of at least 12 metres.

5.7 Safety Plan

5.7.1 A Safety Plan in frame shall be permanently exhibited for the guidance of the ship's crew at the deckhouse, using graphical symbols in accordance with IMO Resolution A.654(16).

5.7.2 The text of the Safety Plan shall be in English and Traditional Chinese.

5.8 Additional Protection

5.8.1 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 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.

5.8.2 The additional protection should be able to be turned on and off when required. [D]

Chapter 6 – Lifesaving Appliances (LSA) and Arrangements

6.1 General Provisions

6.1.1 Lifesaving appliances shall be provided in the Vessel at appropriate locations in accordance with RO Requirements.

6.1.2 Lifesaving appliances shall be of approved types conforming to the International Life-Saving Appliance Code (LSA Code) adopted by the Maritime Safety Committee of the Organization by Resolution MSC.48(66) and approved by an RO.

6.1.3 Sixteen (16) inflatable lifejackets shall be supplied and so placed as to be readily accessible and their positions shall be clearly indicated.

6.1.4 An adequate number of lifebuoys shall be provided as per RO requirements. Lifebuoys shall be marked with the ships name on both sides.

Chapter 7 - Machinery

7.1 General Requirements

7.1.1 The Tenderer should note that the Vessel is for use in Hong Kong and it is desirable that the main engines, gearboxes, electric generators 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. [D]

7.1.2 The Vessel shall be equipped and fitted with all machinery 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.

7.1.3 Two personnel accesses with reasonable separation shall be provided for the engine compartment. The design of the engine compartment layout shall be approved by an RO and agreed by GNC. The machinery, associated piping systems and fittings relating to the main engines and electric generator 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.

7.1.4 Sufficient space and headroom in the vicinity of the machinery for local operation, inspection and routine maintenance for all the machinery shall be provided. Hinged hatch covers with hydraulic jack support open at aft deck for removal of the major items independently from engine room, such as the main engines, gearboxes, electric generator, etc. It shall be carefully designed to enable their removal from Vessels for maintenance in a practicable manner so to avoid the need for the deck or shell plate to be cut.

7.1.5 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.

7.1.6 Provision shall be made to facilitate cleaning, inspection and maintenance of main engines, electric generators, hydraulic pumps etc. and their associated piping and equipment.

7.1.7 Lifting brackets for moving heavy equipment shall be as deemed necessary. The lifting capacity shall be marked with its maximum load after a load test satisfactory to GNC.

7.1.8 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 deckhouse.

7.1.9 The vessel must be capable of withstanding the condition of operational criteria in Paragraph 3.3.8 in the event of an inversion. Machinery and equipment are securely mounted and normal running condition shall be resumed after rollover. The requirements for withstanding the condition of operational criteria in the event of inversion shall be acceptable to FSD and GNC officers.

7.2 Main Propulsion Engines

7.2.1 The Vessel shall be equipped with two 24 volts electrically started, fresh water cooled marine diesel engines of adequate power for the Contract Speed and the diesel engines shall meet IMO Tier II emission requirements, and the rating of the engines are not less than 1,800 operating hours per year. [E]

7.2.2 Type approved certificates issued by an RO or other entities acceptable by GNC in compliance to meet IMO Tier II emission requirements shall be provided.

7.2.3 The main engines shall drive the impellers of waterjets through reduction gears as required.

7.2.4 The main engine's exhausts and silencers shall be protected according the requirements of RO 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.

7.2.5 The main propulsion engines and associated systems shall be capable of operating with self-righting capability features. The self-righting capability features are stipulated in Paragraph 7.2.6. A tenderer shall demonstrate that the engines can continue to operate, without increased risk of damage, whilst inverted or that the control system will automatically reduce the engine speed to idle in the event of an inversion. [E]

7.2.6 Self-righting capability features include Paragraphs 7.2.7 to 7.2.10, shock load requirements, prevention of oil and oil-mist entering combustion system, inclination requirements, additional software and sensor for engine performance.

7.2.7 Shock load requirements - Engine must withstand shock loads of 3g vertical, 2g longitudinal and lateral. The engine mounting and damper elements must be able to support the engine weight during roll-over. Engine exhaust compensator design to compensate for increased movement of engine.

7.2.8 Prevention of oil and oil-mist entering combustion system - Oil and oil-mist are not allowed to enter the cylinder through the air inlets. Crankcase ventilation is designed to prevent oil entering the cylinder through air inlet. Special oil pan design with greater depth for extreme inclinations. Secured oil dipstick prevents popping out due to transient high pressure.

7.2.9 Inclination requirements - Engine must be capable to operate without restrictions under inclination angles up to 40° in the longitudinal direction and 30°in transversal direction. High incline angle is detected by sensor and automatic engine speed reduction at high incline angles.

7.2.10 Additional software and sensor for engine performance - High incline angles are detected by sensor and an automatic engine speed reduction is initiated. Additional software for engine performance, idle, clutch in and out, shutdown, crankcase valve control, protecting the engine from uncontrolled combustion. Safety measure to protect the engine when there is a pressure increase in the crankcase due to the closing of the crankcase breather valve.

7.2.11 The exhaust system is to be so designed that no seawater will flow back into the engine during capsize, which is detailed in Paragraph 3.2.7, or the exhaust piping system is designed to retain seawater during rollover and the exhaust gas is led to overboard through other outlet during capsize.

7.2.12 All relevant vents, breathers and any other part of the main propulsion engine which may leak in the case of an inversion must be modified such that any leakage is minimised and no system should lose any amount of fluid or ingest any amount of air which would impair the operation of the engines after an inversion.

7.2.13 An inspection cover shall be provided that can be opened for clearing blockages for the waterjet assembly without ingress of sea water into the waterjet compartment when the waterjet is waterborne.

7.3 Main Engines Control

7.3.1 The controls and instrumentation of the main engines, which shall be designed for one man operation in the deckhouse, shall be ergonomically laid out and grouped around the steering position in the deckhouse control console.

7.3.2 Each engine has its own electronic screen based engine alarm and monitoring system comprising of one local operation panel in engine room and a remote panel in wheelhouse. On the engine room panel, it is possible to start/stop, engage/disengage the clutch and control the engine rpm locally. All relevant engine parameters are presented on the screens and engine alarms are presented.

7.3.3 Instrumentation and controls in the control console shall be comprehensive and shall include:

(a) Starting and stopping of main engines from the deckhouse;
(b) Emergency stop button with guard cover;
(c) Deckhouse /local control change over switch and indicator;
(d) Steering controls (wheel and joystick) for the waterjet system;
(e) Shaft speed indicators;
(f) Engine tachometers with running hour meter;
(g) Sea water cooling pressure;
(h) Coolant water temperature and pressure;
(i) Engine lubricating oil temperature and pressure gauges;
(j) High cooling water temperature alarm and de-rate function;
(k) Engine low lubricating oil pressure alarm and trip;
(l) Gearbox lubricating oil low pressure gauge;
(m) Gearbox lubricating oil low pressure alarm and trip;
(n) Ammeter for each engine;
(o) Engine exhaust gas pyrometer;
(p) Fresh water tank content gauge;
(q) Fuel oil tanks content gauge;
(r) Engine overspeed alarm and trip (visual and audible);
(s) Main engine expansion tank low level alarm;
(t) Battery charging control lamps;
(u) DC power on light;
(v) Central illumination dimmer for all light in the control console;
(w) Lamp test;
(x) Alarm test and reset;
(y) Inversion sensor warning light;
(z) A standard engine maker's engine control panel to be provided in the engine compartment; and
(aa) Any other instrumentation recommended by the engine maker and GNC.

7.4 Waterjet System

7.4.1 General

(a) The design of the whole waterjet system and control system shall be a patent design approved by a recognised Classification Society or equivalent for the operating power range of the Vessel. Classification design construction and inspection certificates shall be provided for the waterjet units. The waterjet system shall be installed in accordance with the manufacturer's instructions.

(b) The reduction gear is directly flanged on the main engine. Engine and gear resilient mounted to the hull. Torsional vibration calculations for the shafting system shall be carried out and be approved by a recognised Classification Society.

7.4.2 Waterjet Units

(a) Each waterjet unit should be driven by a main propulsion engine through a compatible reduction/reversible gearbox and intermediate shaft flexible coupling.

(b) The waterjet system shall include the following alarms with individual indication in the deckhouse:

(i) Power failure of the remote control system;
(ii) Power failure of the alarm system;
(iii) Low level in the lubrication oil tank (if provided);
(iv) Low lubrication oil pressure (if forced lubrication oil system);
(v) Low level in the hydraulic supply system; and
(vi) Power failure safety system.

7.4.3 The waterjet pump unit shall be mix flow pump design, the waterjet pump unit including steering nozzle shall be in stainless steel cast. Two full control stations in wheelhouse front each arranged with steering tiller, handle, docking joystick, clutch control and a common alarm and monitoring screen. [E]

7.4.4 Controls and instruments of the main engine/waterjet units shall be designed for one man operation in the deckhouse and comply with recognised Classification Society requirements.

7.4.5 Besides the ordinary manoeuvring system being multiplied, each system shall be entirely separated all the way from the control lever in the deckhouse down to the waterjet units, there shall be a reserve manoeuvring system extending, completely separate, all the way down to the waterjet units.

7.4.6 The back-up system shall be used if there is a fault in the main system. The switch-over shall not be automatic, but done by the coxswain with the selector button situated in the vicinity of the back-up levers. However, this shall require knowledge of how the steering and reversing devices are manoeuvred individually.

7.4.7 If for any reason there is a loss of all control functions, the Vessel shall be directly manoeuvred by manual operation of the solenoid valves located in local compartment. Forward / reverse and steering manoeuvring can be made directly at each solenoid valve after change over to manual mode of control.

7.4.8 The waterjet systems shall have their own, closed hydraulic system, used for waterjet control only.

7.4.9 The impeller shall be capable of being reversed in rotation and thrust through the main engine reversible gearbox for back flushing and clearing of the waterjet intake grill.

7.4.10 The waterjets, gearboxes and all associated systems must be capable of operating normally after a 180° inversion. The contractor must demonstrate the waterjets, gearboxes and all associated systems will operate normally after an inversion.

7.4.11 All relevant vents, breathers and any other part of the waterjets or gearboxes which may leak in the case of an inversion must be modified such that any leakage is minimised and no system should lose any amount of fluid or ingest any amount of air which would impair the running of the waterjets or gearboxes after an inversion.

7.5 Reduction Gearboxes

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

(a) Gear oil heat exchangers shall be 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.

(b) Reduction gear shall be sized to match the waterjet manufactures requirements.

(c) The gearboxes shall be provided with alarms for low oil level and oil temperature. Alarms shall be repeated both locally and at the deckhouse.

(d) Each gearbox shall include the following:

(i) A flexible coupling of Proprietary Make to absorb ahead and astern maximum thrust and also fully absorb torsional vibrations;
(ii) A Power Take Off (PTO) for the hydraulic system;
(iii) Built-in gear type oil pump;
(iv) High oil temperature alarm; and
(v) Higher oil temperature cut out.

7.6 Electric Generator Engines

7.6.1 Two (2) electrically started, fresh water cooled diesel electric engine integral with alternating current alternator, of self-excited, brushless and ventilated type, shall be installed. [E]

7.6.2 The capacity of these generators shall be able to supply all power necessary to ensure that normal operational conditions of propulsion and safety can be achieved.

7.6.3 The generator engine shall be capable to endure vessel capsizing for intermittent and continuous for rolling and pitching no less than the requirements of SOLAS regulation.

7.6.4 If the generators have an automatic cut off in case of excess heel then they must be capable of restarting within 15 seconds after the vessel returns to upright. In this situation, it can be assumed that the generators are at full operating temperature.

7.6.5 All relevant vents, breathers and any other part of the generators which may leak in the case of an inversion must be modified such that any leakage is minimised and no system should lose any amount of fluid or ingest any amount of air which would impair the operation of the generators after an inversion.

7.6.6 The exhaust system is to be so designed that no seawater will flow back into the engine during capsize, which is detailed in Paragraph 3.2.7.

7.6.7 The generators at its continuous service rating, shall have sufficient capacity for:

(a) supplying all full operational electrical load of the whole Vessel including air conditioning and accessory system running at full capacity plus not less than a 15% reserve margin, and

(b) 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 generator is supplying full operational electrical load including air conditioning running at full capacity of the whole Vessel.

7.6.8 Electrical load analysis and calculations shall be approved by an RO before submission to GNC.

7.7 Electric Generator Engine Control

7.7.1 The controls and instrumentation of the generator engines shall be designed for one man operation in the deckhouse, the instrumentation and controls in the control console shall be comprehensive and 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;
(h) Inversion sensor warning light;
(i) Protective devices such as overspeed, low lubricating oil pressure trip etc. as recommended by the engine builder; and
(j) A standard manufacturer' local control panel to be fitted in the engine compartment.

7.8 Instrumentation and Control

7.8.1 A control station in the deckhouse shall be provided with comprehensive instrumentation and controls for remote operation and monitoring of the main engines, generators and other auxiliaries to facilitate for unattended engine compartment operation.

7.8.2 One fire detector panel and one engine compartment carbon dioxide firefighting panel shall be installed in the vicinity of the control station.

7.8.3 Additional controls and monitoring devices shall also be provided locally in the vicinity of that machinery or equipment.

7.8.4 All the instruments such as temperature sensors, pressure sensors, level gauges etc. shall have obtained type approval certificates by an RO or the manufacturer's certificate complying with the national standards of the place of manufacture of the relevant instrument. The Contractor shall provide copies of the type approval certificates or the manufacturer's certificate to GNC on or before the Delivery Acceptance.

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

7.8.6 At least two independent means of stopping the main engines from the deckhouse control station under any operating conditions shall be available.

7.9 Interceptor system

7.9.1 The interceptor system shall be of 24VDC system and the interceptor shall be mounted on each side of the transom. The interceptor system shall perform functions including automatic trim control, automatic list control, coordinated turn control and active stabilization. [E]

7.9.2 An interceptor shall consist of an interceptor blade, which can extend and retract in one direction automatically through changes in GPS reading, and causes stagnating flow region around the hull bottom.

(a) Automatic trim control

The interceptor system shall be capable of automatically extending and retracting the interceptor blade through changes in GPS reading for the boat's optimal trim at speeds.

(b) Automatic list control

The interceptor system shall be capable of automatically extending and retracting the interceptor blade through changes in GPS reading to counteract any listing motions deviating from the preset list angle at speeds caused by uneven loading and unfavorable weather and sea conditions.

(c) Coordinated turn control

The interceptor system shall be capable of automatically extending and retracting the interceptor blade through changes in GPS reading and rudder signal to adjust the heeling angle of the boat during turns to reduce the side force on board.

(d) Active stabilization

The interceptor system shall have a Ride Control Unit installed at the boat's LCG and automatically detects and process the boat rolling and pitching motion at speeds, giving command to the interceptor blade to extend and retract automatically.

7.10 Engine Compartment Ventilation

7.10.1 Arrangements shall provide sufficient air to the engine and shall give adequate protection against damage, as distinct from deterioration, due to ingress of foreign matter, which is detailed in Paragraph 3.2.7.

7.10.2 The air supply inlet vents shall be connected to louvres of efficient design in preventing ingress of water during extreme weather conditions and the case of a 180° inversion. All vents shall be provided with weather-tight covers, fire dampers and coamings of adequate height.

7.10.3 In case of an inversion and an ingress of water through the ventilation system then no machinery shall be fitted beneath the ventilation inlets or exhaust openings within the Engine Room and suitable provision must be made to ensure that any water is drained away from machinery or electrical installations quickly.

7.10.4 Engine compartment shall be adequately ventilated so as to ensure that when machinery therein is operating at full power in all weather conditions, including heavy weather, an adequate supply of air is maintained to the compartment for the safety of personnel and the operation of the machinery.

(a) 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. The ventilation design shall be such to avoid any hot spot or "dead air" area.

(b) 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 is required to avoid flow noise (Typically 5 m/s depending on vent or louvre design).

7.10.5 Waterjet inspection compartments and tank spaces 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. The inspection cover shall be watertight.

7.10.6 For guidance, the ventilation air to the compartment as stated should: [D]

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

(b) as the prime movers draw combustion air from 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 should not be less than that required for combustion plus 50%.

7.10.7 Automatic shut-off device shall be provided according to RO Requirements when CO_2 system activated.

7.10.8 Ventilation openings are allowed to show limited leakage during capsize provided that this does not cause damage to machinery or equipment mounted underneath, and provided that the leakage is so limited as not to impair the crafts stability.

7.10.9 All ventilation openings that need to be open for proper functioning of the craft shall be:

(a) Located such that they are not less than 0.2m above the waterline at every angle of heel in any loading conditions or;

(b) Ducted in such a way that they are not less than 0.1m above the waterline at every angle of heel in any loading conditions or;

(c) Equipped with an automatic closing device that does not rely on electronic, manual or any other active control to close and subsequently open.

7.10.10 Systems that need shut-down to prevent damage during capsize shall do so automatically in such an event.

7.11 HVAC System

7.11.1 HVAC System

(a) At least two Proprietary Make of water cooled chillers and fan coil blower units shall be installed. The Contractor shall propose specific equipment for approval by GNC prior to purchasing.

(b) The system and all its components shall be suitable for use in a vessel which has roll over capabilities and mounted such that any such inversion will not cause damage to the system.

7.11.2 The temperature and humidity of the deckhouse and accommodation shall be maintained at the following levels: -

SUMMER

	Value	Notes
External air temp	40 ºC	70% relative humidity
Internal air temp	21 ºC	60% relative humidity
Sea Water temp	≤ 30°C	

WINTER

	Value	Notes
External air temp	0 ºC	60% relative humidity
Internal air temp	21 ºC	60% relative humidity
Sea Water temp	≥ 10°C	

This is to be with full complement and passengers 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.

7.11.3 The refrigerant shall be CFC and HCFC free.

7.11.4 Emergency stop switches of the air conditioning system in addition to the normal power 'on/off ' switches shall be installed in the deckhouse control station.

7.11.5 Mould and bacteria resistant replaceable filters shall be fitted at air inlets.

7.11.6 The fan coil blower units within the deckhouse and accomodation 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 compact deck house and accomodation space and its other installed fixtures and fittings, the Contractor shall agree with MD the exact installation position of the indoor units before installing the blower units in the cabin(s).

7.11.7 Sufficient fresh air induced to the air-conditioned area be based on ISO 7547 standard for Shipbuilding – Air-conditioning and ventilation of accommodation spaces; and there shall be not less than 25 m3/hr per person so as to keep the CO2 level low enough for health reasons. Shut-off facilities for fresh air supply shall be provided (which shall be automatic in the case of an inversion)

7.11.8 Sufficient ventilation shall be provided in case of air-conditioning breakdown.

7.11.9 Any ventilation openings (inlets and outlets) shall have automatic shutoff flaps or similar to minimise any water ingress in the case on an inversion. Suitable drainage from ventilation ducting for any water ingress shall be provided.

7.12 Piping System

7.12.1 Piping System

(a) Piping connections and joints shall be constructed and designed in accordance with the rules and regulations of an RO.

(b) Pipe bends should be kept to a minimum and have sufficient radius to facilitate smoothness of flow. [D]

7.12.2 Piping material shall be marine grade stainless steel 316 with substantial thickness.

7.12.3 All pipes for essential services shall be secured in position to prevent chafing or lateral movement. Long or heavy lengths of pipe are to be supported by bearers so that no undue load is carried by pipe connections or pumps and fittings to which they are attached.

7.12.4 Suitable provision for expansion shall be made, where necessary, in each range of pipes.

7.12.5 Where expansion 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 protected against mechanical damage.

7.12.6 So far as practicable, pipelines, including exhaust pipes from engines, shall not 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. Where it is not practicable to comply with these requirements, drip trays or shields shall be provided as found necessary.

7.12.7 Watertight bulkheads, decks or structural members having pipeline penetration shall be designed and compensated in accordance with RO Requirements.

7.12.8 The material of the gaskets shall be capable of resisting chemical attack of the fluid being conveyed. Galvanic corrosion shall be avoided if different materials used in the system.

7.12.9 Machinery and piping designation and marking.

(a) All piping and equipment shall be labelled and colour-coded. And each pipe running through each compartment shall be colour coded, labelled, and have the direction of flow marked in at least two places.

(b) Colour coding of machinery and piping shall be in accordance with the following:

(i)	Firemain	-	Red
(ii)	Sea Water	-	Dark Green
(iii)	Fuel Oil	-	Dark brown
(iv)	Lube Oil	-	Striped Black/Yellow
(v)	Fresh Water	-	Blue
(vi)	Hydraulic Oil	-	Orange

7.13 Fuel Oil System and Fuel Oil Tanks

7.13.1 As Government vessels are committed to utilise sustainable / renewable fuel blends, the propulsion engines and the electric generator 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.

7.13.2 The fuel oil of the main engines and electric generators shall be supplied from one or more fuel oil tanks. The Contractor is free to design the number and location of the fuel oil tank to fulfil the specification requirement. The total capacity of fuel oil tanks shall be at least 3,500 litres and sufficient to meet the endurance requirements in Section 2.4.

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

7.13.4 Boost pumps shall be arranged to lift fuel to the engines through coalescing filters (Racor, Fleetguard or equivalent).

7.13.5 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.

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

7.13.7 An electric motor-driven pump shall be provided for transferring the fuel.

7.13.8 The Contractor shall provide the initial fills of fuel oil, lube oil, coolant, and hydraulic fluids using fluids and additives prescribed by engine manufacturer. The Contractor shall provide a summary listing of all fluids and quantities used.

7.13.9 All materials used in fuel systems shall be resistant to deterioration by its designated fuel and to other liquids or compounds with which it may come into contact under normal operating conditions, e.g. grease, lubricating oil, bilge solvents and sea water.

7.13.10 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.

7.13.11 An easily removable coarse strainer shall be built into the filling line.

7.13.12 Two 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.

7.13.13 Where necessary, flexible pipes of approved type may be used as short joining lengths to the engine. [D]

7.13.14 Water separators should be fitted to the fuel supply line, if required. [D]

7.13.15 Fuel Oil Tank(s)

(a) Fuel oil tanks shall be arranged to allow Vessel operation at acceptable trim in all conditions of loading and with consideration for the requirements for good static and running trim, the Vessel shall be built with two or more integral fuel tanks to service the Vessel's main propulsion engines and ship service electric generator. The tanks shall be interconnected to permit fuel transfer between the tanks.

(b) The actual location of the fuel tanks is to be designed and approved by an RO and accepted by GNC.

(c) The tanks shall be integral with the hull and designed such that the loads of a full tank are safely induced into the hull structures.

(d) Internal surfaces of the fuel oil tank shall be left unpainted and shall be cleaned thoroughly to the satisfaction of MD.

(e) Provisions to the fuel oil tanks

(i) A tank content gauge and low level alarm shall be fitted on the deckhouse control station. A level gauge in litres shall be provided for each tank;

(ii) Rigid fuel suction pipes near the tank bottom shall be provided;

(iii) An inspection hole, air vent with a suitable self-closing device in case of an inversion and flame trap on deck and discharge valve with remote operated quick closing device shall be provided;

(iv) Suitable provision such as drip trap shall be made for collecting the oil discharge;

(v) Baffles shall be provided, the total open area provided in the baffles shall be not greater than 30% of the tank cross section in the plane of the baffle;

(vi) 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;

(vii) The fuel oil tank shall be tested by a head of water equal to the maximum to which the tank may be subject, but not less than 2.5 m above the top of the tank. The static test pressure shall be applied for five minutes without pressure drop. After the test, the test fuel tank shall not show any leakage;

(viii) Sounding pipes with chained cap shall be provided.

(ix) Tank drain shall be provided.

(x) The compartment or space containing the fuel oil tank shall be fitted with two ventilating pipes of arrangement acceptable to GNC.

7.14 Fresh Water System

7.14.1 One or two independent stainless steel fresh water tank with a total capacity of not less than 500 litres shall be arranged in the Vessel to supply fresh water to the main deck and galley.

7.14.2 The fresh water shall be supplied by a fresh water pump to achieve a pressure at the taps located at main deck and galley to GNC's satisfaction. This system act as the potable fresh water system and a hose which freely reaches all parts of the Vessel shall also be provided.

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

7.14.4 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 fresh water tank shall be fitted with the following:

(a) Inspection / cleaning access cover
(b) Filling / sounding pipe
(c) Air vent pipe

7.14.5 The fresh water tank shall not be integral with the hull and shall be installed so that the loads due to the mass of the full tank are safely induced into the structure.

7.14.6 The thickness of the fresh water tank shall sustain the loads due to the mass of the full tank with due consideration given to upward and downward acceleration due to the Vessel's movements at maximum speed in the sea without damaging the integrity of the tank and ship's structure.

7.14.7 The fresh water tank shall not be directly adjacent to any other tanks carrying liquid of any kind.

7.14.8 The fresh water tank shall be tested without leakage by a head of water equal to the maximum to which the tank may be subject, but not less than 2.5 m above the top of the tank. The static test pressure shall be applied for five minutes without pressure drop.

7.14.9 A capacity indicator calibrated in litres shall be provided.

7.14.10 The pressurised unit shall be provided with a starter, pressure switch, pressure gauge, relief valve and suction valves. The fresh water pump shall maintain the pressure automatically.

7.14.11 A hot water calorifier of not less than 20l capacity shall be fitted to the fresh water system to enable hot water delivery to the galley.

7.14.12 Domestic fresh water piping shall be made of copper. Certificate of piping material is to be submitted before the delivery of the Vessel. The welding joints of the domestic fresh water piping 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.

7.14.13 Hot and cold fresh water shall be delivered to the sink in the galley area for washing purposes via a mixer tap unit.

7.14.14 Cold fresh water taps completed with PVC braided / reinforced transparent hoses shall be fitted on the main deck aft, forehead and deckhouse side to provide for cleansing purposes.

7.15 Sanitary, Grey and Black Water system

7.15.1 The toilet water closet for the Vessel shall be flushed by an integral electric powered pump and emergency hand operated flushing pump. Including the hand basin discharge and floor drains, all discharges should be collected in a tank and discharged overboard by an automatic electric pump via a non-return shipside valve.

7.15.2 Piping material should be of copper and chrome plated of substantial thickness.

7.15.3 One stainless steel grey water tank with capacity not less than 500 L shall be installed in the Tank Space within the crew compartment for sanitary purposes.

7.15.4 Toilet, basin and galley sink shall be designed to discharge into a 500 L grey / black water holding tank, to be discharged back at the base.

(a) The tank shall be fitted with a level gauge and a "Tank Full" indicator installed in a highly visible location in the galley area and the bridge.

(b) The toilet shall receive feed water from fresh water tank via a toilet and tank flush pump connected to the fresh water tank through a non-return valve

(c) A discharge macerator pump shall be provided for pumping out the contents of the holding tank. This shall be primarily lead to the shore connection, but shall also be arranged with a backup underwater discharge. The shore connection shall be arranged with an international shore connection.

7.16 Bilge System

7.16.1 The Vessel shall be fitted with a bilge system to the RO Requirements. The bilge pump for each compartment shall be electrically powered.

7.16.2 A bilge audible and visual alarm panel shall be fitted in the deckhouse control station for engine compartment, waterjet compartment, accommodation space, fore peak and tank room.

7.16.3 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 five 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.

7.16.4 A bilge water holding tank of minimum of 300 litres in capacity shall be provided in the engine compartment.

7.16.5 The bilge of the engine compartment and waterjet compartment shall lead to the bilge water holding tank. An electric motor-driven pump with associated piping shall be provided in pumping out the bilge water ashore. A direct overboard shall be provided in case of an inversion or emergency affecting the safety of the Vessel.

7.17 Seawater System

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

7.17.2 Sea chests provided for the main and auxiliary machineries should be installed in the vicinity of their respective seawater pump suctions but with adequate distance between each other to avoid water flow disturbance. [D]

7.17.3 Seawater piping shall be constructed of marine grade stainless steel or any other RO approved material. A suitable strainer with isolation valves and air vent shall be fitted to each seawater system. Due consideration shall also be given for quick and easy access to the seawater strainers.

7.17.4 Cathodic protection shall be provided as necessary.

7.18 Floor Plates, Handrails and Guards

7.18.1 The floor of the engine compartment shall be covered with unpainted aluminium chequer plate for safe operational use.

7.18.2 All boundary bars, handrails, gratings, ladders, platforms, stanchions and vertical supports, etc. in the engine compartment and waterjet compartment shall be of lightweight construction. Aluminium chequer floor plates shall be secured by fixing with sections but shall be readily removable for access to bilges, pumps, shaft, pipe work and strainers etc. for ease of maintenance.

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

7.18.4 Removable guards for the protection of personnel and machinery shall be provided over exposed moving parts of the machinery, hot pipe work, etc.

7.18.5 Splash plates, casings, fenders, screens, etc. shall be provided for the protection of personnel and machinery.

Chapter 8 - Electrical System

8.1 General Requirements

8.1.1 All the electrical equipment and installation shall meet the RO Requirements.

8.1.2 All electrical equipment, fittings, instruments, switches, cables, insulation, sheathing, circuit breakers, rating standards and their installations shall comply with the latest Regulations of the International Electro-technical Commission (hereinafter referred to as IEC), Electrical Installations in Ships, with considerations of self-righting capability and water resistance taken into account.

8.1.3 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 the circuit conductors before heat can damage the conductor insulation, connections or wiring-system terminals.

8.1.4 Switches and controls shall be marked to indicate their use, unless the purpose of the switch is obvious and its mistaken operation will not cause a hazardous condition. Each cable shall be clearly labelled and carry its own unique identification code.

8.1.5 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.

8.1.6 All Equipment installed shall be provided with manuals for operation and maintenance.

8.1.7 The standard of installation shall enhance the Equipment's safety features of not presenting any hazards to the operator, e.g. all metal panels exposed to the operator shall be grounded properly. Warnings of any potential hazards shall be displayed in both English and Traditional Chinese, or with universally recognised labels.

8.2 Electricity Distribution Network

8.2.1 The main electrical AC power supply shall be provided by two electric generators. The electric generators shall have unrestricted continuous rating and be located in the engine compartment. Each generator alone shall be able to supply the Vessel’s required electrical power.

8.2.2 Each electric generator shall be sized based on a 15% growth margin above the predicted maximum load condition. The Vessel’s electrical load calculation shall include summer and winter, static and transient, loads on AC, DC, shore power, and ship service systems. The Vessel’s electrical load calculation is to be approved by an RO and accepted by GNC.

8.2.3 The electric generator shall maintain an output voltage within ±5 percent over the entire load range and frequency within ±1.5 Hz.

8.2.4 The electric generator starting circuit shall be 24 VDC. Starting and normal shutdown controls shall be mounted on the electric generator along with generator oil pressure and water temperature gauges; AC voltmeter and ammeter shall be directly connected to existing wiring systems with the use of a double-pole, double-throw (DPDT) transfer switch / centre-off switch for an ammeter to read both legs (AC Volts readings).

8.2.5 The electric generator shall be protected against short-circuits and overloads by multipole circuit-breakers (overload protector).

8.2.6 The distribution of the electricity to the equipment is through circuit breakers fitted on an electrical distribution board.

8.2.7 Power distribution panels / electrical distribution boards shall be positioned in the deckhouse.

8.2.8 Circuit breakers shall be provided for each circuit. 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. Circuit breakers shall indicate whether they are in the open or closed position. All circuit breakers shall be labelled to identify the circuit being protected.

8.2.9 Twenty percent (minimum of three) spare circuit breakers shall be provided in each distribution panel, both AC and DC. The Vessel's Electronic Navigational Equipment shall be supplied from an independent distribution panel, which shall in turn be supplied from a single breaker in the main DC panel.

8.2.10 Twenty percent (minimum of two) spare wiring penetrations shall be provided through each bulkhead except the forward collision bulkhead. Spare penetrations shall be plugged watertight with rubber plugs.

8.2.11 All single-phase loads shall be balanced on each light feeder. Loads of one type such as heaters or receptacles shall not be concentrated on a single branch or leg.

8.2.12 All supply panels shall be fitted with a miniature circuit breaker of double-pole type with over-current and short circuit trips. All junction boxes shall be readily accessible and the prime supply panel shall be positioned inside the deckhouse. A special arrangement is required for the navigation lights supplied from this prime panel.

8.3 Main Switchboard

8.3.1 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.

8.3.2 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 to power panels located close to the user services and in general located in the engine compartment. Connections and components on panel-boards shall be in locations protected from the expected conditions in conformity with IEC 60529:

(a) IP 67 as a minimum, if exposed to short-term immersion; IP 55 as a minimum, if exposed to splashing water;

(b) IP 20 as a minimum, if located in protected locations inside the Vessel.

8.3.3 Switchboards shall be permanently marked with the nominal system voltage.

8.3.4 A self-standing dead front marine type main switchboard of aluminium construction with adequate ventilation louvres shall be fitted in an accessible and well ventilated position in the engine compartment and shall contain the following:

(a) Sector for electric generators 220V AC;
(b) Sector for 24V & 12V DC; and
(c) Sector for shore power.

8.3.5 Due consideration shall be given in respect of the switchboard location to avoid any risk of damage resulting from oil and water spray or other mechanical hazards. Adequate guardrail(s) and insulated mat(s) shall also be provided.

8.3.6 Megger test and other relevant tests shall be carried out and witnessed by GNC. The results for these tests shall be submitted to GNC before Delivery Acceptance.

8.3.7 An appropriate laminated electrical diagram shall be attached on each switchboard.

8.3.8 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 electric generator shall be indicated.

8.3.9 Apart from the spare feeder breakers, the switchboard shall contain but not be limited to the following:

(a) Electric generator Sector shall provide the following:
    (i) Air circuit breaker of adequate capacity with over-current trip and short circuit trip;
    (ii) Interlock device to ensure only one electric generator is connected to the busbar;
    (iii) Voltmeter, ammeter, wattmeter and frequency meter;

(iv) Indication lights for "Power Available", "Breaker Opened" & "Breaker Closed"; and
(v) All necessary fittings and any other protective devices.

(b) 220V Single Phase Sector shall provide the following:
(i) Meters or earth lamps to indicate the state of insulation;
(ii) Moulded 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.

(c) 24V and 12V DC Feeders Sector:
(i) Transformer / rectifier of adequate capacity for converting AC power to DC power. The rectifier shall be of 1-phase full wave regulated type with voltage regulation ±5% and ripple factor 4% at 100 Hz;
(ii) Magnetic automatic relay switch 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) Metres or earth lamps to indicate the state of insulation;
(vii) Moulded 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.

(d) Shore Power Connection Sector:
(i) Moulded case circuit breaker for shore connection box shall be provided on the main switchboard.
(ii) The shore connection box shall be capable of receiving 220V single phase 50 Hz 30 Amp current on a 2-wire system and the cables between the connection box and the main switchboard shall be of sufficient capacity to supply the necessary electrical equipment.
(iii) An earth terminal shall be provided for connection of the Vessel's earth to the shore earth.
(iv) An instruction shall be provided at the connection box to give full information of the system and the procedures for carrying out the connection.

8.4 DC Power Source

8.4.1 Batteries for Main Engines and Electric Generator Starting

(a) Two independent banks of 24V batteries shall be provided for starting of each of the two main engines and the electric generators.

(b) The capacity of the batteries shall be sufficient to provide at least six consecutive starts of each one of the main engines, and at least three consecutive starts of the electric generator from cold, without recharging.

(c) Electrical connections shall be arranged so that the batteries can be used to start either main engine or electric generator engine by operating a manual change-over switch in the engine compartment.

(d) The batteries shall be charged by engine driven alternators with backup service provided by an automatic battery charger. 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 main engine starting.

(e) Batteries to be of maintenance-free type
(i) There will be two sets of 24V batteries charged directly from engine driven alternators, electric generator and/or the solar panel system. There shall be one battery set allocated to each engine.

(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 years, or 200 full discharge cycles at full load, rated in accordance with cognizant regulatory body requirements.

(f) Each engine driven alternator shall have its own built-in voltage regulators, automatic cut-off, and any other required protective devices.

(g) The batteries shall be located as close as practicable to the engines in order to minimise 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.

8.4.2 Batteries for Routine and Emergency supply

(a) 24V battery shall be provided for routine and emergency supply, all emergency equipment shall operate from a dedicated 24V DC power supply.

(b) In event of main electrical AC power failure, 24V DC batteries shall act as an 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.

(c) 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 for a period not less than six hours.

(d) The batteries shall be installed in a separate compartment located outside of the engine compartment above deck. The compartment shall be well ventilated and prevent ingress of water.

8.4.3 Batteries for Electronic Equipment

(a) 12V battery shall be provided solely for the electronic equipment.

(b) The batteries shall be installed in a separate compartment located outside of the engine compartment above deck. The compartment shall be well ventilated and prevent ingress of water.

8.4.4 12/24V DC services shall be supplied from the switchboard in the steering console 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 control console;
(f) Electric locks;
(g) Public address;
(h) One hand-held searchlight and one fixed searchlight;
(i) Siren; and
(j) Any other navigational and electronic equipment (if applicable).

8.4.5 The batteries as required in Paragraphs 8.4.1 and 8.4.2 shall be subject to continuous trickle charge under normal operation of the Vessel by an automatic battery charger. Under the battery fully discharged condition, the charger shall be able to perform a quick charge function.

8.4.6 Apart from the charger, a provision shall also be made to allow the batteries to be charged by an engine driven alternator. The battery chargers shall provide automatic control between float and boost charges. 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 fully charged condition within ten hours.

8.4.7 Battery charger installations shall meet all cognizant regulatory body requirements including:

(a) The chargers shall be sized such that a completely discharged battery bank can be recharged to 80% capacity within eight hours (100% at ten hours). At the end of the charge, the charge shall be tapered to a trickle value.

(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 main propulsion engines and the 220V AC generator. Battery chargers shall not be mounted directly over batteries.

(e) The battery systems must have the ability to be charged from the solar panels. The solar panel system shall be fitted to the roof of the deckhouse as per Conceptual General Arrangement Plan and utilise maximum practical roof space for maximum solar collection. The capacity of solar panel system shall be provided the power consume by lighting and ENE (excluded the radar).

(f) Battery selector/isolator switches shall be provided between battery chargers and the battery banks they serve.

(g) Provisions shall be made to allow either main engine to be started by the other engine's starting batteries.

8.4.8 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 in the deckhouse.

8.4.9 Batteries shall be permanently installed in a dry, ventilated location above the anticipated bilge-water level.

(a) Battery compartment(s) shall be actively ventilated whenever batteries are charging.

(b) Batteries shall be located in areas so as to avoid heat soak. Emergency batteries shall be located in the area outside the engine compartment such as, deckhouse.

(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.

8.4.10 Batteries shall not be installed directly above or below a fuel tank or fuel filter.

8.4.11 Any metallic component of the fuel system within 300 mm above the battery top, as installed, shall be electrically insulated.

8.4.12 Battery cable terminals shall not depend on spring tension for mechanical connection to them.

8.4.13 A battery-disconnect switch shall be installed in the positive conductor from the battery, or group of batteries, connected to the supply system voltage in a readily accessible location, as close as practical to the battery or group of batteries except the circuits for engine starting and navigation lighting and 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.

8.4.14 Local information plates showing the voltage, ampere-hour rating, group number and application shall be provided for each battery set.

8.5 Shore Power Supply and Connection

8.5.1 The electrical system shall include the provision for shore power supply (220 VAC, 50 Hz) designed to an approved standard.

8.5.2 The shore power system shall be interlocked to prevent the Vessel's electric generator from providing power to the shore. Indicating lights for "shore power available", "shore power breaker on" and "shore power breaker closed" to be fitted.

8.5.3 The Contractor shall provide a 1:1 isolation transformer for the shore power supply. 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

8.5.4 The watertight connection box shall be designed with a quick release receptacle.

8.5.5 Not less than 20 metres long shore connection power cable of adequate rating with quick release watertight plug shall be provided.

8.5.6 The 20 metres shore connection power cable terminating at compatible connections to mate with existing facilities, to be identified by GNC. Suitable stowage on board shall be provided for the cable.

8.6 Circuit Breaker

8.6.1 All circuit breakers shall have time delay thermal overload trip and instantaneous short circuit current trip. The overload trip shall be set at 110% of the maximum circuit load current. The cable rating shall be in excess of the circuit breaker overload tripping current.

8.6.2 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.

8.7 Motor and Control Gear

8.7.1 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 the deckhouse.

8.7.2 Motors installed in the engine compartment 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.

8.7.3 A circuit diagram shall be placed in the local control box of each electrical installation.

8.8 Cable, Wiring and Fuse

8.8.1 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.

8.8.2 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 minimise earth faults.

8.8.3 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 to be supplied and allowable voltage drop for the load to be carried.

8.8.4 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.

8.8.5 The metallic sheathing, armour or braid of cable shall be properly earthed at both ends. All bare terminals shall be properly insulated by approved cable insulators.

8.8.6 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.

8.8.7 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 1 m 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.

8.8.8 Wiring shall be run along perforated metal trays and shall be secured in such positions as to allow easy maintenance.

8.8.9 Wiring shall not be installed below the engine compartment floor plates.

8.8.10 Cables and wiring inside accommodation areas shall run behind linings which shall have removable panels for inspection and maintenance.

8.8.11 Where electric cables have to be fitted on the decorative surface of bulkheads, they shall be enclosed in conduits.

8.8.12 RO approved watertight cable glands shall be provided in way of watertight bulkhead or deck penetrations.

8.8.13 The penetration should be located as high as practicable and well clear from the ship side. [D]

8.8.14 Each electrical cable that is part of the electrical system shall have a means to identify its function in the system, except for conductors integral with engines as supplied by their manufacturers.

8.8.15 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.

8.8.16 Tally plates showing the cable size and the number of cores shall be provided for each of the main power cables.

8.8.17 All fuses shall be of cartridge type and rated adequately for the protected circuits.

8.8.18 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.

8.9 Lighting Fixtures

8.9.1 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.

8.9.2 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.

8.9.3 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.

8.9.4 All lighting in the deckhouse control panel shall be fitted with a dimmer control at night. Emergency lighting of 24V DC supply shall be provided for all compartments, emergency embarkation stations and open decks as per RO Requirements.

8.9.5 Emergency exit routes shall be identified and illuminated as required by RO Requirements.

8.9.6 Lighting shall be provided in deckhouse above the desks and working areas.

8.9.7 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. Fixtures shall be installed so that illumination there from will not be obstructed by fixed pipes, ducts, bins, berths, etc.

8.9.8 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.

8.9.9 All sockets, terminal blocks, and switch and receptacle interiors shall be made of non-flammable phenolic material.

8.10 Navigation Light

8.10.1 All navigation and signal lights to be provided shall be in compliance with the International Regulations for Preventing Collisions at Sea 1972, as amended by International Maritime Organisation (IMO) Resolution A464(XII) of the Inter-governmental Maritime Consultative Organization and Resolutions A.626(15), A.678(16), A.736(18), A.910(22), A.1004(25) and A.1085(28) of the International Maritime Organization, except Rules 39, 40 and 41. Type Approved Certificate in respect of each model of the navigation and signal lights issued by an RO shall be provided on or before the Delivery Acceptance at the latest.

8.10.2 The lighting shall be controlled from a control and alarm signal panel in the deckhouse. 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.

8.10.3 Navigation light circuits shall be independent of any other circuit. There shall be two essentially separate power supply systems to the distribution board: one from the main AC power source and one from the emergency DC power source.

8.10.4 The following navigation 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 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) One all round flashing red light on top of mast without restriction, indicating the Vessel is on duty;
(h) Three Black balls;
(i) One Black diamond;
(j) One Whistle;
(k) One Bell and;
(l) Any other navigation lights as required.

8.10.5 Three sets of spare bulbs (one per light) shall be provided for the navigation and signal lights.

8.11 Searchlight

8.11.1 Two Proprietary Make 220V AC 600 W adjustable remote control searchlight shall be provided (Xenon or LED).

8.11.2 The searchlights shall be installed on the top of the deckhouse. The switches for the searchlight shall be mounted adjacent to the searchlight control handle/joystick. The searchlights shall be remotely controlled by handle/joystick located in the deckhouse control station for turning and tilting.

8.11.3 Tarpaulin covers shall be provided for the searchlights.

8.11.4 One 24V DC LED portable search lights (with luminosity equivalent to not less than 150 W conventional type) with 30 metres water proof cable reels and plugs shall be provided in the deckhouse.

8.12 Floodlights

8.12.1 Eight Proprietary Make 220V AC LED fixed floodlights (with luminosity equivalent to not less than 35 W conventional type) shall be installed on the top of the deckhouse. These shall cast lighting suitable for the intended use of the vessel and to allow safe operation of the aft deck equipment at night.

8.12.2 One Proprietary Make 220V AC Xenon fixed floodlight (with luminosity equivalent to not less than 300 W conventional type) shall be fitted at the forward end of the Vessel on the foredeck (low profile mounting) to illuminate forward of the vessel. The orientation of this floodlight shall be fixed.

8.12.3 The layout and orientation of all lighting is to be approved by the GNC.

8.13 Power Receptacles / Sockets

8.13.1 Receptacles/sockets installed in locations subject to rain, spray or splashing shall have a minimum protection of IP 55, in accordance with IEC 60529 when not in use, e.g. protected by a cover with an effective weatherproof seal.

8.13.2 A system of 220V AC 13A and 24V DC 5A socket outlets shall be provided in all the internal compartments, fore and aft ends of the Vessel on the main deck and in the deckhouse of the Vessel.

8.13.3 Sockets shall be provided in the deckhouse for personal computers, charger for portable VHF, charger for digital camera, charger for mobile phone, desk lamp, spare etc.

8.13.4 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.

8.13.5 Sockets for different voltage systems shall be clearly labelled and with different pin sizes so that one system cannot plug into the other.

8.13.6 Power sockets on the weather deck, in the engine compartment 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.

8.13.7 The layout of all sockets shall be approved by the GNC.

Chapter 9 - Electronic Navigational Equipment

9.1 Description of Electronic Navigational Equipment (ENE) System

9.1.1 The Contractor shall be responsible for the supply, delivery, testing, installation, commissioning and a 12-month warranty from the date of the Acceptance Certificate and provision of operational and maintenance service manual and training of the following ENE items to be fitted on board the Vessel for FSD:

(a) Loudhailer/Siren and Public Address System;

(b) Magnetic Compass and Fluxgate Compass;

(c) Marine Radar;

(d) Electronic Chart Display and Information System (ECDIS);

(e) International Maritime Mobile (IMM) VHF Radio with VHF DSC of GMDSS;

(f) Automatic Identification System (AIS);

(g) CCTV System;

(h) Wind Speed / Direction Indicator;

(i) Marine Band Hand-held Waterproof Radio Transceiver;

(j) Thermal Night Vision System;

(k) Third Generation Mobilising System and Digital Trunk Mobile Radio System;

(l) Wired Intercom System; and

(m) Multi-beam sonar.

9.1.2 The Contractor shall provide all labour, materials, transportation, installation calibration, testing and commissioning, Warranty Services in Warranty Period and test equipment etc. which are necessary to complete the work required in this chapter.

9.1.3 An integrated system is preferred, so that information and also the display monitors of different systems, such as ECDIS, radar system, AIS receiver, can be shared in order to utilise the limited space available in coxswain operation area and to provide users a better displaying interface.

9.1.4 All Equipment offered shall be designed for marine applications and shall allow effective operation under most arduous condition i.e. poor weather, strong winds and heavy rains, severe vibration, etc. Exposed components shall be weather-proof and adequate protection against splash and water shall be provided for all electronic equipment fitted on board.

9.1.5 All components of the Equipment exposed to the weather shall be sea water resistance. Internal components shall be fully enclosed (IP65) with heavy duty seals and sufficient heat dissipation mechanism (e.g. ventilation, conduction, etc.) to protect the Equipment.

9.1.6 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. All radar and radio equipment shall meet both the applicable requirements of the International Maritime Organization and the licensing requirements of the Office of the Communications Authority of Hong Kong.

9.1.7 All siting, installation and cabling in respect of compass, VHF, radar, etc. shall comply with the relevant rules and regulations of Hong Kong.

9.1.8 All ENE and electrical appliances shall have Hong Kong warranty and their on-site maintenance shall be locally available.

9.1.9 When the generation / use of calendars are employed for logging of reports, activation of 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.

9.1.10 The circuit-breaker for the ENE shall equip with lockout device so that the breaker can be locked during the equipment maintenance.

9.1.11 Lightning protection shall be provided and installed wherever applicable. The lightning arresters for all outdoor antennas shall be installed at the antenna ends.

9.1.12 Equipment supplied shall complete with all standard and/or maker recommended accessories as required for normal operation.

9.2 Loudhailer / Siren and Public Address System

9.2.1 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.

9.2.2 Loudhailer/Siren

(a) The system shall comprise a master control unit in the wheelhouse and two weather proof horn type loudspeakers, in conformance to IPX5 or better, located at forward and aftward 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 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 for night operations.

(d) The master control unit, 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 horn type loudspeakers shall be weatherproof reflex type, with power rating not less than 30 watts each and with impedances compatible with the amplifier.

(g) 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.

(h) An electric fog horn shall be installed.

9.2.3 Public Address System

(a) There shall be at least two speakers installed around the crew area for a one-way internal broadcast to the crew from the microphone at the control panel. 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.

(b) The positions of the master control unit of the loudhailer/siren system, control panel and both the position & quantity of speakers of the public address system shall be finalised in the detailed design stage.

9.3 Magnetic Compass and Fluxgate Compass

9.3.1 The Contractor shall provide one magnetic compass and one fluxgate compass with digital display.

9.3.2 The magnetic compass shall have a direct-read dial with dial size of at least $2\frac{3}{4}$ inch.

9.3.3 The magnetic compass shall have a green night lighting function.

9.3.4 The magnetic compass shall have a built-in compensator to adjust for deviation.

9.3.5 The power of the equipment shall be supplied from the 12 or 24 V DC system of the Vessel.

9.3.6 The compass dome shall be constructed of heavy duty, optically clear polymer, and shall provide clear and accurate magnification of the dial.

9.3.7 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.

9.3.8 An electronic display unit shall be installed at a position for easy viewing of Vessel heading by the coxswain.

9.3.9 The fluxgate compass shall be electronic such that GPS/DGPS/DGNSS will not cause deviation.

9.3.10 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.

9.3.11 Performance Requirements of fluxgate compass:

(a)	Reference	Either magnetic north or true north.
(b)	Accuracy	$\pm$1.0∘ typical or better.
(c)	Resolution	0.1∘ or better.
(d)	Deviation Compensation	Automatic.
(e)	Operating Temperatures	0℃ to 50℃
(f)	Waterproofing	IPX5 or better.

9.3.12 Performance requirements of magnetic compass:

(a)	Resolution	2∘ typical or better.
(b)	Mounting option	$\pm$1.0∘ typical or better.
(c)	Waterproofing	0.1∘ or better.

9.4 Marine Radar

9.4.1 The Contractor shall supply two radars, one is X-band and one is S-band. Both radars shall have an independent transceiver, a scanner and a colour display unit which satisfy the following requirement.

9.4.2 General Requirements for X-Band and S-Band Radar

(a) The equipment shall be a relative motion high performance radar suitable for vessels and comprises a transceiver, an antenna and a colour display unit, suitable for bright daylight and night viewing.

(b) The radar shall have interface to accept navigation data such as latitude/longitude position of the Vessel given by the GPS receiver.

(c) The radar shall be able to track high speed small crafts easily.

(d) The radar shall also be able to detect tiny targets such as small buoys or wooden stakes.

(e) The radar shall be using solid state technology or equivalent technology such that the warm up time from power on to operation is less than 1 minute or better.

(f) The Contractor shall ensure that the type and the number of provisions of the radar are appropriate to the class of the Vessel.

(g) The radar shall be equipped with a collision avoidance function that is an Automatic Radar Plotting Aid – ARPA or other equivalent function capable of tracking at least 20 targets.

(h) The collision avoidance function shall be able to display the "no go areas" directly on radar screen. This function shall support the navigator finding a save way and avoiding situations of possible collision. This function shall also analyse the movement of the plotted objects and determine in which areas the danger causes by a possible crash is exceptional high. These areas are displayed as a hatched field. If the navigator avoids these so-called "no go areas", it navigates most probably on a safe route. This function shall show true zones (in relation to other true objects e.g. chart underlay, buoys, true marks, traffic separation zones, navigation lines).

(i) 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.

(j) The radar scanner unit shall be installed well clear of obstruction 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.

(k) Complete interface kit shall be provided to interface the radar for the gyro compass, fluxgate compass, GPS/DGPS/DGNSS, 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/DGNSS receiver.

(l) 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.

(m) 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.

(n) The radar shall have standard NMEA 0183 or NMEA 2000 interface ports, capable of accepting navigational data from a wide selection of GPS/DGPS/DGNSS 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.

(o) The power of the equipment shall be supplied from the DC 24V system of the Vessel.

(p) 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.

(q) 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.

(r) The display unit shall be a high resolution Thin-Film Transistor (TFT) colour display, combining brilliant display quality and compact design with a long life time.

(s) 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; and

(xii) Heading marker ON/OFF.

(t) The marine radar system shall comply with latest International Maritime Organization (IMO) regulations and requirements on IMO Res. A.823(19), MSC 64 (67) Annex 4, MSC.192(79) and A.820 (19)-High Speed Craft Code.

9.4.3 Performance Requirements

(a) The marine radar shall perform at least or better than the following requirements in this paragraph.

(b) Display Unit

(i)	Display	TFT colour LCD
(ii)	Screen Size	1917 inch or larger
(iii)	Resolution	1280 x 1024 pixels or better
(iv)	Range	0.125 nm – 96 nm
(v)	EBLs (Electron Beam Lithography)	2
(vi)	VRMs (Voltage Regulator Module)	2
(vii)	Parallel Index Lines	2
(viii)	Display Presentations	RM (R), RM (T), TM
(ix)	Display Heading Modes	H Up, N Up, C Up, R Up
(x)	Gyro Input	NMEA, Fast NMEA
(xi)	Log Input	NMEA, pulse

(c) X-band Transceiver

(i)	Peak Power (kW, typ.)	25
(ii)	Radar Max Range	72nm or better
(iii)	Receiver Noise (dB)	6.0 or better
(iv)	Pulse Width (μsec)	Short: 0.08 or better Med 1: 0.3 or better Med 2: 0.6 or better Long: 1.2 or better

(d) S-band Transceiver

(i)	Peak Power (kW, typ.)	30
(ii)	Radar Max Range	96nm or better
(iii)	Receiver Noise (dB)	5.0 or better
(iv)	Pulse Width (μsec)	Short: 0.06 or better Med 1: 0.25 or better Med 2: 0.5 or better Long: 1.0 or better

(e) Antenna for X-band Radar

(i)	Operating Frequency	:	X–band
(iii)	Scanner Size	:	6 feet
(iv)	Horizontal Beam Width	:	1.2 deg or less

(v)	Vertical Beam Width	: 25 deg or less
(vii)	Polarisation	: horizontal
(viii)	Rotation Rate (RPM)	: 24 – 48 or better (It shall be adjustable according to the selected range scale or pulse length for optimum detection)
(ix)	Wind Load	: 100 kts

(f) Antenna for S-band Radar

(i)	Operating Frequency	: S–band
(iii)	Scanner Size	: 12 feet
(iv)	Horizontal Beam Width	: 1.9 deg or less
(v)	Vertical Beam Width	: 26 deg or less
(vi)	Gain (dB)	: 28 dB or better
(vii)	Polarisation	: horizontal
(viii)	Rotation Rate (rpm)	: 24 – 48 or better (It shall be adjustable according to the selected range scale or pulse length for optimum detection)
(ix)	Wind Load	: 100 kts

(g) 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 1.5 degree. Bearing discrimination shall be better than 2.0 degrees.

(h) ARPA (Automatic Radar Plotting Aid) Requirement

(i)	Target Acquisition	: 70 targets or better
(ii)	Tracking	: Automatic
(iii)	ARPA Range Scales	: From 0.75 to 12 nautical miles or better
(iv)	Readout of Selected Target	: Range, bearing, course, speed, CPA (Closest Point of Approach), TCPA (Time to Closest Point of Approach)
(v)	Target Vector	: Relative, true
(vi)	Intercept Mode	: Automatically calculate intercept course and Time to Go (TTG) to tracked target Adjustable warning limit – warming for CPA to a desired adjustable limit

(i) 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.

(j) The following standard interfaces shall be provided:

(i) USB interface for external units or updating by USB stick

(ii) CAN Bus (Controller Area Network)

(iii) Video Graphics Array (VGA) video output to add remote display or connect Voyage Data Recorder (VDR)

(iv) Alarm output via National Marine Electronics Association (NMEA)

(v) Connection to gyro or Global Positioning System (GPS), via NMEA, or Fast NMEA

(vi) SENC (System Electronic Navigation Chart) data input from Synapsis ECDIS (Electronic Chart Display Information System)

(k) The following system integration function shall be provided:

(i) AIS (Automatic Identification System) display of AIS targets, additional information to provide a better overview of traffic situation

(ii) ECDIS / GPS Display route coming from ECDIS / GPS

(iii) ARCP-Panel (Autopilot Remote Control Panel) Autopilot operation directly from radar workplace

(iv) SENC-Data (System Electronic Navigation Chart-Data) Input of selected chart symbols from ECDIS

9.5 Electronic Chart Display and Information System (ECDIS)

9.5.1 General Requirements

(a) One set of ECDIS must provide the following functions:

(i) Navigational calculation

(ii) Chart updating

(iii) Piloting

(iv) Voyage monitoring

(b) The ECDIS shall be installed with DGPS/DGNSS receiver and echo sounder. It shall consist of a screen monitor, a remote GPS antenna and differential beacon receiver, an echo sounder and a processor unit with controller.

(c) The ECDIS shall be able to show the radar, AIS, depth of water by echo sounder and ENC information. Different display options shall be allowed, including but not limited to the following combinations:

(i) Electronic Chart only

(ii) Electronic Chart + Radar

(iii) Electronic Chart + AIS

(d) The information received by the Global DGPS/DGNSS receiver shall be input to the marine radar and display on the marine radar and the screen monitor of ECDIS. 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 is acceptable.

(e) One screen monitor of size not less than (17 inches) diagonal high resolution colour LCD for the Vessel. The screen monitor must fulfill the following features:

(i) 1000 nits Brightness;
(ii) HDMI, DVI and Composite inputs;
(iii) On-class menu keys; and
(iv) Can be operated as radar, chart plotter, depth sounder, alarms etc.

(f) The ECDIS 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 monitor of ECDIS.

(h) Complete interface kit shall be provided to interface with the colour chart plotter for the navigation equipment on board, including but not limited to, the radar, echo sounder, AIS, GPS/DGPS/DGNSS. The colour chart plotter shall accept and display information given by the radar, echo sounder, AIS, GPS/DGPS/DGNSS receiver and 3D sonar.

(i) The processor unit of the ECDIS shall accept and display information given by the ENE equipment: Radars, VHF, AIS transponder, DGPS/DGNSS and three control consoles. The processor unit shall have high-performance quard-core processor for rapid, responsive operation of the multiple touch screen monitor.

(j) The ECDIS should provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment. [D]

(k) The ECDIS shall be capable of reading and loading IHO S-57 (Version 3.1) ENC data file and update the same where necessary.

(l) The chart information to be used in ECDIS should be the latest edition, can be corrected by official updates (S-57 digital charts) by the Marine Department Hong Kong Hydrographic Offices of MD with records of update shown on the ECDIS.

(m) The ECDIS should enable the mariner to execute in a convenient and timely manner all route planning, route monitoring and positioning currently performed on paper charts. It should be capable of continuously plotting the ship‘s position. [D]

(n) The ECDIS shall be provided with USB ports for maintenance and updating of data purposes.

(o) The ECDIS should be capable of displaying both English and Traditional Chinese characters of the ENC. [D]

(p) The EDCIS should store 12 hours history voyage record and can be reproduced on the EDCIS. [D]

(q) The Contractor shall provide software updates to ensure the ECDIS is at its latest version. [D]

9.5.2 Performance requirements

(a) Navigational Features

Total Waypoint	:	2000 or more
Routes	:	50 route plans or more
Alarms	:	including but not limited to, proximity alert, cross-track error, and arrival /anchor watch

(b) Electrical and Physical

Power Source	:	12 - 24V DC (external)
Display (Screen Type)	:	17 inch or greater diagonal high resolution colour display, resolution 1280 x 1024 pixels or better

(c) Environmental

Operating Temperature	:	-10 oC to +50 oC
Storage Temperature	:	-20 oC to +60 oC

(d) GPS Receiver

GPS Receiver Type	:	Equipped with 8 channel parallel receiver or better
Frequency Range (GPS)	:	1575.42±1MHz (C/A code), L1
Sensitivity (GPS)	:	-130 dBm or better
Dynamic Range (GPS)	:	25 dB or better
Warm start fix time	:	less than 30 seconds
Cold start fix time	:	less than 3 minutes

	Position Accuracy	:	no greater than 15m
	Tracking Velocity	:	999 kt

(e) Differential Beacon Receiver

Frequency range	:	283.5-325 kHz
Frequency Step	:	500 Hz
Position Accuracy	:	no greater than 5m

(f) Data Display

Lat/Lon	:	N or S plus 7 digits
	:	E or W plus 8 digits
Antenna Height	:	4 digits, 1m resolution
Speed and Course	:	0.1 Kt or 0.1 Km/h resolution
	:	3 digit 1-degree resolution
Cross Track Error	:	Graphic or direction indication
Bearing	:	3 digits, 1-degree resolution
Range	:	4 digits, 0.01-nm resolution
CDI	:	Active perspective view, selectable scale (0.1, 0.3 or 0.5 nm)
Time	:	Selectable as GMT or local mode
Mapping	:	Resident world map in memory (reversible video)
Language for system	:	(i) English operation and display (ii) Bilingual (English and Chinese) is preferred [D]

(g) Electronic Charts Requirement – Livechart or equivalent

(i) Fully legal, vectorised and layered digital charts compiled according to International Hydrographic Organization (IHO) standards, such as S52, S57 and DX90, shall be required.

(ii) The charts shall accurately reproduce all the colours and details of the standard on paper charts referenced by the Hydrographic Office of MD and shall be identified by their original numbers.

(iii) The charts showing Hong Kong and nearby water shall be required.

(iv) Full chart update service shall be provided by the Contractor.Details of such service shall be submitted to the Government for approval.

9.6 International Maritime Mobile (IMM) VHF Radio with VHF DSC of GMDSS

9.6.1 The Contractor shall supply two sets of International Maritime Mobile (IMM) VHF radio with GMDSS.

9.6.2 General Requirements

(a) The IMM VHF radio shall conform to the performance requirements and standards adopted by the International Maritime Organization and meet the licensing requirements of the Office of Communication Authority of Hong Kong.

(b) The radio shall be integrated with a class A Digital Selective Calling (DSC) transceiver fully compatible with the International Maritime Organization (IMO) GMDSS carriage requirements.

(c) The radio shall be equipped with all the international maritime VHF channels completed with fist microphone with press-to-talk switch or telephone handset, mic/handset hanger, mounting bracket and loud speaker.

(d) The radio shall have an independent dual watch mode selection switch that incorporate with Channel 16 and shall be able to dual watch on any other selective channel.

(e) The following facilities shall be provided at 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 selection of Channel 16

(v) Channel selection and indicator

(vi) Independent dual watch mode selection switch

(vii) Transmission power selector for HIGH and LOW Power (25 W/ 1 W)

(f) The operating temperature of the radio shall be -5℃ to +55℃ or better. The water ingress protection for the radio shall be IPX7 or better.

(g) The radio shall be equipped with a lithium battery of lifetime at least five years.

(h) The radio shall be completed with antenna and integrated microphone, loudspeaker, control knobs/keys, display screen, re-chargeable battery etc., necessary for a stand-alone portable radio. The radio shall be equipped with a 220 V AC battery charger (for battery charging on shore) and one extra set of spare re-chargeable battery.

(i) The Contractor shall also supply a DC battery charger (one for each Vessel extra to the 220 V AC battery charger) which can be readily and directly connected to a DC power outlet at each Vessel such that the portable radio can be charged on the Vessel if necessary. Normally the DC battery charger shall be not in use and shall be stowed on the Vessel with stowing space and facilities provided by the Contractor.

(j) The radio shall be supplied with a belt clip and a shoulder carrying case.

(k) The Contractor shall provide proper stowing space and facilities for keeping of the portable radio and the spare battery such that the crew can take the portable radio out for use when necessary.

9.6.3 Performance Requirements

(a) Transmitter Characteristics

Spurious and Harmonics	:	-70 dB or better emissions
RF Output Power	:	25 W / 1 W (High / Low)

(b) Receiver Characteristics

Sensitivity	:	Less than -117dBm for 20 dB SINAD or equivalent
Adjacent Channel Selectivity	:	60 dB or better
Spurious Image Rejection	:	65 dB or better
Intermodulation	:	65 dB or better
Audio Output	:	Not less than 1 Watt for internal speaker at 10% distortion

(c) Aerial and Feeder

(i) The aerial provided shall be marine type aerial with at least 3 dBi gain, vertically polarised, omni-directional and suitable for mounting on the Vessel.

(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 joint shall be properly covered by waterproof tape or material.

9.7 Automatic Identification System (AIS)

9.7.1 General Requirements

(a) The equipment shall receive navigation information from local AIS-equipped vessels.

(b) The equipment shall be a Class A universal AIS complying with IMO MSC. 74(69) Annex3, IEC 61993-2, ITU-R M.1371-3, ITU-R M.493-13, ITU-R M.825(DSC), IEC 60945, IEC 61162-1/2.

(c) The AIS transponder (receiver module) shall be able to receive AIS information from AIS-equipped vessel nearby such as 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 names, type of ship, call signs, length and beam, heading, destination, latitude, and longitude, location of position-fixing antenna on the ship), short safety-related messages and other navigation data, from vessels nearby.

(d) The AIS supplied shall be completely compatible with all systems using NMEA standard and be able to interface with radar, ECDIS, gyro compass, and external GPS, etc.

(e) Edition of user message on navigation & ship securities shall be available.

(f) The AIS shall be easy to identify other ship's status by providing electronic chart data.

(g) The AIS shall have self-restoring function to enhance stability.

(h) The AIS shall adopt user-friendly one touch keypad (or equivalent).

(i) The AIS shall be weather-proof suitable for outdoor use for ship or vessel (or equivalent).

(j) Each set of AIS shall include:

(i) Not less than 5.6" AIS LCD colour graphic display unit AIS transponder unit

(ii) VHF antenna

(iii) GPS antenna

(iv) Installation / operation handbook

9.7.2 Performance Requirements

(a) The AIS shall comply with the following specifications:

(i) General

Power Consumption	:	50W peak / 10W average (Main Unit)
Power supply	:	12V DC + 10%
Default Frequencies	:	AIS1 (CH 87B) : 161.975 MHz AIS2 (CH 88B) : 162.025 MHz DSC (CH70) : 156.525 MHz
Frequency range	:	156.025 ~ 162.025 MHz
MKD Display	:	5.6"(or larger) Colour TFT LCD

(ii) AIS Transmitter

Power output	:	12.5W or 1.0W (41 dBm ±1.5 dB or 30 dBm ±1.5 dB)
Antenna impedance	:	50 ohms (SO-239)
Channel spacing	:	25 kHz

(iii) AIS Receiver

Sensitivity	:	(PER) < 20% at -107 dBm
Modulation	:	GMSK

Data rate	:	9600 bits/s
Frequency stability	:	< ±1 ppm
Co-Channel	:	10 dB
Adjacent Channel	:	70 dB
IMD	:	65 dB
Blocking	:	84 dB

(iv) DSC Receivers

Sensitivity	:	BER <10-4 at 107 dBm
Modulation	:	FSK (1300 Hz / 2100 Hz)

(v) Serial inputs/outputs

SENS1/2/3/4	:	IEC61162-1/2 (input only)
LONG/AUX/PILOT/RTCM	:	IEC61162-1/2 (input & output)
Display	:	RS422 non-isolated

(vi) GPS Antenna & Receiver

Antenna	:	PATCH ANTENNA / TNC (RG-58U)
Receiver Type	:	16 channel, L1 frequency, C/A code
Acuracy	:	Acquisition -140 dBm / Tracking -150 dBm

(vii) Environment

Operation temperature	:	-15℃ to +55℃
Storage temperature	:	-25℃ to +75℃
Vibration	:	IEC 60945

(b) Aerial and Feeder

(i) The aerial provided shall be 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 joint shall be properly covered by waterproof tape or material.

9.8 CCTV System

9.8.1 General

(a) The Contractor shall finalise the locations of the cameras with FSD during the design stage.

(b) Unless otherwise stated, all cameras shall be high-resolution, water-proof, vandal-resistant type, ICR day and night dome pan tilt zoom camera. They shall be marine type and shall be suitable for operation in rough sea environment.

(c) All cameras shall have image stabilisation function to accommodate the rough sea conditions.

(d) All cameras shall be able to cover diagonal view by wide angle lens or standard lens according to the actual condition.

(e) LCD monitor, screen with not less than 2117 inches diagonal measurement, shall be provided for display of video image.

(f) After installation of the system, the Contractor shall provide free on site operational training on the Vessel to ensure proper operation of the system until MD's satisfaction.

(g) The control and monitoring of the CCTV for general purpose shall be located in the wheelhouse. The Contractor shall finalise the locations with FSD during the design stage.

9.9 Wind Speed and Direction Indicator

9.9.1 A marine type wind speed and direction indicator of proprietary make shall be provided and the wind speed data shall be shown in the ECDIS.

9.9.2 The indicator shall interface to the ECDIS.

9.9.3 The indicator shall provide on board with data display being installed inside the wheelhouse.

9.9.4 The indicator shall be mast mounted at unobstructed position.

9.10 Marine Band Hand-held Waterproof Radio Transceiver

9.10.1 General Requirement

(a) The Contractor shall provide 2 sets of GMDSS VHF waterproof Marine band handheld transceivers.

(b) Each portable maritime VHF transceiver shall be of proprietary make and completed with two sets of rechargeable batteries, batteries charger, helical antenna with V.S.W.R. not exceeding 1.5:1 and carrying case (with shoulder strap or belt clip).

(c) The operation period of each fully charged battery shall not be less than 12 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.

(d) The portable transceiver shall be at least able to transmit and receive on all the 55 International Maritime VHF channels, together with the private maritime VHF single frequency channels 96 (157.925 MHz) and/or 99 (157.975 MHz).

(e) The transceiver shall be of robust, splash-proof, light weight design and made with shock proof material suitable for hand held radio communication both on the Vessel and ashore.

(f) The transceiver shall be fully solid state and of software programmable carrier frequency type. Add-on crystal for carrier frequency will not be acceptable.

(g) The unit shall be a type approved model accepted by OFCA for maritime frequency band application.

9.10.2 Performance requirement

(a) The transceiver shall at least incorporate with the following controls / switches / facilities:

(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 and operating channel display; and

(vii) sockets for external microphone, press to talk switch and loudspeaker.

(b) The transceiver shall at least comply with the following technical specifications :

General		
Operating Centre Frequency Range of	:	International Maritime VHF Band of
Pre-programmed channels	:	GMDSS
Additional programmable channels	:	At least 90
Operating Mode	:	Simplex or Two Frequency Simplex
Channel Spacing	:	25 kHz
Frequency Stability	:	+/- 8 ppm between 0 and 50oC
Housing IP Category	:	IP 57
Transmitter		
RF Transmitting Power	:	2 Watts at High Power Mode 1 Watt at Low Power Mode
Adjacent Channel Power	:	Below -65 dBC
Spurious and Harmonic Emission	:	Below 25 W
FM Hum & Noise	:	40 dB or better
Receiver		
Receiver Sensitivity	:	-117dBm or better for 12 dB SINAD
Receiver adjacent channel selectivity	:	70 dB or better
Intermodulation Response Rejection	:	70 dB or better
Blocking/Desensitisation Level	:	90 dB□V or better
Spurious Response	:	70 dB or better
Spurious Emission	:	Below 20 nW
Total Harmonic Distortion	:	Less than 10 %
Signal/Noise Ratio	:	40 dB or better

9.11 Thermal Night Vision System

9.11.1 General Requirement

(a) Each set of thermal imaging camera system shall include:

(i) thermal night vision camera;
(ii) touch screen multi-function display (MFD);
(iii) joystick control unit for touch screen MFD display;
(iv) external GPS antenna for touch screen MFD display; and
(v) Hong Kong water charts for touch screen MFD display.

(b) It shall be long-range thermal night vision with a colour zoom camera and gyro-stabilization.

(c) The active gyro-stabilization shall provide steady imagery, even in rough seas.

(d) The thermal night vision camera shall come with a colour television camera with 10X optical zoom which shall provide continuous zoom and shall match the thermal night vision camera's e-zoom for easy operation when switching between cameras.

(e) Colour on-screen symbols shall be provided for detailed 3D colour on-screen symbols giving users instant access to system status, position and configuration.

9.11.2 Technical Requirement

(a) Thermal Night Vision Camera:

Thermal Imaging

Sensor Type	:	640 X 480 Vanadium Oxide (VOx) Microbolometer
Field of View (FOV)	:	18 o X 14 o (NTSC)
Focal Length	:	35mm
e-zoom	:	2x & 4x
Frame Refresh Rate	:	< 9Hz or better

Colour Daylight Imaging Camera

Detector Type	:	Colour CCD
Field of View (FOV)	:	58 o (h) X 43 o (v) with 10x optical zoom slaved to thermal night vision camera or better
Lines of Resolution	:	530 or better
Minimum Illumination	:	1.4 Lux or better

System

Stabilisation	:	2-Axis Gyro-Stabilization
Pan/Tilt Coverage	:	360 o Continuous Pan +/- 90o Tilt
Video Output	:	NTSC or PAL
Accessories	:	BNC with BNC-to-RCA adapter included for video out
Power Requirements	:	compatible with the Vessels'power supply
Colour Mode	:	5 different Colour Mode : Greyscale, Red (night mode), GlowBow, Rainbow & Fusion (Note : each also has a polarity inversion ; greyscale <=> WhiteHot and BlackHot)
Camera Modes	:	Pause, Reverse (Rearview)

Environmental

Operating Temperature Range	:	-25 oC to +55 oC (per IEC 60945)
Automatic Window Defrost	:	Standard
Sand/Dust	:	Mil-Std-810E
Water Ingress	:	IPX6 or better
Shock	:	15g vertical, 9g horizontal or better
Vibration	:	IEC 60945; MIL-STD-810E
Lightning Protection	:	IEC 60945
Salt Mist	:	IEC 60945
Wind	:	100 knots (115.2 mph)
EMI	:	IEC 60945

Range Performance

Detect Man (1.8m x 0.5m)	:	up to 3,300 ft. (1.0km)
Detect Small Vessel (4m x 1.5m)	:	up to 2.4 miles (3.9km)

(b) Touch screen MFD shall:

(i) control directly the thermal night vision camera

(ii) be touch screen and non-touch screen with keypad buttons control selectable

(iii) have built in WiFi to take full control and monitoring of the thermal night vision camera / touch screen MFD from smartphone or tablet via free-of-charge mobile apps

(iv) have built in GPS / chartplotter features

(v) be easy to customise the touch screen MFD with full or split screen, windows of charting, GPS, thermal night vision camera and colour daylight imaging camera

(vi) Display : 17 inches TFT backlit, at least 1280 X 800 pixels, LCD multi-function color display unit

Viewing Angles	:	80o left/right and 80o 60o top/bottom
Networking Capability	:	Yes
Waterproofing	:	IPX6
Mounting Methods	:	Surface mount. Trunnion mount with bracket
Cartography	:	Hong Kong Water Chart Datum
Wireless Connectivity	:	WiFi 802.11b/g;
Bluetooth	:	AVRCP 2.1+EDR power class 1.5
GPS	:	Built-in 50 channels; WAAS, EGNOS and MSAS. Automatic signal acquisition and almanac update; Operating frequency: 1575.42MHz; Geodetic Datum: WGS-84, Active Jamming Reduction; Ceramic Chip antenna; Accuracy: without SBAS < 15m 95% of the time. With WAAS/EGNOS <5m 95% of the time.

(c) Joystick Control Unit for Touch Screen MFD Display:

(i) Dedicated thermal camera controller, featuring 3 axis puck control, function keys and an LCD

(ii) Compatible with the thermal night vision camera and touch screen MFD

(iii) To provide the controls to operate and configure the camera

(d) External GPS Antenna for Touch Screen MFD Display

(i) To provide information to the thermal imaging camera system

(ii) Compatible with the thermal imaging camera system

(e) Hong Kong Water Charts for Touch Screen MFD

(i) To provide digital chart data of Hong Kong Water information to the thermal imaging camera system

(ii) Compatible with the thermal imaging camera system

9.11.3 Functional Requirement

(a) In surveillance mode the thermal night vision camera (the Camera) shall pan left and right continuously. The Camera shall continue to pan until surveillance mode is disabled, or the JCU (Joystick Control Unit) is used to move the Camera. When this occurs the Camera does not automatically resume surveillance mode and the mode must be enabled again if required.

(b) The Camera shall include a mechanical stabilisation feature. The mechanical stabilisation feature shall improve image stability by compensating for vessel motion and keeping the Camera aimed at the point of interest. Mechanical stabilisation shall have two aspects: horizontal (azimuth) and vertical (elevation).

(c) Point mode function shall be provided to turn off the horizontal (pan) stabilisation while retaining the vertical (tilt) stabilisation. This can be helpful when users use the Camera as an aide to navigation and keep the camera pointing in the same position relative to the Vessel as it turns.

(d) A user shall be able to reverse the polarity of the video image to change the appearance of objects on-screen. The reverse video option (video polarity) shall switch the thermal image from white-hot (or red-hot if the colour mode setting is active) to black-hot.

(e) The Camera shall have a home position which is a preset position. The home position usually defines a useful reference point. A user shall be able to return the Camera to the home position at any time.

(f) The Camera shall have a rear view mode function to flip the video image horizontally, providing a "mirror image". This is useful when the Camera is rear-facing and a user is viewing the image on a forward–facing monitor.

(g) When user touches the touch screen MFD (cue) and the Camera shall automatically move to the cursor position (slew) so that it shall allow the user to keep chart objects like buoys or obstructions in constant view.

(h) The Camera shall have a target tracking function so that the Camera shall automatically keep "cued" targets in view at all times.

(i) The Camera and the touch screen MFD Display shall auto slew to dangerous MARPA and AIS targets, keeping dangerous targets in the Camera's sight during limited visibility situations.

9.12 Third Generation Mobilising System (TGMS) and Digital Trunk Radio System (DTRS)

9.12.1 The Contractor shall provide cable trunking, conduit and wiring and to install the equipment listed in the corresponding locations to the satisfaction of MD officer & EMSD officers.

9.12.2 Unless otherwise specified, the equipment set out in this Paragraph 11.16 shall be supplied by FSD. The Contractor shall liaise with FSD for the equipment during construction stage.

9.12.3 Technical Requirement of TGMS and DTRS

(a) Equipment in WheelHouse

Category	Item	Equipment	Working Voltage (V)	Working Current (Amp)	Standby Current (Amp)	Size (mm) Depth x width x height	Weight (kg)	Quantity	Remark
TGMS	1	TGMS Mobile Data Terminal (MDT)	12	3	0.7	52 x 236 x 285	2.2	1	
	2	TGMS Wireless Keyboard (WKB) with charging bed	12	2.0 (when charging)	0.1	174.8 x 325.7 x 27.5	3	1	

	3	TGMS OBE Box containing AVLS OBU, TMR and DC-DC converter	12	5	1	450 x 360 x 300	12.5	1	
	4	Dedicated RS232 GPS Data output Port (Data format shall be NMEA 0183 or NMEA 2000). Serial port baud rate :9600 bit/Sec, 8 bit data, No Parity and 1 stop bit.						1	
						Total weight (Approx.):	17.7 kg		

Category	Item	Equipment	Working Voltage (V)	Working Current (Amp)	Standby Current (Amp)	Size (mm) Depth x width x height	Weight (kg)	Quantity	Remark
DTRS Radio	1	Radio Terminal	12	2.2	0.5	169 x 170 x 45	1.07	1	Power shall be directly fed from the attached radio terminal unit.
		Enhanced Control Head	N/A	N/A	N/A	31 x 188 x 60	0.23	1	
DTRS	2	Portable Repeater (PR)	N/A	N/A	N/A	341 x 244 x 430	15	1	
Marine Radio	3	Marine Radio	12	3	1	250 x 190 x 65	1.6	1	
						Total weight (Approx.):	17.9kg		

Category	Item	Equipment	Working Voltage (V)	Working Current (Amp)	Standby Current (Amp)	Size (mm) Depth x width x height	Weight (kg)	Quantity	Remark
DTRS	1	TETRA Mobile Radio	12	2.2	0.5	250 x 188 x 60	1.3	1	
						Total weight (Approx.):	1.3kg		

(a) Equipment on roof or pole of vessel

Equipment	Category	Size (mm)	Weight (kg)	Quantity	Remark
Antenna	**TGMS** WDN **DTRS** DTRS	Approx. 30 dia., 760 height Approx. 30 dia., 660 height	0.8 0.8 0.5	2 set 1 set	Different antennas shall be separated with each other at least 300 mm. The weight of the antennae are estimated for reference only.
		Total weight (Approx.):	2.1 kg		

9.12.4 Physical Installation

(a) Mobile Data Terminal (MDT)

(i) An intelligent remote data terminal enabling FSD staff to send and receive data, provide dispatch information, process and display location on map, etc.

(ii) The MDT shall be installed in the cabinet of the Vessel for the crew to operate safely and conveniently.

(iii) The MDT shall be attached onto a pre-fabricated metal mounting bracket as shown in the diagram below. The Contractor shall provide a mounting platform or area for the metal bracket to fix on.

MDT with Wireless Keyboard

While not in use, the keyboard shall rest on the Keyboard Charging Bed (KCB) for recharging the battery inside the keyboard. The WKB with KCB shall be mounted near the MDT.

Wireless Keyboard

Keyboard Charging Bed

(b) TGMS On Board Equipment Metallic Box

A metallic box shall be installed in the cabinet of the Vessel. TGMS equipment TMR, AVLS OBU and DC-DC converter will be mounted inside the metallic box.

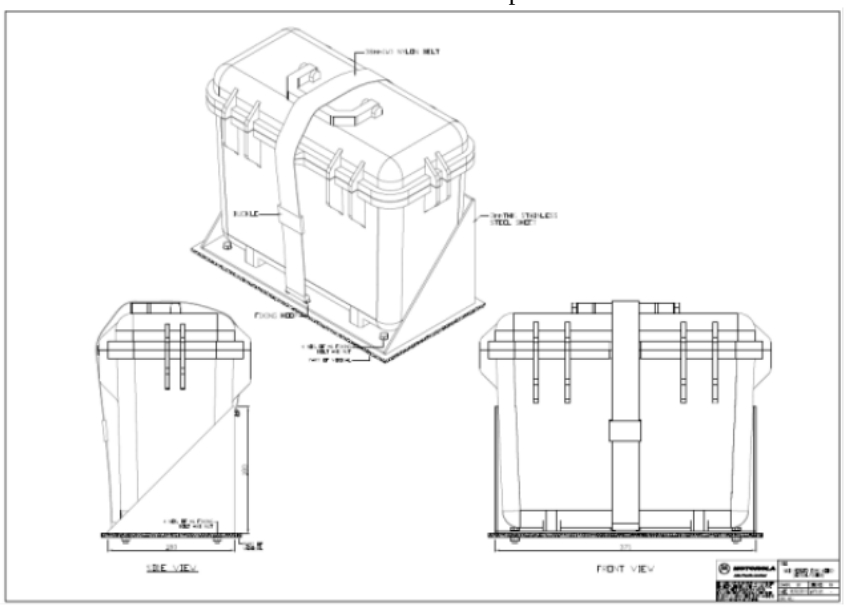
(c) TETRA Mobile Radio Units (TMRU)

A TETRA Mobile Radio consists of enhanced control head and radio terminal. The enhanced control head shall be flush mounted on metal plate in the cabinet while radio terminals are mounted inside the cabinet just behind the enhanced control head. The opening of base plate of the mounting plate shall be around 155 x 35 mm for each enhanced control head.

(d) DTRS Portable Repeater (PR)

It is a box with dimension about 430 mm(Height) x 244 mm(Width) x 341 mm (Depth) to be mounted on the compartment. The Contractor shall provide accommodation for the PR as in recommended in the figure below.

DTRS Portable Repeater



Recommended fixing method of DTRS Portable Repeater

(e) Antenna

There are 1 DTRS TERTA antenna and 2 TGMS TETRA antennas to be mounted on roof or pole of the Vessel. TETRA antennas are marine type dipole antenna which shall be mounted at a minimum separation of **30 cm** from the other antennas.

TGMS TMR antenna

DTRS TETRA and GPS antennas

(f) Interfacing to Electrical Devices of the Vessel

TGMS GPS signal from Vessel's GPS

The signal of Vessel's GPS shall be made available to the OBE box. GPS data format shall be NMEA0183 and serial port shall be RS232. The serial port configurations are as follows:

- Baud Rate : 9600
- Data bits: 8
- Parity : None
- Stop bits: 1

(g) Connecting Cables

(i) The Contractor shall supply all power cables for installation of TGMS equipment through suitable independent fuses.

(ii) The Contractor shall supply and install all RF signal antenna cables. The cables shall be use coaxial cables. (The model currently use is RG type cable.)

(iii) The Contractor shall supply and install all data cables in the table below. The cables shall be of the model specified below or equivalent data cables.

(iv) The routing of the conduits/trunking and cabling shall suit the contour interior compartment to ensure that a proper installation layout can be affected.

(v) The termination of all cables shall be carried out by the Contractor.

(vi) The Contractor shall provide suitable accessories, trunking/conduit facilities and openings for the connecting cables tabulated below:

Summary of Conduits for Wiring Connections

Item	From	To	Purpose	Cable Type	Termination Connector	Dia. (mm)	Min. Bending Radius (mm)	Diameter of conduit (mm)	Max. Length (m)
1	WDN Antenna	TGMS OBE Box	RF Signal	RG58A/U	TNC	5	50	25	10
2	DTRS Antennas	TMRU	RF Signal	RG58	BNC	5	50	25	10
3	MDT	TGMS OBE Box	Data (OBU)	Shielded RS232	FQN14-9Z (Water Proof Connector)	7	75	25	20
4	MDT	TGMS OBE Box	Data (Radio)	Shielded RS232	RS232 DB9 (Female)	7			20
5	TMRU	Main Power	Power	Two Ways Power Cable	Free End	8	50	16	8
6	TGMS OBE Box	12VDC Main Power w/switch from the Battery for TGMS	Power	Welding Power Cable	Free End	4	50	16	8

9.13 Wired Intercom System

9.13.1 General requirement

(a) 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.

(b) Weatherproof type enclosure shall be provided for all the stations.

(c) Incoming calls shall be signalled by audible tone.

(d) Incoming calls shall be signalled by visual means with integral flashing indicator.

9.13.2 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.

9.14 Multi-beam sonar

9.14.1 The equipment shall consist of a transducer, a processor unit and an interconnection display unit which is recessed mounted at the steering console and capable of providing readout of sea depth in feet, fathoms and meters.

9.14.2 The transducer shall be installed at the hull of the boat.

9.14.3 The interconnection display unit shall comprise of a flush-mounted LCD colour display of a type suitable for use on an open deck vessel. The display unit shall provide a clear and clutter free picture in all weather conditions and be suitable for viewing in direct sunlight without the need for a viewing hood or the like.

9.14.4 The interconnection display unit shall be interconnected with the Radar, ECDIS and other navigational equipment.

9.14.5 The measuring depth shall be from 3 metres to 200 metres or equivalent in fathom or feet with at least 3 selectable ranges to indicate shallow, mid and deep ranges. The unit of measurement shall be selected at the front panel of the equipment.

9.14.6 The equipment shall display the cross section of the sea column echo in at least 120 degrees port and starboard.

9.14.7 Shallow water audible alarms shall be provided. Setting of the alarm depth shall be at the front panel of the equipment.

9.14.8 The peak to peak transmitting pulse power of the transducer shall not be less than 100 watts and the nominal operating frequency shall be around 160 kHz.

9.14.9 The power of the equipment shall be supplied from the 12 or 24 V DC system of the Vessel.

9.15 Installation Requirements

9.15.1 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.

9.15.2 Equipment supplied shall be completed with all standard and/or maker recommended accessories as required for normal operation.

9.15.3 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.

9.15.4 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.

9.15.5 All wiring shall be finished in a neat and appropriate manner approved by the Government.

9.15.6 Adequate measures, including but not limited to the following, to prevent interference between the electronic equipment shall be taken:

(a) Separate screened conduits or trunkings shall be provided.

(b) Rules, regulations and recommended practices regarding screening of electric wiring must be observed.

(c) 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.

(d) Lightning protection devices shall be fitted.

(e) 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.

(d) Manufacturers' recommendations shall be strictly observed.

9.15.7 (a) The power, signal and control cables connecting to the flush-mounted equipment shall be long enough to let the equipment wholly place on a safe place like on the panel, table, etc. with valid cable connections for fault finding and equipment testing. These extended cables shall be properly managed and resided inside the console.

(b) Induced mutual interference should be within an appropriate level which would not affect normal operation. [D]

9.15.8 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 to other Equipment by way of the emitted interference.

9.15.9 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 progress.

(c) The Government reserves the right to reject any part of the installation not comply with these TS. 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 cables, casing, mounting accessories and etc. 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.

9.15.10 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.

9.15.11 Electricity

(a) The power supply shall be compatible with 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.

9.15.12 Cable

(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.

9.15.13 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.

9.16 Acceptance Test

9.16.1 The acceptance tests shall comprise the following:

(a) A bench acceptance test which includes functional tests and detailed measurements of the performance of the Equipment to verify that each Equipment complies with all the required performance specifications.

(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 system. The overall installation standard and operational features of each system shall be evaluated. The test shall be carried out during sea trial.

9.16.2 The Contractor shall submit test reports on the performance of the Equipment and deliver the test reports to the EMSD representatives prior to the installation.

9.16.3 The Contractor shall submit schedule of commissioning test of the electronic equipment installed on board at least one month prior to the on-site commissioning test date.

9.16.4 The Contractor shall provide all the necessary test equipment and tools for carrying out the acceptance tests at no extra cost to Government.

9.16.5 At least one month before the end of the Warranty Period, the Contractor shall arrange and perform final acceptance test in the presence of the representatives from EMSD. Should any defects be found during the final acceptance 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. The Warranty Period shall be extended if the defects are not cleared or fixed by the Contractor.

9.16.6 For significant defects (e.g. involving the replacement of Space Parts/ Equipment etc.) found during the final acceptance test, the Warranty Period of the Equipment shall be properly extended as determined by EMSD.

9.17 Documentation & Quotation For the Proposed Equipment

9.17.1 Unless agreed by the Government in the Contract, the Contractor shall within one month after delivery of the Vessel, supply three sets of operation manual, service manual and integrated system/equipment schematic diagram in English (at least two 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 MD and EMSD for approval during construction stage.

Chapter 10 – External Fire Fighting, Search and Rescue Systems

10.1 Hydraulic System

10.1.1 The Vessel shall be fitted with hydraulic system capable of providing the necessary pressure and fluid flow to power the following systems. It should be noted that only one (1) of these systems needs to powered at any one time: -

(a) Fire pump as stated in Paragraph 10.2;
(b) Aft capstan as stated in Paragraph 10.5;
(c) Rescue ramp as stated in Paragraph 10.6;
(d) Anchor windlass as stated in Paragraph 4.15.2; and
(e) Swing Derrick as stated in Paragraph 10.7.

10.1.2 The hydraulic system shall be powered by PTO units mounted to port and starboard main engines or gearboxes input. The system shall require only one PTO unit to be used to provide full operational capability to the system. This system shall be separate to the hydraulic system required for the waterjet controls.

10.1.3 For items (b) to (e), the power supply can be considered either PTO hydraulic or electric generator according to the design operating electrical power rating.

10.1.4 The Contractor shall supply details of the hydraulic and electric system load balance when running consumers.

10.1.5 There shall be as a minimum the following controls and warning lights for the hydraulic system: -

(a) A switch in the wheelhouse to allow the choice of PTO to be used;
(b) Counter or similar to show the relative number of hours each PTO has used;
(c) Hydraulic Oil pressure gauge;
(d) Hydraulic Oil temperature gauge;
(e) Low pressure warning light; and
(f) Any other fault indicating lights and alarms and protective devices such as overspeed, low hydraulic oil pressure trip etc as recommended by the system designer.

10.1.6 The hydraulic system shall be load sensing.

10.1.7 The hydraulic system shall be designed to minimise and fluid leaks in the event of an inversion.

10.2 Fire Pump

10.2.1 The Vessel shall be equipped with a build-in fire pump with ten bar output pressure with not less than 4,000 litres/minute water output and auto-priming system for operation used. The pump shall be provided with independent sea suction and non-return valves. [E]

10.2.2 The Tenderer should note that the Vessel is for use in Hong Kong and it is desirable that fire pump 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. [D]

10.2.3 Stainless steel fixed pipe line shall be used to connect fire pump and fire monitor on foredeck.

10.2.4 The controls and instrumentation of the fire pump engine shall be designed for one man operation in the deckhouse, the instrumentation and controls in the control console shall be comprehensive and include:

(a) Remote start and stop.
(b) Hydraulic oil pressure gauge.
(c) Fault indicating lights and alarms.
(d) Protective devices such as overspeed, low hydraulic oil pressure trip etc as recommended by the pump manufacturer.

10.3 Fire Monitor/Hose

10.3.1 An electrical operation with remote controlled and manual operated jet/fog monitor with adjustable flows with capacity of fire pump shall be installed on the forward section of the vessel. A marine grade stainless steel 316 fire pipe shall be connected with the fire pump.

10.3.2 The monitor shall be capable for vertical movement -20 º to +70 º and rotation angle 270º continuous.

10.3.3 A control panel shall be installed in front of the commander position in the deckhouse.

10.3.4 Two additional outlet branches in BS336 standard shall be provided to connect 40/70 mm flexible fire hose on deck. 20m of flexible fire hose shall be provided.

10.4 Towing Hook

10.4.1 The Vessel shall be fitted with a towing hook mounted on the aft deck.

10.4.2 The towing hook shall have a minimum 8 tonne safe working load capacity.

10.4.3 Towing hook shall be quick released manually and through remote control from the wheelhouse by pushing a button.

10.5 Aft Capstan

10.5.1 The Vessel shall be fitted with a light weight capstan mounted on the aft deck.

10.5.2 The capstan shall have a minimum 600kg line pull capacity and 1500kg holding capacity.

10.5.3 The capstan shall be operated locally and have an on/off switch inside deckhouse.

10.6 Rescue Ramp

10.6.1 The vessel shall be fitted with a rescue ramp, mounted at the transom.

10.6.2 The rescue ramp is to have a minimum safe working load of 200kg.

10.6.3 The rescue ramp will be operated by local controls and shall have an on/off switch on wheelhouse console.

10.7 Swing Derrick

10.7.1 A swing derrick, with electrical or hydraulic winch, outreach 0.5m overboard, safety working load 150 kg, shall be installed and hinged on the starboard aft structure of deckhouse.

10.7.2 The design and calculation of the derrick shall be submitted by RO approval. Load test shall be carried out before vessel delivery according to the lifting appliances and lifting gear regulation, i.e. Cap. 548I Section 45 on “Strength calculation, etc. in respect of cranes” of the Law of Hong Kong.

10.8 Additional Rescue Equipment

10.8.1 The Vessel shall be equipped with the following equipment:

(a) 3 x portable electrically powered salvage pumps, minimum flow rate of 900l/min, each with 25m power cables attached to the pump.
(b) 3 x 10m discharge hoses, suitable for the portable pumps above.
(c) 1 x Man overboard rescue mat.
(d) 2 x 25person liferafts without canopy.

Chapter 11 – Services Support

11.1 General Philosophy

11.1.1 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, petrol 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.

11.1.2 Allowable Vessel downtime (including scheduled preventive maintenance and unscheduled repair and maintenance) shall not exceed 10% of the total hours of operation per month based on the operation profile as specified in Paragraph 2.7.1 of Chapter 2.

11.1.3 Maintainability - the Vessel shall be easy to maintain by ensuring that there shall be:

(a) good access to all installed items for monitoring, service and overhaul.
(b) ease access to in-situ service and maintenance in the HKSAR.

11.2 Information to be Provided Prior to and at Delivery Acceptance

11.2.1 Information provided prior to Delivery Acceptance:

(a) Detailed Inventory List for the whole Vessel to be submitted to the Government for approval.
(b) The Inventory List shall cover all discrete items down to major component/unit level.
(c) Full details of each item includes:
  (i) Item number.
  (ii) Description.
  (iii) Type/model.
  (iv) Quantity.
  (v) Manufacturer.
  (vi) Manufacturer's reference number.
  (vii) Location in Vessel.
  (viii) Local agent/supplier address, telephone and fax numbers.
(d) **FOUR** paper copies and **ONE** soft copy of the Inventory List shall be provided to GNC.

11.2.2 "As Fitted" drawings and other information shall be supplied.

The Contractor shall supply the following items upon Delivery Acceptance of the Vessel:

(a) **FOUR** complete sets of paper print drawings of the Vessel and **ONE** soft copy in Compact Disk (CD-ROM).
(b) **FOUR** complete sets of paper print as fitted electrical schematic, cabling, wiring and single line diagrams for electrical equipment installed on board and conduit / trunk route diagram and **ONE** soft copy in CD-ROM as per the Vessel delivered.
(c) **FOUR** copies of ship equipment list for all bought-in machineries and electrical equipment. The list shall include:
  (i) Description.
  (ii) Type/model.
  (iii) Makers part no. or equivalent.
  (iv) Location.
  (v) Quantity.
  (vi) Supplier or agents name and contact address.

(d) **FOUR** copies (at least one original) of maker operation, maintenance and workshop manuals for all machineries / equipment in English.

(e) **FOUR** paper copies and **ONE** 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.

(f) **FOUR** copies of On Board Operator's Manual (English and Traditional Chinese) covering:

(i) Daily user check and operation procedure.
(ii) Operating detail of each system.
(iii) Emergency operation procedure.

(The precise format and detail required will have to be subject to the GNC's approval when the configuration of the Vessel and outfitting is decided.)

(g) The first draft of the On Board Operator's Manual (in both English and Traditional Chinese) shall be submitted to GNC for approval one month before documentation acceptance.

(h) The documentation for all Equipment, spares and stores, special tools and test equipment shall be provided at the Delivery Acceptance of the Vessel.

11.2.3 Tools & Test Equipment for Electronics

(a) Delivery of all test and tool equipment for the electronics equipment of the Vessel will be directly to EMSD.

(b) All items shall be properly documented, preserved and packed.

11.2.4 Photographs

(a) As-Fitted Photographs

(i) Two 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.

(ii) Each print shall be enclosed in a suitable album and labelled showing the position of the content.

(b) Official Photographs

(a) Four 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 200 mm x 150 mm colour photographs with specifications of Vessel particulars showing the profile of the Vessel in Hong Kong Waters shall be provided upon Delivery Acceptance.

(c) Four 150 mm x 100 mm colour photographs showing the profile of the Vessel in Hong Kong Waters shall be provided upon Delivery Acceptance.

(c) Softcopy of Photographs

All photographs as required in the sub-paragraphs (a) and (b) above shall be taken by way of digital camera in JPEG format at a resolution of not less than 5.0 M pixel. The photographs shall be stored in Compact Disk (CD-ROM) and forwarded to GNC at the time of Delivery Acceptance.

11.2.5 Certificates and Reports

Copies of the following documents (one original with two copies and one 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.
(d) Complete record of the trial commissioning tests.

(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) Hull construction material issued by RO.
(k) 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 to the TS.
(l) Any other certificates as appropriate.

11.2.6 Ship Model

(a) Tenderer is required to quote a separate price in Schedule 1 of Part V for the supply of ship model(s) (scale 1:25) for display and training purpose. The ship model(s) shall be provided upon Delivery Acceptance.

(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 limiting 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.

Chapter 12 - Training

12.1 Training on Electronics Equipment

12.1.1 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 Equipment being supplied and installed. The trainer shall be able to communicate in English/Chinese with the local trainees effectively.

(c) It is anticipated that two 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.

(e) Each trainee shall receive one copy of comprehensive training documents before the start of each course.

(f) Training manual in Traditional Chinese and English shall be provided and submitted to MD and EMSD for approval at least one month prior to commencement of the aforementioned two types of training respectively.

12.1.2 Operator Training Course

(a) This course shall provide training for trainers.

(b) The course shall provide a full knowledge and appreciation of the day-to-day operation of all Equipment. This shall include hands-on demonstrations and operation of all Equipment including the necessary routine cleansing requirement.

(c) The course shall be held immediately before the commissioning of the Equipment on the Vessel.

(d) A total of up to 20 trainees will attend the course. The training course shall accommodate the specified number of trainees.

12.1.3 Equipment Maintenance Training Course

(a) The Contractor shall provide full training facilities (e.g. accommodation, facilities and equipment) with a training schedule. The course shall enable the maintenance staff:

(i) to 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 Equipment being offered; and

(ii) to effectively maintain the Equipment. This shall include practical demonstrations and tests.

(b) The maintenance training shall include, but not be limited to the following items:

(i) Introduction of the Equipment locations;
(ii) Equipment operational, working principle and functional descriptions;
(iii) Equipment block and schematic functional descriptions;
(iv) Equipment adjustment/calibration procedure and parameter settings;
(v) Equipment construction and mounting;
(vi) Equipment interfacing and signal interfacing;
(vii) Preventive maintenance and trouble-shooting

(c) The course shall be held immediately after the commissioning of the Equipment on the Vessel.

(d) A total of up to 20 trainees will attend the course. The training course shall accommodate the specified number of trainees.

12.2 Training on Operation and Maintenance of the Vessel

12.2.1 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 Section of Government Dockyard.

12.2.2 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 training course for 20 Government officers in the HKSAR after the Delivery Acceptance of the Vessel. An operation training programme 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.

12.2.3 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 20 Government officers from the Government Dockyard in the HKSAR or overseas after the Delivery Acceptance 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.

12.2.4 All facilities, venue, and materials necessary for the above-mentioned training courses and otherwise required in these Technical Specifications shall be provided by the Contractor unless otherwise specified. The training shall also be conducted in Chinese and/or English with relevant training materials to be supplied by the Contractor. The training materials shall be provided before the training, in both paper and CD-ROM format.

Chapter 13 – Abbreviations

AC	Alternating Current
A/C	Air conditioner
AIS	Automatic Identification System
AML	Additional Military Layers
Amp	Ampere
ARCS	Admiralty Raster Chart Service
ARPA	Automatic Radar Plotting Aid
ASTM	American Society for Testing and Materials
AUX	Auxiliary
AWS	American Welding Society
BS	British Standards
BSB	Data encoded in the BSB format
BSI	British Standards Institute
CAT	Categorisation
CDI	Course Deviation Indicator
CD-ROM	Compact Disc Read-Only Memory
CFC	Chlorofluorocarbon
CH	Channel
CO_2	Carbon Dioxide
COG	Course over Ground
CPA	Closest Point of Approach
CPU	Central Processing Unit
dB	Decibel
dBm	Decibel-milliwatts
DC	Direct Current
DGNSS	Differential Global Navigation Satellite System
DGPS	Differential Global Positioning System
DNC	Digital Nautical Chart
DPDT	Double-pole, Double-throw
DSC	Digital Selective Calling
DVI	Digital Video Interface
EBL	Electronic Bearing Line
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Charts
ENE	Electronic Navigational Equipment
FTP	Fire Test Procedures
GA	General Arrangement
GB	Gigabyte
GHz	Gigahertz
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
GZ	Righting Lever
HCFC	Chlorodifluoromethane
HD	Hard Disk
HDMI	High Definition Multimedia Interface
Hz	Hertz
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronic Engineers
IHO	International Hydrographic Organization
IMD	Intermodulation Distortion
IMM	International Maritime Mobile
IMO	International Maritime Organisation

IP	Ingress Protection
IPX	Internetwork Packet Exchange
IS	Intact Stability
ISO	International Organization for Standardization
ITU-R	International Telecommunication Union – Radiocommunication Sector
JIS	Japanese Industrial Standards
JPEG	Joint Photographic Experts Group
kg	Kilogram
kHz	Kilohertz
Km	Kilometre
kW	Kilowatt
LCD	Liquid Crystal Display
LCG	Longitudinal Centre of Gravity
LED	Light-emitting Diode
LSA	Life-Saving Appliance
m	Metre
M	Mega
m/s	Metre per Second
m^3	Cubic Metre
MCR	Maximum Continuous Rating
MHz	Megahertz
MJ/m2	Megajoule per Square Metre
MKD	Minimum Keyboard Display
mm	Millimetre
MMSI	Maritime Mobile Service Identity
MSC	Maritime Safety Committee
NDT	Non-Destructive Test
nm	Nanometre
NMEA	National Marine Electronics Association
NUC	Not Under Command
ppm	Part per Million
PVC	Polyvinyl Chloride
RADAR	Radio Detection And Ranging
RF	Radio Frequency
RG58U	RG58U Type Coaxial Cable
ROT	Rate of Turn
RPE	Registered Professional Engineer
rpm	Revolutions per Minute
RT	Radioactive Test
RTCM	Radio Technical Commission for Maritime Services
SINAD	Signal-to-noise and Distortion Ratio
SOG	Speed over Ground
SOLAS	Safety of Life at Sea
TCG	Transverse Centre of Gravity
TCPA	Time to Closest Point of Approach
TFT	Thin-film Transistor
TIFF	Tagged Image File Format
TS	Technical Specifications
TTG	Time to Go
UHF	Ultra High Frequency
USB	Universal Serial Bus
UT	Ultrasonic Test
UTC	Coordinated Universal Time
V	Volt
VAC	Voltage of Alternating Current
VCG	Vertical Centre of Gravity
VDC	Voltage of Direct Current
VGA	Video Graphics Array

VHF	Very High Frequency
VMAP	Vector Map
VRM	Variable Range Marker
V.S.W.R.	Voltage Standing Wave Ratio
W	Watt
WMS	Web Map Service

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. 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 Schedule 6 in Part V and electronic navigational equipment), fittings and outfit (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, 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 24 hours (excluding Hong Kong public holidays) 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 48 hours after the fault report is first issued. The MD must be informed of what corrective maintenance and rectification actions have been taken within 72 hours of receiving the relevant fault report.

1.7.2 To provide all necessary transport, replacement Equipment, 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 48 hours, the MD may arrange 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 2.2.3 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 Schedule 6 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 Paragraphs 9.1.1 in Chapter 9 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, labour and equipment in order to carry out such work:

2.2.1 Engines

(a) Renew the lubricating oil and replace the filters for the main engines as per the manufacturer's recommendations;

(b) Clean all the engine air filters and change the filter elements as necessary;

(c) Clean the coolers of the engines and renew all zinc anodes if provided;

(d) Check all the engines' belts and adjust if necessary;

(e) Check tappet clearances for the inlet and exhaust valves, ignition timing and idle speed and adjust if necessary;

(f) Conduct function tests for the engines' protection system and their associated sensors, gauges and other measuring devices; and

(g) Any other work required or recommended by the engine manufacturer.

All of the work listed at Paragraphs 2.2.1(a) to (g) shall be carried out by the manufacturer's authorised agent. All the work procedures shall comply with the manufacturer's specifications and requirements.

2.2.2 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;

(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 2.2.2(a)(iii) above, two coats of touch up primer and one coat of touch up shall be applied; and

(v) One full coat of finishing paint shall be applied to the hull below the water line.

(b) Paint Above the Water Line

(i) Damaged paint on the hull above the water line shall be repaired properly. After repair, two coats of touch up primer and one coat of touch up 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 waterjets.

(d) 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.

(e) Renew all zinc anodes.

2.2.3 The following shall be tested at the dock trial / sea trials as part of the Guarantee Slipping:

(a) Engine control and steering system;
(b) Engine alarm and shut down function (including emergency stopping of engines);
(c) Navigational equipment, lights and sound signals;
(d) Ahead and astern running and crash stop test;
(e) Steering trial;
(f) Other trials as required by the Government Representative; and
(g) Any item or component found defective shall be repaired or replaced.

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 2-6 for GNC's approval within two (2) months after the Contract Date.
3	Completion of installation of engines, waterjet system	
4	Self righting test	
5	Completion of installation of electronic navigation equipment	
6	Sea trial	
7	Pre-shipment Construction and Handling Inspection	
8	Shipment to Hong Kong	
9	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
	Delivery Date	

Item No.	Drawings Approval	Completion Date
	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.
	Lines Plan	
	Structural Construction Plan in Mid-Ship anlkhead Section	
	Construction Profile and Deck Plan	
	Shell Expansion Plan	
	Tank Capacity Plan	
	Engine Mounting Arrangement	
	Power / Speed Estimation and Curve	
	Intact, Damaged Stability Plan and Self Righting Stability Criteria	
	Details of Navigational / Communication Equipment	
	Details of Deck Equipment, Outfitting, Furniture, etc.	
	Details of Engines' Arrangement	
	Control Console Arrangement and Schematic Diagram	
	Instrumentation and Control System	
	Calculation of Fuel Capacity	
	Details of Electrical and Electronic Equipment	
	Electrical Load Calculations	
	Schematic Layout of Electrical Circuits	
	Paint Schedule	
	Lightning Protection Arrangement	
	Torsional Vibration Calculation (if applicable)	
	Others as required	

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Fast Rescue Vessel"			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 – steel 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 steel 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			
	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 : "Fast Rescue Vessel"				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 fire pump				
(g)	General inspection on installation of waterjet system				

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Fast Rescue Vessel"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
(iii)	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			
(d)	Functional test of sanitary system			
EM- 9	Fire fighting system:			

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Fast Rescue Vessel"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
(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			
(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			
(d)	Inspection of transformers			
(e)	Inspection of tally plates			

Part VII - Annex 4 - Main Items Inspection Timetable

VESSEL NAME : "Fast Rescue Vessel"			Inspection date	Outstanding/ Re-inspection/ Remarks
Item	Items to be inspected			
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 waterjet inspection			
(c)	Shaft line checking of waterjet 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	Inclining Experiment / Self-righting Test			
EM-27	(a) Official Speed Trial			
	(b) Other Official Sea Trials			

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

Date of Test:		Place of Test:	
Vessel's Identification:		Vessel's Name:	

Conditions at Endurance and Performance Test (Official Sea Trial)			
Person On board	**6 Persons**	Dummy Weight	**75 kg**
Fuel and Water	**Not less than 50% of Fuel and Water Tank**	Other Equipment	**100 kg**
Sea Conditions	**Sea state 2 : wave height 0.1 - 0.5 metres**		

Engines:	**Port Side**	**Starboard Side**	**Waterjet:**	**Port Side**	**Starboard Side**
Maker			Maker		
Type			Type		
Serial Number			Diameter		
Rated Power			Serial Number		
Rated Speed			Direction of Rotation		

Engine Load	**Engine Speed (rpm)**	**Vessel Speed (Knots)**	**Time (Start)**	**Time (Finish)**	Fuel Consumption (litres/minutes)	**Engine Oil Pressure (Bar)**	**Engine (in) CW Temp. (^{o}C)**	**Others**	**Others**
__% of rated Power	At Minimum Cruising Speed		Not less 15 minutes						
40% of Rated Power/rpm			Not less 15 minutes						
60% of Rated Power/rpm			Not less 15 minutes						
80% of Rated Power/rpm			Not less 15 minutes						
100% of Rated Power (Endurance Test)			Not less 30 minutes						

Remarks:

Witness by:	MD Representative	Shipyard Representative

Part VII - Annex 6 - As-fitted Drawings and Machinery/Equipment documents and information literature to be delivered to the Government after 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/MD during the design and construction of the Vessel and 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 Waterjet system 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 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 and firefighting system 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 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 Navigational 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 Any drawings as required by GNC.

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.

Part VII - Annex 7 – 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	