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Gatineau
Québec
K1A 0S5
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SOLICITATION AMENDMENT
MODIFICATION DE L'INVITATION

The referenced document is hereby revised; unless otherwise indicated, all other terms and conditions of the Solicitation remain the same.

Ce document est par la présente révisé; sauf indication contraire, les modalités de l'invitation demeurent les mêmes.

Comments - Commentaires

Vendor/Firm Name and Address
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Issuing Office - Bureau de distribution
Ship Construction, Refit and Related
Services/Construction navale, Radoubs et services
connexes
11 Laurier St. / 11, rue Laurier
6C2, Place du Portage
Gatineau
Québec
K1A 0S5

Title - Sujet NAVAL LARGE TUG CONSTRUCTION PROJ.	
Solicitation No. - N° de l'invitation W8472-13NLTE/A	Amendment No. - N° modif. 001
Client Reference No. - N° de référence du client W8472-13NLTE	Date 2012-12-06
GETS Reference No. - N° de référence de SEAG PW-\$SMC-023-23383	
File No. - N° de dossier 023mc.W8472-13NLTE	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2013-01-18	
Time Zone Fuseau horaire Eastern Standard Time EST	
F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input type="checkbox"/> Other-Autre: <input type="checkbox"/>	
Address Enquiries to: - Adresser toutes questions à: Bilodeau, Allen	Buyer Id - Id de l'acheteur 023mc
Telephone No. - N° de téléphone (819) 956-5950 ()	FAX No. - N° de FAX () -
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction:	

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée	Delivery Offered - Livraison proposée
Vendor/Firm Name and Address Raison sociale et adresse du fournisseur/de l'entrepreneur	
Telephone No. - N° de téléphone Facsimile No. - N° de télécopieur	
Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)	
Signature	Date

Solicitation No. - N° de l'invitation

W8472-13NLTE/A

Client Ref. No. - N° de réf. du client

W8472-13NLTE

Amd. No. - N° de la modif.

001

File No. - N° du dossier

023mcW8472-13NLTE

Buyer ID - Id de l'acheteur

023mc

CCC No./N° CCC - FMS No/ N° VME

SEE FOLLOWING ANNEXES:

- **QUESTIONS & ANSWERS DATED DECEMBER 6TH 2012**
- **DND TUGS STATEMENT OF TECHNICAL REQUIREMENTS**

LARGE NAVAL TUGS CONSTRUCTION PROJECT
PROJET DE CONSTRUCTION DES GRANDS REMORQUEURS DE LA MARINE
Questions et réponses / Questions and Answers
PW-\$\$MC-023-23383 - W8472-13NLTE/A

Q et R 1 à 5 / Q&A 1 to 5
6 dec 2012

<p>Q1 Est-ce que ceci fait parti de la SNACN ?</p> <p>R1 Ces gros remorqueurs font partie des petits navires réservés aux chantiers autres que ceux sélectionnés dans le cadre de et conformément à la Stratégie nationale d'approvisionnement en matière de construction navale.</p>	<p>Q1: Is this part of NSPS?</p> <p>A1 These large tugs are amongst the small ships to be sourced to other than the NSPS selected shipyards in accordance with the National Shipbuilding Procurement Strategy.</p>
<p>Q2: Quand voulez-vous lancer l'appel d'offre des remorqueurs et les avoir en exploitation ?</p> <p>R2: Le projet d'acquisition en est à ses débuts. Les informations fournies par l'industrie grâce à cet engagement aidera le Canada à l'élaborer un plan global concernant le besoin, l'appel d'offres, l'approche contractuelle et éventuellement un calendrier de mise en service.</p>	<p>Q2 When would you like to put this out to tender and have the tugs operating?</p> <p>A2 The procurement is in its early stages. Information provided by industry through this engagement will assist Canada in developing a comprehensive plan regarding the requirement, tendering, contracting and eventual in-service timelines.</p>
<p>Q3 Pouvez-vous SVP nous expédier l'information technique supplémentaire en guise de référence ?</p> <p>R3 Le document auquel vous faites référence est l'Énoncé des besoins techniques. Il sera rendu disponible par le biais d'un amendement à la Demande Prix & disponibilité sur MERX.</p>	<p>Q3 Can you please send us this additional technical information for our reference?</p> <p>A3 The document you are making reference to is the Technical Statement of Requirements. It will be made available through MERX by an amendment to the Price & Availability Enquiry.</p>
<p>Q4 Nous avons lu les documents et ont noté qu'il y a plus d'information (l'Énoncé des exigences techniques) qui est disponible sur demande. SVP, laissez-nous savoir comment pouvons nous obtenir une copie de ce document, merci.</p> <p>R4 Veuillez SVP vous référer à la R3.</p>	<p>Q4 We have read the paperwork and have noted that there is a larger package of information (the Technical Statement of Requirements) which is available upon request. Please let us know how we can obtain a copy of this document, thanks.</p> <p>A4 Please refer to A3.</p>

2012-12-06

LARGE NAVAL TUGS CONSTRUCTION PROJECT
PROJET DE CONSTRUCTION DES GRANDS REMORQUEURS DE LA MARINE
Questions et réponses / Questions and Answers
PW-\$\$MC-023-23383 - W8472-13NLTE/A

<p>Q5 Seuls des chantiers navals peuvent donner des prix, est-ce exact ?</p> <p>R5 Toute entreprise qui est admissible en vertu de la Politique sur l'approvisionnement en matière de construction navale peut contribuer à cette demande de P et D, y compris donner des prix.</p>	<p>Q5 Only shipyards can offer prices, is that correct?</p> <p>A5 Any company that qualifies under the Canadian Shipbuilding, Repair, Refit and Modernization Policy may provide their input to this P&A Enquiry, including prices.</p>
<p>Q6</p> <p>R6</p>	<p>Q6</p> <p>A6</p>
<p>Q7</p> <p>R7</p>	<p>Q7</p> <p>A7</p>
<p>Q8</p> <p>R8</p>	<p>Q8</p> <p>A8</p>



TECHNICAL STATEMENT OF REQUIREMENTS

For

Naval Large Tug Enhancement Project

NLTE

LIST OF EFFECTIVE PAGES

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NOTE

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Date of issue for original and changed pages are:

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Change ...1...

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LIST OF ACRONYMS AND ABBREVIATIONS

AFFF	Aqueous Film Forming Foam
AIS	Automatic Identification System
APCI	Approved Products Catalogue Index
ARPA	Automatic Radar Plotting Aids
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
BCC	Bridge Control Console
CFB	Canadian Forces Base
CGSB	Canadian Government Standard Board
COTS	Commercial-off-the-shelf
CSA	Canada Shipping Act
DGPS	Differential Global Positioning System
DND	Department of National Defence Canada
DSC	Digital Selective Calling
ECDIS	Electronic Chart Display and Information System
EMI/EMC	Electromagnetic Interference/Electromagnetic Compatibility
EOL	End of Life
EPIRB	Emergency Position Indicating Radio Beacon
GMDSS	Global Maritime Distress Safety System
GPM	Gallons(US) Per Minute
GPS	Global Positioning System
GSM/GFE	Government Supplied Material/Government Furnished Equipment
HAZMAT	Hazardous Material
HP	Horsepower
HVAC	Heating, Ventilation and Air Conditioning
IACS	International Association of Classification Societies
IAPP	International Air Pollution Prevention
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineer Society
IMO	International Maritime Organization
ISO	International Organization for Standardization
KG	Height Vertical Centre of Gravity above top of keel plate
LCG	Longitudinal Centre of Gravity

LED	Light Emitting Diode
MARPOL 73/78	International Conference for the Prevention of Pollution From Ships 1973, as modified by the Protocol of 1978
MCR	Maximum Continuous Rating
MEPC	Marine Environment Protection Committee
MSC/Circ	Maritime Safety Committee/Circular
NACE	National Association of Corrosion Engineers
NPSH	Net Positive Suction Head
NSF	National Sanitation Foundation (NSF) International
PCB	Polychlorinated biphenyls
PWGCSC	Public Work and Government Services of Canada
RF	Radio Frequency
RFP	Request for Proposal
SAE	Society of Automotive Engineers
SAR	Search and Rescue
SART	Radar transponder – Marine search and rescue
SHINNADS	Shipboard Integrated Navigation and Display System
S-I Units	Système International d'unités (International System of Units)
SNAME	The Society of Naval Architects and Marine Engineers, United States of America.
SOLAS	International Convention for Safety of Life at Sea
SOW	Statement of Work
T&R Bulletin	Technical and Research Bulletin
TBT	Tributyltin
TCMS	Transport Canada Marine Safety Branch
TP	Transport Canada Publication
TSOR	Technical Statement of Requirement
ULC	Underwriter Laboratories Canada
UPS	Uninterrupted Power Supply
VHF	Very High Frequency (30 to 200 MHz)
WAN	Wide Area Network

LIST OF REFERENCE DOCUMENTS

The latest official version of the listed reference shall be used.

Reference	Title
Canada Labour Code	Marine Occupational Safety and Health Regulations
Canada Shipping Act	Collision Regulations
Canada Shipping Act	Large Fishing Vessel Inspection Regulations
Canada Shipping Act	Safe Working Regulations
Canada Shipping Act	Hull Construction Regulations
Canada Shipping Act	Towboat Crew Accommodation Regulations
Canada Shipping Act	Life Saving Regulations
Canada Shipping Act	Navigation Safety Regulations
Canada Shipping Act	Fire Detection and Extinguishing Regulations
ANEP-25	Guidelines for Environmental Factors in NATO Ships
ASME A13.1	Scheme for the Identification of Piping Systems
IMO Res MSC.97(73)	International Code of Safety for High-Speed Craft, 2000
Transport Canada Marine Safety	Approved Products Catalogue Index
	Ship Station (Radio) Technical Regulations
	Ship Station (Radio) Regulations
ASTM F1155	Standard Practice for Selection and Application of Piping System Materials
ASTM F1166	Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities
ASTM F1455	Standard Guide for Selection of Structural Details for Ship Construction
ASTM F1808	Standard Guide for Weight Control Technical Requirements for Surface Ships
ASTM F992	Valve Label Plates
C-09-153-003/TS-000	Explosives Safety Manual Volume 3 –Ships
CFTO D-23-003-005/SF-0021	Specification for Maintenance Painting of HMC Ships The Preservation and Painting of HMC Vessels
CFTO C-03-001-024/MS-002	Stability and Buoyancy Requirements for Surface Ships
CFTO C-03-001-024/MS-003	Procedures for Conducting Inclining Experiments on Canadian Forces Surface Ships

CGSB 3-GP-11c	Naval Distillate Fuel
CFTO C-23-045-000/AG-001 Section 9	Volume 1 Damage Control (SEA) Shipboard Damage Control
CFTO R-85-011-001/MS-001	US Navy Shipboard Color Coordination Guidance Manual
Health Canada Safety Code 6	Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz –Safety Code 6
IEC 60533	Electrical and Electronic Installation in Ships – Electromagnetic Compatibility
IEEE Std 45	Recommended Practice for Electric Installation on Shipboard
IMO MEPC.60(33)	Guidelines and specifications for pollution prevention equipment for machinery space bilges of ships
IMO MSC/Circ. 920	Model Loading and Stability Manual
IMO MSC/Circ.891	Guidelines for the on-board use and application of computers
IMO MSC/Circ.982	Guidelines on Ergonomic Criteria for Bridge Equipment and Layout
IMO Res A.468(XII)	Code on Noise Levels On Board Ships
IMO Res A.534	Code of Safety for Special Purpose Ships
IMO Res A.813	General Requirements for Electromagnetic Compatibility (EMC) for all Electrical and Electronic Ship’s Equipment
ISO 3046 Series	Reciprocating internal combustion engines - Performance
ISO 6954	Mechanical Vibration – Guidelines for measurement, reporting and evaluation of vibration regard to habitability on passenger and merchant ships
ISO 8528 Series	Reciprocating internal combustion engine driven alternating current generating sets
MARCORD 22-11	Security of Small Arms and Small Arms Ammunition
MARCORD NA-02	Maple Leaf Emblem Wearing By HMCS Ships and Auxiliary Vessels.
MARPOL73/78 Annex VI	Regulations for the Prevention of Air Pollution from Ships and NO _x Technical Code
MIL-L-9000	Lubricating Oil, Shipboard Internal Combustion Engine, High Output Diesel
National Defence Security Policy	Chapter 28 Small Arms and Ammunition
NSF/ANSI 61	Drinking water system components –Health effects
SAE J1942	Hose and Hose Assemblies for Marine Applications
Ship Safety Bulletin No. 03/92	Navigation Bridge Visibility
SNAME T&R Bulletin 3-47	Guide for Sea Trials
FED-STD-595B	Standard Paint Colours, Part 1 Colour Identification and

	Selection.
TP 13585	Delegated Statutory Inspection Programme
TP 1861	Standards for Navigation Lights, Shapes, Sound Signals Appliances and Radar Reflectors
TP 3668	Standards for Navigating Appliances and Equipment
TP 3685	Standards Respecting Noise Control and Hearing Protection in Canadian Towboats Over 15 Tons, Gross Tonnage
TP 7301	Stability, Subdivision and Load Line Standards
TP 7319	Standards for Pyrotechnic Distress Signals and Similar Devices
TP 7322	Standards for Rescue Boats
TP10943	Passenger Vessels Operations and Damaged Stability Standards
TP11469	Guide to Structural Fire Protection
TP127	Ship Safety Electrical Standards
TP13617	Guidelines for Control of Ballast Water Discharge from Ships in Waters Under Canadian Jurisdiction

Some of the sources for ordering standards or documents are:

American Society For Testing and Materials (ASTM)	http://www.astm.org
Engineering Society for Advancing Mobility Land Sea Air and Space (SAE)	http://www.sae.org
US Government Federal Standard is available through Federal Supply Service, FSS Product Acquisition Center	http://apps.fss.gsa.gov/pub/fedspecs/
Institute of Electrical and Electronics Engineers (IEEE)	http://www.ieee.org
International Association of Classification Societies Ltd (IACS)	http://www.iacs.org.uk
International Electrotechnical Commission (IEC)	http://www.iec.ch
International Maritime Organization (IMO)	http://www.imo.org
International Organization for Standardization (ISO)	http://www.iso.org
NSF International	http://www.nsf.org
Society of Naval Architect and Marine Engineer (SNAME)	http://www.sname.org
Transport Canada Marine Safety	http://www.tc.gc.ca/MarineSafety

PART 1 GENERAL TECHNICAL REQUIREMENTS

SECTION 1 DESIGN CONSIDERATIONS

1.1 INTRODUCTION

1. The Large Naval Tugs shall provide sufficient capability to the Queen's Harbour Master in HMC Dockyards Halifax and Esquimalt to support naval operations. The primary role of the tugs will be to effect harbour berthing operations, harbour fire protection, coastal towing, and various naval fleet support duties.

2. The intent of this Technical Statement of Operational Requirements (TSOR) is to define the requirements for the design, construction and outfit of the vessels.

1.2 DESIGN PHILOSOPHY

1. The tug design shall meet the following principal parameters:

Draft	Not greater than 6m.
Free running speed	Not less than 12 knots (at 90 % of the maximum unrestricted continuous rating) in Sea State 2 at full load condition.
Bollard Pull	Minimum of 37 tonnes. Bollard Pull shall be suitable to meet operational requirements to cold move an auxiliary vessel with the following notional particulars 210m length overall with 25,200 tonne displacement. Estimated wind area above design waterline 3500 m ² , and estimated underwater area below design waterline 1450 m ² ;
Range	Not less than 2400 nautical miles (NM) at a transit speed of 10 knots for propulsion engines, generators, and the corresponding equipment for ship's operation in Sea State 2 at 0°C ambient air temperature with the fuel capacity determined from the difference between 95% Full Departure and 10% Full Arrival conditions.
Endurance	Sustained operations for (10) days with full complement. Provisions and stowage for full complement for (10) days. Fresh water tank capacity a minimum 20 tonnes potable water, (assuming 100% full Fresh Water Departure Condition and 10% full Arrival condition)
Full Complement	Full Complement is defined as (10) persons, mixed gender.
Prime Movers	(2) Medium Speed Diesel Engines
Propulsors	Twin propulsion units providing 360 degrees of vectored thrust.

2. The tugs shall be designed to perform the following operations;

- Ship Handling; Effect cold and hot moves and provide berthing assistance to all existing classes of Canadian replenishment vessels (PROTECTEUR class), major and minor warships, (HALIFAX, IROQUOIS, and KINGSTON- classes), auxiliary vessels, submarines (VICTORIA class), floating industrial plants and barges and projected future Canadian naval platforms (i.e. JSS, AOPS, CSC);
- Coastal Towing; Conduct out-of-harbour coastal towing and recovery of major and minor warships, auxiliary vessels, floating industrial plants and barges, to a distance of up to 750 NM from home port; Service naval buoys in harbour and at remote locations by towing and positioning the floating crane;
- Firefighting ; Provide a 24/7 afloat firefighting response capability within the CFB Halifax and CFB Esquimalt Naval Dockyards; Provide 24/7 afloat firefighting, towing, and monitoring services to nuclear powered vessels, as directed by Nuclear Emergency response Teams;
- Harbour/Coastal Duties; Act as stand-by vessels during warship ammunitioning and de-ammunitioning; Act as stand-by tug during fuelling operations (Halifax); Provide fuel spill clean up and salvage response by towing barge to spill area and deploying clean up equipment such as containment booms, skimmers; Provide a salvage response capability by towing the floating crane and/or the recovery barges to the salvage area of deployment; Open, close and secure the gates of the Floating Force Protection Boom (Halifax); Pick up and move the moorings and boom sections and open, close and secure the gates of the Floating Force Protection Boom (Esquimalt); Transfer a minimum of 20 tonnes, per visit, of potable water to the DRDC research barge (YR494), CFAV QUEST, and warships within close proximity of Esquimalt and Halifax Harbour; Provide exercise support, such as simulating a vessel of interest in coastal waters and Canadian maritime exercise areas; Serve as a test and trials platform of trials equipment in coastal waters, such as towing a submersible.

3. The tugs shall be designed to meet the requirements of *MARPOL 73/78*, and shall be designed for operation within the limit of Canada Shipping Act, Near Coastal Voyage Class 1. The vessels shall be designed and built under Classification Survey that must be part of International Association of Classification Societies (IACS) and TP13585. It is not intended to enroll the vessel in the *Delegated Statutory Inspection Programme*. However, the process of TP 13585 shall be utilized and Classification Society in place of Transport Canada Marine Safety shall perform the inspection and certification required by Statute, Regulation or Convention in accordance with the process as outlined in *TP 13585 Delegated Statutory Inspection Programme*.

4. The vessel's systems shall be selected with simplicity of operation and maintenance as a prime consideration. For in-harbour operations, the vessel's crew will normally consist of (3) personnel. For out-of-harbour the vessel's crew will consist of (9) crew. The maximum complement of the vessel shall be (10) personnel. While underway, the vessel will be controlled from the Bridge by the Master and machinery shall be monitored from the Bridge by the Engineer. A microprocessor based control system related to the safe propulsion and navigation of the vessel shall be provided. The systems shall be designed to require the minimum amount of training and familiarization prior to entry into service. With the exception of familiarization training and training on the control systems, no further training is to be required to competently sail these vessels.

5. The vessel shall be constructed of steel and shall be built in accordance with approved drawings, using approved materials and products tested, inspected and certified by a Classification Society. The large naval tugs shall have a minimum service life of 25 years. The Contractor shall ensure the design and the material used in the construction of the vessel shall meet the 25 years service life requirement. Equipment, machinery and materials shall be selected to ensure reliable vessel operations for 2,000 hours of annual operations.

6. All the materials, machinery, equipment and outfitting, including all items of metal, plastic, synthetic fibres and pipes, for all purposes throughout the vessels, shall conform to the following basic requirements:

Be certified and stamped accordingly where required.

Be in accordance with the international standards in effect at the time of contract award set forth by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC) and the American Society for Testing and Materials (ASTM) Shipbuilding Standards.

7. All materiel and equipment shall be of proven technology and quality, entirely suitable to the marine application and purpose intended. The Technical Authority reserves the right to request samples of the proposed materials to be furnished for acceptance consideration.

8. The vessel shall be designed for full mission capability (all systems fully operational) and available for operations for 85 % of the calendar year.
9. The vessel shall be able to fulfill its primary mission requirements when operated a maximum of 10 hours in a 24-hour period for 10 day missions.
10. Critical failures are those failures that result in the loss of capability to float upright, communicate, move, activate damage control systems, or prevent the vessel from performing its assigned primary mission. The ship systems shall be designed and configured to have compensating provisions that can mitigate the effect of critical failure. The Contractor shall conduct a failure mode and effect analysis (FMEA) in accordance with *International Code of Safety for High-Speed Craft, 2000* Annex 4 Procedures for Failure Mode and Effects Analysis for the following ship systems;

- Main propulsion system;
- Ship service electrical power generation and distribution system;
- Navigation and communication systems;
- Machinery control system; and
- Damage control system

The report shall demonstrate that the vessel's systems are not rendered inoperable due to a single critical failure (single point of failure shall be compensated for by redundancy or alternate operating procedure that will prevent the loss of the system in the event of failure). The FMEA report shall identify tests and trials necessary to support the conclusions on the analysis.

11. To achieve a high operational availability for the ship, the selection of material and equipment shall be based in part on the in-service maintenance concepts of:
 - Repair by Replacement of defective components or assemblies that eliminates the requirement for component repair on board; and
 - Maintain by Exchange of the complete equipment where Repair by Replacement is too time consuming, complex or inhibited by post repair testing requirement.

12. A "Condition based" or "Usage based" maintenance philosophy shall be adopted without compromising safety or operational availability. The machinery and equipment arrangement shall provide an adequate and safe accessible maintenance envelope. Access to all routine maintenance items shall be provided, and shall not require the removal or disassembly of any equipment.

1.3 HULL DESIGN

1. The vessel shall be developed from a parent ‘proven’ ship currently in satisfactory operation for a minimum of 1,000 operating hours. The ‘proven’ design shall be operating, or shall have operated in a coastal maritime environment. The ‘proven’ design shall have inherent volume and deck area, stability characteristics, lightweight and deadweight distribution, reserve buoyancy, speed, and propulsion/electrical power which, after modification, shall meet this Technical Statement of Requirements (TSOR). The hydrodynamic and maneuvering characteristics of the ‘proven’ ship must be known and documented and capable of being demonstrated by sea trials.

2. The Contractor shall provide with the response to the Request for Proposal, the design of a selected parent ‘proven’ vessel that has been previously built and operated in service. The Contractor, in concert with a ‘proven’ designer, shall provide documentation to support the suitability of the ‘proven’ vessel and describe the modifications required to meet the TSOR.

3. Only designs which have been built and are operational will be considered. Details sufficient to evaluate the described experience shall include the following;

Design Data – Indicate when and by whom the contract was let and when the final design was completed and when the first of class ship was delivered.

Drawing Data – Include a legible General Arrangement on 11” x 17” format.

Drawing shall include principal particulars, all deck equipment and fittings, all compartments labeled and identified and class notations.

Capability Data – Describe the capability of the tug in comparison to the requirements of this TSOR.

4. The Contractor shall specify and provide substantiation of the bollard pull of the proposed ‘proven’ design, to the nearest tonne, required to satisfy the requirements of the TSOR.

1.4 POWER TRAIN AND CONTROL

1. The power train is defined as the prime movers (diesel engines), generators and electric motors (if hybrid or electric propulsion is selected), shafts, bearings, shaft seals, input gearboxes, and propellers as applicable to the drive system installation. Power train and control equipment selection must be selected from among models currently in production, and are available in North America with proven logistical support chains (sales offices, warehousing spares, and field service representatives) already established and currently operating in Canada.

2. The Contractor shall be responsible for the complete integrated solution for the entire propulsion package. The power train, power train resilient mountings and any sub-bases incorporated into the propulsion engine or gearing arrangements shall have a 2-year warranty which commences from Certificate of Acceptance of the vessel by DND
3. The proposed complete power train shall be of a proven design configuration, having successfully demonstrated in-service operation for a minimum of 3,000 hours.
4. All diesel engines, both for main propulsion and as generator prime movers, shall be selected from approved marine engine models listed by both the Classification Society and Transport Canada Marine Safety. The selected diesel engines and their respective control systems shall be of the same model for the entire class of tugs. The diesel engines and control systems chosen shall be appropriate for continuous and satisfactory operation in a marine environment and have predecessors that have been successfully operated at sea and have had undergone successful normal major overhauls.

1.5 AUXILIARY SYSTEMS

1. The auxiliary systems are defined as all installed systems required to support the operation of the vessel excluding the propulsion system. These include fuel oil, firemain, fire fighting, bilge and ballast, lubricating oil, diesel engine combustion air intake and exhaust, compressed air, steering system, HVAC, machinery space ventilation, fresh water, black grey water and sanitary flushing system, fire detection and extinguishing system, hydraulic, navigation and communication, and electrical power. Components and equipment of systems must be from among models currently available in North America with proven logistical support chains (sales offices, warehousing spares, and field service representatives) already established and currently operating in Canada.
2. Essential auxiliary systems are defined as those systems required to maintain propulsion capability and damage control. These systems include fuel oil, firemain, bilge and ballast, lubricating oil, diesel engine combustion air intake and exhaust, steering system, machinery space ventilation, fire detection and extinguishing system, navigation and communication, and electrical power.
3. The power generation and distribution system shall include a 2-year warranty, which commences from Certificate of Acceptance of the vessel by DND, covering power generation motors, generators and associated controls. The 2-year warranty, shall also cover all engine and/or generator mountings and any sub-bases that may be incorporated into the engine or generator arrangements.

1.6 OPERATING ENVIRONMENTS

1. The vessel shall be designed to operate in coastal waters as defined under the Canada Shipping Act for Near Coastal Voyage, Class 1. The vessel shall be able to:

Conduct towing operations (Vessel size; 1000 tonnes displacement, 56 metres LOA) in Sea State 3.

Operate (maintain course on desired heading at 100% MCR) in Sea State 5 – the ship shall be capable of transiting to suitable ports of refuge on the route with the best heading to evade worse weather.

2. The vessel and its systems shall be capable of surviving, without serious damage to mission essential systems, and the watertight integrity of the hull envelope, or injury to embarked personnel, under the following extreme ambient environmental conditions:

Factor	Maximum	Minimum
Free Air Temperature	35°C	-35°C
Relative Humidity	100%	0%
Wind	37.5 knots steady, 60 knots gusts	
Sea Temperature	32°C	0°C
Sea Water Salinity	39 parts per thousand	0 parts per thousand
Sea State	5	

Sea State is defined in the following table:

Sea State	Significant Wave Height (m)		Sustained Wind Speed (knots)		Model Period (sec)
	Range	Mean	Range	Mean	
3	0.5 to 1.25	0.88	11 to 16	13.5	7.5
5	2.5 to 4	3.25	22 to 27	24.5	9.7

The upper limits of wave height and wind speed shall be used unless otherwise specified.

3. Exposed equipment and machinery shall be provided with watertight housings as required. All machinery, structure, and outfit shall be designed to withstand the resultant forces from the ship/sea interactions and the environmental loads. All essential propulsion and auxiliary equipment, and the associated fluid systems (such as lubrication system, fuel oil systems and hydraulic systems) shall be designed to operate when the vessel is upright, and under the list, roll, trim and pitch conditions likely to be encountered in service in Sea State 5.

1.7 ARRANGEMENTS

1. As a minimum, the vessel shall have spaces adequate to accommodate the following:

- Bridge;
- First-aid station furnished with a first-aid kit;
- Pyrotechnics locker;
- Flag lockers;

Deck Stores;
Wet Gear/ Drying Locker;
Nuclear Monitoring Equipment Locker;
Garbage Store;
HAZMAT locker;
Locker for Spill Control and Disposal Kits;
Firefighting Equipment Storeroom;
Firefighting Gear Lockers;
Galley (co-located to Mess);
Mess/Recreation Area to seat (10) crew in (1) sitting;
Cabins for (10) crew (as per Canadian Towboat Regulations);
Washplaces (2);
Laundry area;
Fore peak;
Chain Locker;
Chain and Rope Storage;
Provisions Store;
Linen Locker;
Cleaning Gear Lockers;
Propeller Compartment;
Engine Room;
Generator Compartment;
Spares Parts Store; and
Workshop Area.

The technical authority shall approve the final arrangement of compartments prior to build.

2. The forward, after, and waist decks of the tug shall, as far as possible, be free of obstructions, to provide a clear, open working deck area, especially within the working radius of winches and lines. The tug shall be capable of operating under the flare of current Canadian major warships.

The Open deck area shall be adequate for:

- a. Anchor handling
The forecastle shall be equipped with anchoring equipment.
- b. Towing and line handling
Deck equipment shall be fitted and configured on both the aft deck and foredeck to facilitate towing and ship berthing assist functions of the tug.
- c. Mooring
The tugs shall be configured with a suitable arrangement of deck fittings, including sufficient cleats, chocks and fairleads, to facilitate securing of mooring lines to the tug for berthing.

The vessel shall be configured with at least head, stern, and two spring lines to facilitate berthing.

- d. **Equipment Stowage**
The vessel shall be fitted with a SOLAS approved Rescue Craft and a launching/recovering system.
- e. **Fuel Spill Clean-up Response**
The vessel shall be configured for deploying containment booms, skimmers, and other clean-up equipment.
- f. **Dangerous Goods Stowage Racks and Lockers**
The vessel shall be fitted with a pyrotechnics locker and a stowage rack for gasoline containers for the Rescue Craft.
- g. **Ship/Shore Safe Access**
The tug shall have at least one point of through-access on each of the port and starboard sides of the gunwales to enable the placement of a gangway to provide for safe access between the vessel and shore or between other vessels berthed alongside via the brow/gangway.
Arrangement to embark/disembark pilot between tug and warships when vessels are underway at 5 knots or less and the tug is against the side of the warship. It is desirable that the hull and superstructure arrangement allow the pilot to step from one vessel to another by means other than a pilot boarding ladder.
The vessel shall be capable of being refuelled and provisions embarked (including water, fuel and stores), or discharged (including potable, grey and black water tanks, and dirty lube oil) from either side.
- h. **Firefighting**
The tug shall be fitted with the requisite equipment to conform to FiFi 1 notation of a Classification Society.

PART 1 GENERAL TECHNICAL REQUIREMENTS

SECTION 2 SPECIALTY ENGINEERING

2.1 HUMAN ENGINEERING

2.1.1 General

1. The following industry standards and recommendations relating to human factor shall be used for the design of vessels, systems, subsystems, and equipment to ensure effectiveness, efficiency, safety and accessibility for the operation and maintenance of the vessels, where applicable:

ASTM F1166-07 Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities;
IMO MSC/Circ.982 Guidelines on Ergonomic Criteria for Bridge Equipment and Layout.

2. The equipment arrangement, space outfitting and furnishing shall be designed to accommodate the 5th to 95th percentile of the population.

2.1.2 Access

1. The accommodation, machinery spaces, working areas and other normally manned spaces shall have at least two means of escape. There should be no direct access from a machinery space to berthed accommodation. Arrangements shall be provided to give access for examination, painting and cleaning to all compartments in the vessels by means of approved doors, manholes, scuttles and bolted plates. Electrical cable and piping shall be kept clear of all access areas.

2. For spaces below the main deck, the main means of escape shall be a stairway or inclined ladder and the second escape may be a trunk or a stairway. For spaces above the main deck, the means of escape shall be stairways, inclined ladders, or doors to an open deck.

3. Passageways shall have a clear width of at least 900 mm. The width of doorways and passageways shall be adequate to allow the removal of furniture and galley equipment. The clear opening of all doors to stairs and ladders shall be at least equal to the actual stair width.

4. All access openings shall have suitable rounded corners and shall be effectively framed.

5. The width of all stairways and inclined ladders shall be a minimum of 560 mm. Stairways shall be aligned in the fore and aft direction. Stairways and inclined ladders, outside the machinery spaces shall have a maximum angle of inclination from the horizontal of 50° with handrails. The inclined ladders, inside machinery spaces and exterior, shall have an angle of inclination from the horizontal not more than 50° with handrails. Vertical ladders shall have a minimum width of 450 mm.

6. Dimension of clear openings to escape/access hatch on deck shall not be less than 580 mm x 580 mm or 580 mm diameter. The escape/access hatch shall be quick-acting type, hinged with counterweight and with locking arrangement such that the hatch can be opened from either side. Manholes of at least 600 mm x 400 mm shall be provided for tanks, voids spaces, chain lockers, and cofferdams. At least two manholes located well apart shall be fitted to each enclosed space. Manhole covers shall be secured by studs with all nuts, bolts, and washers of non-ferrous material and screws shall be stainless steel.

7. Hinged closures (doors and hatches) installed in weather locations, as far as practical, should be hinged on the forward side. Doors should not open into passageways and should open into compartments. Hatches should hinge up against the structure to avoid obstruction of passages or deck areas and means for securing the hatch open shall be provided. Flush deck manholes should be used in the interior in way of working, walking or operating areas, where above deck projections create a personnel hazard. All hatch covers and manholes covers should be easy to handle by one person and they shall be as strong as the surrounding deck structure. All hatches to manned stations shall be operable by one person from above and below.

8. The minimum clear deckhead height below the services or false ceilings shall be at least 2.10 m in all habitable spaces, working spaces and passageways. All doors shall have a clear opening height of 2050 mm above the deck or false deck.

9. Removal routes shall be provided for all major equipment, excepting engines or other equipment repaired in-situ. The structure and layout of the machinery/equipment shall be designed and constructed to permit ready access to all parts for operation, inspection, maintenance, and repair, and removal. The engine and machinery shall be arranged such that maintenance access is provided to perform all routine service required annually or more frequently without removing the engines or machinery, or removing or disassembling any machinery or equipment. The oil dipsticks for all equipment or engines, gearboxes, and other machines shall be located on the inboard side.

2.1.3 Colour

1. The interior colour scheme for all furnishing and finishing materials shall be developed from CFTO D-23-003-005/SF-002 Specification for Maintenance Painting of HMC Ships. Paint colours called up in the scheme shall be in accordance with FED-STD-595B (formerly CGSB 1-GP-12c), *Standard Paint Colours, Part 1 Colour Identification and Selection*.

2.2 HABITABILITY

2.2.1 Furnishings

1. The accommodations shall be designed in accordance with the *CSA Towboat Crew Accommodation Regulations*.

2. Joiner bulkheads, shipside linings and false ceilings shall be fitted in all cabins, mess/dining room, interior passageways, and Bridge.

3. Linings shall not however be installed on the ship side in any space where the standing deck is at or below the Deep Displacement waterline.

4. Stainless steel faced bulkhead and shipside linings and ceilings shall be provided in the Galley. The outer face of joiner bulkheads panels fitted in the Galley shall be stainless steel satin finish.
5. Linings and false ceilings shall be installed in a manner that will not impede damage control efforts. Joiner work shall conceal vents, piping and wiring, and provide access as required. Full accessibility to components requiring access for inspection, maintenance or operation must be maintained. Where necessary for frequent access or inspection, ceilings/linings shall be provided with portable or hinged access panels with latch fastening.
6. Access panels shall not be covered by fittings or systems, be easily removable and replaceable, shall be large enough that to allow any valves that they cover to be removed as well as operated, not require special keys or tools to open them, have securing arrangement that are captive.
7. All joiner bulkheads, linings and ceilings shall be approved TCMS products.
8. Color, patterns and design shall be submitted to the Technical Authority for approval.

2.2.2 Furniture Standards

1. Furniture shall be commercial design, modular construction and free of sharp edges and burrs suited for marine environment shipboard use. Large articles of furniture shall be mounted on sub-bases and secured at top and sides by hasps where possible. The furniture shall not be rigidly attached to non-structural or joiner bulkheads. Maximum use of low maintenance materials and finishes for ease of cleaning should be incorporated into all accommodation furnishing.
2. All materials selected for furnishings shall have properties to reduce flame spread.
3. All berths, drawer units, lockers, sideboards and dining tables support shall be constructed from metal and semi-gloss baked enamel finish. Interface of dissimilar metals for installation shall have proper isolation. Vinyl upholstery shall not be used. Accommodation upholstery shall be a woven fabric and shall be fire retardant, washable and fastened to frame with non-corrosive attachments.
4. Quality of all outfit items selected shall be to the approval of the Technical Authority.

2.2.2.1 Berths

1. Berths shall be single, 2-tier. All berths shall be designed for one standard size mattress with a minimum dimension of Length 2000mm x Width 800mm x Thickness 150mm.

2. Each berth tier shall be provided with:
 - A mattress,
 - A reading light with individually controllable switch properly positioned;
 - Stowage space for a personal floatation device (approximately 180 mm x 320 mm x 140 mm);
 - Stowage for an emergency escape survival suit;
 - Stowage space for an Emergency Escape Breathing Device (approximately 130 mm x 260 mm x 270 mm); and
 - Stowage space for reading material (approximately 300 mm x 300 mm x 75mm).
3. Drawers shall be fitted below the lower tier of the lowest bunk. Drawers shall be furnished with cylinder locks keyed identical to the kit lockers. Three sets of keys per locker shall be provided.
4. Each berth shall be fitted with removable rails, fixed privacy screen panels at each end and a privacy curtain. Grab rails and ladders shall be fitted as required to assist in getting in and out of the upper berth.

2.2.2.2 Personal Storage Locker

1. One (1) personal storage locker shall be provided for each crewmember. The lockers shall have minimum dimensions as per CSA regulations. The lockers shall provide the following types of stowage:
 - Minimum (2) shelves;
 - Boot stowage;
 - Hanging bar for clothes; and
 - Clothes hooks.
2. Drawers shall be fitted with stops. Doors shall be fitted with a positive closing mechanisms. Doors/drawers shall be furnished with cylinder locks keyed alike. Three sets of keys per locker shall be provided. Lockers shall be identified by a numbered plate on the front. Lockers shall be located so they will permit free air circulation and free unobstructed access throughout the compartments.

2.2.2.3 Desks, Writing Tables

1. Desks where fitted shall be of a single pedestal type.
2. Single pedestal desks shall be a minimum of 1100 mm long x 750 mm depth and shall be 750mm high from the deck to the writing surface. The desk top shall have a minimum thickness of 35 mm. A two drawer deck mounted filing cabinet shall be fitted below the desk top, either to the right or left of the sitting position to suit the compartment configuration.

3. Each desk shall be fitted with an individually switched desk light.

4. Each desk where fitted shall be provided with an adjustable desk chair. Desk chairs shall have a padded seat and back and shall be fitted with arm rests.

2.2.2.4 Chairs

1. Chairs should be of a lightweight design with upholstered seat on a light metal frame.

2.2.2.5 Toilet Cabinets

1. Cabinets shall be of stainless steel construction and shall be equipped with stainless steel shelves with edge rails and a mirror on the door. Doors shall have secure catches. Cabinets shall be mounted so that the centre of the mirror is 1.64 m above the deck.

2.2.3 Crew Cabins

1. No more than (2) crewmembers shall be assigned to one cabin. Single cabins shall contain a single berth settee. Double cabins shall contain a 2-tier single berth. Each cabin shall contain the following furnishings;

- (1) desk;
- (2) chairs in double cabin, (1) chair in single cabin;
- (1) bookcase;
- (2) personal storage lockers in double cabin, (1) personal storage locker in single cabin;
- (1) toilet cabinet complete with mirror on the door and light situated above the cabinet,
- (2) towel bars in double cabin, (1) towel bar in single cabin;
- (1) desk light;
- (2) berth lights;
- (1) waste basket;
- (2) coat hooks;
sidelight curtains with hooks, holdbacks and rod;
berth curtain and rod for each berth;
berth ladder for where an upper berth is fitted; and
Automatic Telephone connection in the Master's and Engineer's cabin.

2. Ventilation grilles and diffusers shall not be obscured by other fittings. All air discharges shall be designed such that they are not directed on personnel. It is important that the temperature of the enclosed area be held relatively uniform and that air temperature at desk level and at deckhead level should not differ by more than 3 degrees.
3. Fixed furniture, such as berths and personal stowage lockers, shall be fitted in such a manner as to avoid gaps and preclude any void space between the piece of furniture and surrounding bulkheads or between adjacent pieces of furniture.
4. Berths shall be oriented with their length along the fore and aft ship's axis, with the head of the berth forward.
5. Individually controlled lighting and ventilation shall be provided for each berth.
6. Where port lights and or windows are fitted, adequate save-all arrangements shall be provided to prevent water or condensation dripping into the compartment.

2.2.4 Toilet Spaces

1. A minimum of (2) gender-neutral facilities shall be provided. Each one shall be fitted with the following;
 - (1) water closet with hinged seat;
 - (1) washbasin with overflow in a vanity type installation with waterproof finished counters and backsplash;
 - (1) toilet cabinet with mirror on the door and light situated above the cabinet; and
 - (1) shower stall with interior light, curtain, curtain rod, hook and holdback.
2. The washroom shall be outfitted with all necessary fittings including;
 - (1) toilet tissue roll holder;
 - (1) towel rail;
 - (1) paper towel dispenser/disposal unit;
 - (1) shaver outlet;
 - (1) soap dish in shower stall if none fitted integral to shower unit;
 - (1) soap dish in way of washbasin;
 - (1) waste container;
 - coat hooks; and
 - grab rails.
3. All washroom entrance doors shall have a locking device for privacy. Entrance doors shall feature gender neutral signs fitted permanently.
4. Shower stalls modules shall be of a one piece modular construction with an integral base. The base shall be sloped to facilitate drainage and be fitted with a saveall

and shower curtain to prevent water from entering the toilet space. The base shall be fitted with a flush mounted drain located at the lowest point.

5. Shower stall units shall be fabricated or moulded from materials that do not corrode or requires painting or coating and have a non-slip floor. The entrance to the shower module shall have rounded stall corners. Water Drains and supply lines to both the control valve and the shower head shall run outside of the shower module.

6. Showers shall be fitted with a thermostatic mixing/flow control valve and incorporate a safety device to prevent scalding.

7. Decks in sanitary spaces shall be sloped to facilitate drainage and shall be fitted with scuppers at their lowest point to ease drainage and avoid pooling of water. All scupper covers shall be free to be lifted easily for cleaning.

2.2.5 Mess

1. A mess, contiguous to the Galley, shall be provided for the crew. The mess shall be fitted with upholstered settees and table(s) having a seating capacity for 10 crew.

2. A cupboard and counter, and drawers for stowage of cutlery and utensils for the entire complement shall be provided. Cupboards and counter shall be aluminium or stainless steel. A bookcase shall be fitted. Outfit shall include window curtains and rods and coat hooks as applicable.

3. A drinking fountain shall be fitted.

4. Dining area outfit and furnishings shall be designed to ensure there are no crevices or inaccessible voids which could collect food, waste or other extraneous matter.

5. For the combined lounge/recreation area and mess an audio/visual entertainment cabinet shall be fitted with a television, DVD player, DVD storage, and stereo equipment.

6. The mess shall be outfitted with a computer outlet, an audio visual outlet, and an Automatic Telephone connection.

2.2.6 Galley

1. The galley shall be equipped to allow the crew to prepare meals. The galley shall consist of food storage spaces, food preparation area, cooking spaces, and a garbage stowage space. The galley shall be furnished with the following:

- (1) domestic type electric range all stainless steel finishes with grill top, (2) burners and convection oven of 57 litre (L) minimum. Unit top shall be fitted with sea rails constructed of stainless steel;
- (1) range exhaust hood of stainless steel construction incorporating a grease trap and filter;

- (1) vertical upright commercial type refrigerator of 500 L minimum, with stainless steel finish. Door latch shall be locking and suitable for marine use;
 - (1) vertical upright commercial type freezer of 595 L minimum, with stainless steel finish. Door latch shall be locking and suitable for marine use;
 - (1) microwave oven of 34 L minimum;
 - (1) dishwasher;
 - (1) stainless steel double sink;
 - (1) 4-slice heavy-duty automatic toasters;
 - (1) 12-cup minimum commercial quality coffee maker fitted with sea rails; and
 - (1) bulkhead mounted heavy duty electric can opener.
2. Sink counters shall be of all stainless steel construction with 450 mm backsplash in way of sink. All other backsplashes for countertops shall be 150 mm. Double sink shall be stainless steel with radius corners throughout, each side approximately 300 x 300 x 250 mm. A standard single lever, mixing valve faucet and spray nozzle attachment on flexible hose should serve the double sink.
3. Equipment abutting other pieces of equipment or furnishing such as table tops, counter tops and bulkheads shall have stainless steel blank-off strips installed to avoid grease or soil catching crevices. Panels of quilted stainless steel shall cover bulkheads behind the heat producing equipment. The space between the heat producing equipment and the bulkhead shall be sealed against entry of vermin, cooking ingredients or other extraneous matter.
4. Tables and counters should be provided to the maximum practical extent. Normal width of counters accessible from one side only shall be 750 mm, with a height above deck between 915 and 1065 mm. All counter tops shall, wherever possible, be provided with cabinet units fitted with shelves, cupboards or draws underneath the working surface.
5. Cupboards shall be of all-stainless steel construction, bulkhead mounted with shelving, self-closing hinged doors with positive closing latches and locking arrangements. Each lock shall be provided with (3) sets of keys. Cupboards above sink counter shall have dividers sized for dishes. Over counter top cabinet units shall suit the space available and should be either 230 mm in depth and sited 450 mm above the counter top, or 380 mm in depth and sited 750 mm above the counter top.
6. Stowage space under counters shall include the following:
- Shelves with upstands for packaged and canned supplies;
 - Stowage for pots and pans in form of deep drawers with spaces sized for utensils;
 - Racks for pot lids;
 - Drawers shall be all-stainless steel construction; and
 - Cutlery and tool drawer(s).

7. Shelves and drawers shall be removable for easy cleaning and drawers shall be provided with positive closing latches. Drawers shall be fitted with a back-stop restraint. No drawers shall have a height less than 100 mm.
8. A garbage container with a minimum capacity of 30 L with a self-locking lid shall be provided.
9. All portable galley equipment shall be provided with appropriate storage for securing at sea.
10. Construction details of furnishings and equipment shall provide for the elimination of sharp edges, corners and burrs which might cause injury to personnel.
11. The entrance door(s) shall be large enough to allow for the removal of the largest component of Galley equipment without the need to dismantle it. In no instance however shall the entrance door be less than 900 mm wide. Entrance doors to Galley shall have a 150 mm coaming.

2.2.8 Bridge

1. The size and layout of the Bridge shall accommodate normal operations.
2. The Bridge shall be outfitted with navigational aids, communications and electronic equipment and the following:
 - Chart table with a top at least 750 mm long x 750 mm wide, 915 mm above floor and fitted with drawers and lockers underneath;
 - Chart table lamp;
 - Flag locker;
 - Storage and access for Nuclear Monitoring Equipment;
 - Bookshelf; at least one linear metre long and 300mm deep;
 - Bridge Control Console (BCC) to suit installation of steering, navigation, and communication equipment and controls;
 - Machinery Control Console(MCC) to suit installation of alarm, machinery controls and indicators, and auxiliary machinery monitors and controls;
 - Firefighting (FiFi) Control Console (FCC);
 - Two Captains chairs with sliding base for sitting or standing, (1) in way of Master's position and (1) in way of Engineer's position;
 - Clock and barometer;
 - Clinometer;
 - Magnetic compass located centreline;
 - Medical cabinet, including first aid kit;
 - Stowage spaces for shapes, binocular boxes adjacent to helm position, lead lines;
 - and
 - Handrails under all windows and at all consoles and control positions.

2.2.9 Storerooms and Stowage Spaces

1. Storerooms and stowage spaces including lockers, cupboard and drawers shall be fitted to provide stowage facilities for ship provisions, equipment or gear associated with the vessel's function.

2. Shelving and stowage bins shall be provided in the stowage spaces. Lockers may be arranged in a common stowage space to afford convenience and economy of space.

3. All storerooms, stowage spaces and lockers shall be fitted with locking arrangements.

4. All exterior lockers shall be weathertight and be supplied with a drainplug and keep chain.

5. All lockers shall be metal construction and fitted with a hasp and staple unless otherwise specified. Lockers for flammable liquids shall be of steel. Lockers shall have louveres or other similar means of circulation unless otherwise noted for specific lockers.

6. The following storage and stowage spaces shall be provided:

a. First Aid cabinet, metal construction bulkhead mounted in Bridge.

b. Provision Storeroom. The Provisions Storeroom shall have the appropriate volume of storage to accommodate dry provisions, fruit, vegetables and potatoes, frozen provisions, such as meat and fish, to sustain the ship's crew for a (10) day endurance. The temperature shall be maintained at 11° to 15° Celsius. The provisions storeroom shall be fitted with the following;

Adjustable, 3-tier, stainless steel shelving, with easy clean surfaces fitted with keep battens to ensure the storage is secure when partially empty;

Adjustable shelving to have a positive locking mechanism so there is no danger of shelves becoming loose or shifting with the shelf fully loaded;

A step-stool with rubber padded feet complete with stowage;

A freezer unit for frozen provisions for (10) days with adequate holding down arrangement;

A refrigerator with volume capacity to accommodate dairy, fruit, vegetable and potato stores requirements for (10) days with adequate holding down arrangement;

The volume of stores is calculated from the following formula;

Volumetric Requirement = Space Factor x No. of Days x No. of Crew

Volume for provisions store shall be based on space factors as outlined in the table below.

Category	Storeroom	Space Factor (per crew/day)
Provision	Dry Provision	0.008707 m ³
	Freezer (Meat, fish and all frozen provisions)	0.006354 m ³
	Dairy	0.009186 m ³
	Fruit and Vegetable	0.005244 m ³
	Potato	0.000844 m ³
	Soft Drink	0.00475 m ³

c. Linen Locker. The Linen locker shall provide the necessary stowage for one complete set of bed linen for the ship's complement. The locker shall be fitted with metal shelving.

d. Wet Gear/Drying Locker. The locker shall be fitted with convenient access from the weather deck. The locker shall be fitted with a hanging rail, drip tray over the entire length, twin double doors with adequate closing devices. Doors shall be louvered to allow circulation of hot air by means of a forced air heater and natural exhaust to the exterior.

e. Cleaning Gear Locker. The locker shall be fitted to accommodate cleaning equipment and cleaning products. The locker shall be fitted with adjustable, perforated shelves fitted with keep battens to ensure the stowage is secure when partially empty. Secure stowage, racks or bins shall be fitted as required for brooms, mops, buckets, and cleaning products.

f. Survival Suit Locker.

g. Fuel Oil Spill Control Locker (about 1.5 cu. metres) shall be located for direct access from the weather deck.

h. Deck Stores. Deck stores shall be provided with all necessary shelves, bins, and stowage racks for the stowage of, as a minimum, mooring and towing hawsers and other ropes, spare mooring gear, rope reels, scramble net, and Jacob's Ladder. Deck Stores shall be directly accessible from the weather deck. Shelving shall be adjustable, perforated metal with keep battens as appropriate. Deck stores shall be force ventilated.

i. Rescue Boat Locker. The locker shall be located adjacent to the rescue boat stowage area for spare outboard motor, lifejackets, fenders, boat gear, oars and paddles, and toolbox. The compartment shall be fitted with the necessary stowage aids to secure all items stored.

- j. A quick release type stowage rack shall be fitted for two portable 20 L containers for the outboard motor fuel tank. Located so as to not interfere with operations.
- k. Fire Fighting Equipment Storeroom. The storeroom shall be located below deck and fitted with adjustable metal shelving. Each shelf shall be lipped and portable keep battens. The storeroom shall be fitted with (4) standard personal stowage lockers for fire fighting gear. The lockers shall be of metal construction.
- l. Fire Fighting Gear Lockers. Lockers shall be fitted in the deckhouse port and starboard. The lockers shall be fitted with adjustable, perforated metal shelving. Each shelf shall be lipped and portable keep battens. The lockers shall be fitted with grating on deck and plugged drain holes on outboard corners.
- m. HAZMAT locker. The locker shall have a stowage capacity of approximately 0.5 m³ and be open to weather deck for storage of hazardous material such as paint and inflammable liquids.
- n. Pyrotechnics ready-use locker. The locker shall capable of being flooded and shall be installed on the exterior of the superstructure on the wheelhouse deck.
- o. Spare Parts Store. A storage shall be fitted to facilitate stowage of machinery spare parts and supplies to support at-sea operations for 10 days. The store shall be readily accessible from the Main Machinery Space and Workshop Area. The Spare Parts Store shall be fitted with lockers fitted with adjustable, lipped metal shelving.
- p. Nuclear Monitoring Equipment Locker. A locker shall be fitted to accommodate NME equipment, suits, hoods and masks. Dimensions for the locker shall be 1.0 metre x 1.0 metre x 2.0 metre. The locker shall be fitted with shelving and a lock. The locker shall be located in close proximity to the Bridge.

7. Where lockers are fitted within compartments and in way of equipment, passage between the stowage bins/locker and equipment shall be as least 610 mm wide and provide adequate maintenance envelope for the equipment installed in the compartment.

8. A stackable, commercial quality clothes washer and dryer shall be fitted. The dryer shall have a dedicated exhaust system to the vessel exterior. A laundry tub with hot and cold fresh water supply shall be co-located with the washer/dryer. A soap dispenser, a paper towel dispenser and a supply cabinet shall be fitted in way of the laundry tub. Supply cabinet to be sized to accommodate laundry supplies. As far as space permits this self-serve laundry area shall be co-located in way of the accommodation area.

2.2.10 Workshops/Work areas

- 1. A Workshop/Work area shall be provided in or near the machinery space.

2. The Workshop/Work area shall be furnished with a workbench with the top work area not less than 1524 mm x 914 mm approximately 940 mm height. The workbench shall feature a coaming, drawers, shelves and lock-up doors.
3. A multi-purpose lathe, a 6-inch parallel jaw vice, a milling machinery, and a drill press shall be fitted to the bench.
4. Special tools for completion of first line operator maintenance for the vessel, complete with appropriate stowage, shall be provided.
5. Suitable stowage for an anticipated tool fit shall be provided. Bins and racks shall also be fitted to store chain blocks, slings, eyebolts and other maintenance items.
6. Adequate electrical outlets for 115 volts AC and Low Pressure air points for power tools shall be arranged close to the workbench. All electrical cabling, compressed air lines, and fluid leads shall be protected.

2.2.11 Garbage and Trash Stowage

1. The vessel shall have well vented stowage room/area for containers/bins to collect sorted garbage, recyclable material and regular waste.
2. With all accommodation occupied the vessel shall be able to process and store the amount of solid waste as indicated in the table below for the maximum number of days of endurance plus 20%.

3. Waste storage shall be divided as follows;

Food waste;
 Paper, books, fine cardboard, newspapers, magazines, etc.
 Corrugated cardboard;
 Metal cans and glass; and
 Plastic.

Waste Stream	Volume /Person/Day (m ³)	Weight/Person/Day (kg/person/day)
Food and Galley Waste	0.00085	0.5488
Cardboard and Paper	0.0014	0.5035
Metal and Glass	0.0014	0.2449
Plastic	0.00043	0.0907
Wood Waste	0.000283	0.004536
Textile Waste	0.000283	0.05443

4. The Garbage stowage shall have a raised grating platform above the deck to allow fluid to drain to the lowest point of the compartment during cleaning and washing down activities. A means of draining the stowage shall be fitted within the lowest, outboard point within the garbage compartment.
5. Containers for the collection of materials to be recycled are to be located in way of the galley/ mess area of the ship.

2.3 NOISE AND VIBRATION

2.3.1 Noise

1. The airborne noise in ship compartments, accommodation, and at manned deck stations with normal full ventilation, with all equipment in the space running at operating level, and vessel sailing at full speed ahead shall meet the following requirements:

Canada Labour Code Marine Occupational Safety and Health Regulations; TP 3685 Standards Respecting Noise Control and Hearing Protection in Canadian Towboats Over 15 Tons, Gross Tonnage; and TP 1861 Standards for Navigation Lights, Shapes, Sound Signals Appliances and Radar Reflectors.

2. The noise level at listening posts shall be in accordance with *TP1861*.
3. Where the level of noise is 85 dB(A) or more or where the peak level of impulse noise exceeds 140 dB(A), permanent signs, in both official languages, shall be posted warning persons entering the spaces. A cabinet or stowage of three muff-type hearing protection devices shall be installed near the entrance to the any space with noise level that can exceed 85dB(A).
4. The main propulsion engines and close-coupled gearboxes, and generator sets may be resiliently mounted on foundations in order to meet the requirements of noise and vibration levels at all engine operating speeds and power output. The design and installation of resilient mounting systems shall allow for the simple examination of mounts and for the replacement of any single mount without disconnection of any propulsion equipment interface or equipment beyond the limits of adjacent mountings. The life of all resilient mountings shall be at least 10 years. Unless its protective coating is applied by the mount manufacturer, all resilient elements shall not be painted. Where resilient mountings are installed, the type and quantity of the mounting shall be listed on the foundation drawing and in the material list. Where equipment is resiliently mounted, all pipe and duct connections shall be made through flexible sections.
5. Rotating equipment and machinery shall be selected to have the lowest practicable noise level at normal operating speeds.

6. The Contractor shall conduct a noise survey on the first of class vessel in accordance with the procedure outlined in TP 3685. Any deviations in excess of prescribed limits shall be addressed and rectified by the Contractor.

2.3.2 Vibrations

1. To ensure safety, operational proficiency and comfort of the crew, the vibration levels of the vessel shall be to Classification B (Crew Accommodation Area) to *ISO 6954 Mechanical Vibration – Guidelines for measurement, reporting and evaluation of vibration regard to habitability on passenger and merchant ships*.

2. The Contractor shall carry out the following mathematical vibration analysis, as required, to support system design;

Torsional vibration. The Contractor shall be responsible, in collaboration with the equipment suppliers, for checking the propulsion system to ensure that no torsional vibration which may be damaging to the equipment exists within the operating range and under all conditions of operation. There shall be no restricted speed ranges within the operating profile.

Modal analysis of all resiliently mounted machinery. Fatigue and modal analysis of all machinery mounted on a sub-base that is resiliently mounted to demonstrate that the design is adequate to avoid any fracture/failure in the sub-base for the entire life of the vessel.

3. The mast structure and the associated platforms and overhangs shall be designed to provide rigid foundations to support the electronic navigation equipment such as radar and antennae. The magnitudes of vibration shall be reduced to levels compatible to the environmental qualifications of the installed equipment to avoid excessive induced stress in the equipment and to minimize the movements of the equipment for the proper functioning of the equipment.

4. The Contractor shall conduct vibration measurements on the first of class vessel. Any deviations in excess of prescribed limits shall be addressed and rectified by the Contractor.

5. Calculations shall be submitted to the Technical Authority for review.

2.4 OCCUPATIONAL SAFETY AND HEALTH

1. The vessels shall be designed to provide a safe and comfortable working environment for the crew. The vessel shall meet the requirements of the Canada Labour Code and the related statutory regulations. The interface between the vessels and shore shall be designed to provide safe accessible embarkation and disembarkation of the complement to and from the vessels. The vessels shall have a First-aid station furnished with first-aid supplies and equipment in accordance with the *Marine Occupational Safety*

and Health Regulations. Additional stowage provision shall be provided at the training station to store items that are listed in Type “C” first-aid kit as per Treasury Board of Canada Chapter 2-5 of the “Occupational Safety and Health” First-Aid Safety and Health Directive http://www.tbssct.gc.ca/Pubs_pol/hrpubs/TBM_119/25RECON_e.asp but not included in the *Marine Occupational Safety and Health Regulations*. The First-aid station may be a part of the lounge/mess area.

2. Inspections shall be a part of Compartment Inspection prior to ship acceptance to verify the vessels shall comply with the safety requirements and to verify the location of any hazardous material and controlled materials onboard.

3. A Radio Frequency (RF) survey shall be conducted on the first of class vessel with all electromagnetic emitters transmitting. The RF survey shall be carried out in accordance with *Health Canada “Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz - Safety Code 6.”* Permanent Warning and Danger signs, in both official languages, shall be posted for identifying hazardous devices and for area demarcation, where applicable.

2.5 STABILITY AND SUBDIVISION

2.5.1 Trim and Stability

1. The Contractor shall prepare a Trim and Stability Booklet in accordance with *IMO MSC/Circ.920 Model Loading and Stability Manual*. The assumed weight for passenger and crew shall be 90 kg per person and an equal 90 kg shall be taken for the weight of personal effects.

2.5.2 Stability Requirements

1. This vessel shall meet or exceed the intact and damage stability criteria for type III vessels in the Canadian Forces Technical Order *Stability and Buoyancy Requirements for Surface Ships (C-03-001-024/MS-002)*.

2. The Contractor shall deliver a stability book with each vessel as well as a copy to the technical authority.

3. The stability electronic files (including all files required to make a stability manual) shall be delivered to the technical authority in readable GHS format.

2.5.3 Weight and Centre of Gravity Control

1. The Contractor shall customize a weight control program based on the industry standard *ASTM F1808 Standard Guide for Weight Control Technical Requirements for Surface Ships*
2. The Contractor shall be responsible for the preparation of the weight estimates and report to support the preliminary and critical design reviews.
3. The Contractor shall consider all the Government Furnished Equipment and Government Supply Material as part of the ship's baseline design weight based on the information provided with the SOW. Any weight differences between the actual weight and the information provided with the SOW shall be applied to the Government Furnished Equipment Margin.
4. The following weight margin shall be allocated to the Technical Authority and shall be included in-all weight estimates until the ship is completed and as-built weight assessed:
 - a. **Contract Modification Margin**

This margin is the weight and moment allowance in the weight estimates to account for increases associated with Government originated contract modifications issued during the contract implementation. The contract modification margin is 2 tonnes.

This margin shall be applied at the lightship centre of gravity. Only the Technical Authority shall have the rights of using the Contract Modification Margin.
 - b. **Government Furnished Equipment Margin**

This margin is the weight and moment allowance in the weight estimates to account for increases associated with Government Furnished Equipment. The Government Furnished Equipment margin is 15% of the identified Government Furnished Equipment weight.
 - c. **Design and Build Margin**

This margin is the weight and moment allowance in the weight estimates to account for increases associated with changes made through the evolution of information from the beginning of the design through the construction of the vessel. The Design and Build margin is ??? tonnes at the beginning of the design and ??? tonnes at the beginning of the construction.

This margin shall be applied at the centre of gravity. Only the Designer / Shipyard (as applicable) shall have the rights of using the Design and Build Margin.

5. The Contractor shall submit a final complete weight report that reflects the as built condition of the vessel. The final weight report shall also show the weight account reconciliation with the lightship derived from the inclining experiment.

2.5.4 Inclining Experiment

1. The contractor shall conduct an inclining experiment in accordance with the Canadian Forces Technical Order, *Procedures for Conducting Inclining Experiments on Canadian Forces Surface Ships*.

2.5 ELECTROMAGNETIC INTERFERENCE/ELECTROMAGNETIC

2.6 COMPATIBILITY

1. The Contractor shall select, locate and install all electrical and electronic equipment to ensure compatibility between the equipment concerned and other radio communication and navigational equipment carried onboard. All equipment, where applicable, shall be in accordance with TP 127E regulations.

2. All the navigational equipment installed on the vessels shall be type approved by Industry Canada with Type Approved Certificate and TCMS approved products.

2.7 HYDRODYNAMICS

1. The hydrodynamics performance shall be derived from a parent “proven” ship. The predicted hydrodynamics performance inclusive of the environment conditions outlined in this TSOR shall be submitted to support the Preliminary Design Review and the Critical Design Review.

PART 2 SPECIFIC TECHNICAL REQUIREMENTS

SECTION 1 HULL STRUCTURES

1.1 GENERAL

1. The vessels shall be constructed and certified to the requirements of and under the inspection of a Classification Society. For the purpose of classification, the vessel shall be considered as mono hull, general-purpose service craft or workboat suitable for sea going service. The vessel shall be classed as: American Bureau of Shipping “Maltese Cross” A1 Tug, Firefighting F1, Escort (n,8), LMC, UMS or the equivalent notations from another Class Society recognized under Transport Canada’s DSIP.

2. All steel and aluminum structural materials shall conform to the requirements of TCMS and Classification Rules for Building and Classing Steel Vessels. High-tensile or specialty steel shall not be used in the structure.
3. All steel plates, sections and castings shall be new and to Classification Society requirements. All shall have the manufacturer's name and test marks clearly stamped on the materials. Test certificates shall be supplied to the Technical Authority. Materials shall be tested in accordance with Classification Society requirements.
4. Steel plate generally shall be shipbuilding steel approved by a Classification Society, with steel shapes to ASTM A36. Detailed design shall be such as to preclude local stress raisers, discontinuities and pockets for the inception and development of corrosion.
5. The hull construction of the vessels shall be sufficient to withstand the environmental loads created from Sea State 5. The Contractor shall determine the hull plate thickness with any proposed hull corrosive protection system to meet the 25-years service life requirement.
6. All metal construction shall be of welded design.
7. Structural details shall be designed in accordance with ASTM F1455 *Standard Guide for Selection of Structural Details for Ship Construction*.
8. Where frames, floors, beams, girders, etc. cross-welded seams or butts in plating or webs, these should be neatly scalloped to clear such seams. All cutouts in structure should be circular or have radius corners and shall be compensated by insert plates where required.
9. Longitudinal strength should be maintained by insuring continuity of main fore and aft members. Where cuts or interruptions impair the strength of main structural member continuity, effective compensation shall be fitted.
10. All discontinuities of frames or beams for the purposes of installing through hull fittings or manholes, pipes, etc. should be suitably fitted with header bars.
11. Limber holes shall be provided in deck bottom longitudinals to allow satisfactory bilge drainage and to prevent the accumulation and retention of liquids.

1.2 WELDING

1. Vessel to be of welded construction in accordance with TCMS requirements, the Canadian Welding Bureau and the specification requirements. Welding operators, supervisors and equipment to be fully approved and certified in accordance with CSA Code W-47.1, W-47.2, W-59 and W-59.2 and all electrodes to be to the requirements of CSA W-48 Series.
2. The structural members within the hull bottom or in other areas where water may collect shall have double continuous welds. This shall include keel, keelson, bottom girders and stiffening, engine and reduction gear foundations to shell plating. Engine

foundations, oiltight and watertight bulkheads, integral tanks, and exterior structure and fittings shall be double continuous weld.

3. All butt joints shall be properly prepared, free of cracks, and lack of fusion.
4. Types and sizes of welds to meet Classification Society approval. Manual and machine butt welds, edge preparation and procedures shall be submitted to and approved by the Classification Society.
5. Limber holes and scallops in the bottom area or in other areas where water may collect shall be welded all around to seal faying surfaces.

1.3 SHELL AND SUPPORTING FRAMING

1. All plates to be used should be as long a length as practicable and shall be continuous butt-welded.
2. To avoid propeller induced vibration, the lowest natural frequency of stiffened bottom shell plating in the forward third of the vessel shall be at least 25% greater than the maximum propeller blade rate frequency.
3. The sheer strake and the deck stringer plates shall be free of cuts, gouges, arc strikes or other irregularities.
4. A minimum of 75 mm clearance shall be provided between the longitudinals and the longitudinal seams of plating. Bottom and side longitudinals, if fitted, shall be made continuous with butt welds with the butts at least 75 mm from any shell plate butt.

1.4 PILLARS AND STANCHIONS

1. Pillars and stanchions should be landed on structural framing members and aligned with the webs of the supporting structure in the longitudinal and transverse planes.

1.5 FOUNDATIONS

1. Machinery foundations shall be integrated with the bottom structure, transverse frames, longitudinals, girders and keelson. The natural frequency of machinery/equipment foundations shall not coincide with the blade rate frequency at any speed up to the maximum speed, and/or the exciting frequency of the supported machinery in conjunction with resilient mounts (if used).
2. Adequate chocks shall be arranged for machinery foundation that supports proper alignment of machinery. The rigidity of machinery foundations and adjacent supporting structure shall be sufficient to prevent either permanent or transient hull deflection of enough magnitude to interfere with operation of the machinery and equipment. The foundation shall have a rigidity greater than that of the drive shaft line to ensure that none

of the components of the drive shaft line are stressed beyond their limits when flexing of the hull occurs and resulting misalignment of the drive shaft line.

3. Foundations shall be provided for all auxiliary machinery and equipment in the machinery space and on decks and shall be of adequate construction to prevent vibration. Decks shall be reinforced in way of equipment and machinery as required.

4. Foundations shall be arranged in such way to provide adequate clearance for servicing and disassembling modules or parts such as pumps, filters, valves and pistons without dismantling other machinery, structure or piping.

1.6 WEATHER DECK AND INTERNAL DECKS/ PLATFORM

1. Deck longitudinals shall be butt-welded throughout with the longitudinal butts separated from any deck butt by at least 75mm. Openings should be kept to a minimum in particular in the strength decks within the 3/5 length amidships.

2. Decks and supporting structure shall be re-inforced as required in way of winches, bollards, windlasses, cranes and all other deck equipment and machinery fitted.

1.7 WATERTIGHT BULKHEADS

1. The number of openings in watertight bulkheads should be kept to a minimum and in accordance with *CSA Hull Construction Regulations* and classification rules. All bulkheads shall be vertically stiffened using toe-welded angle or flat bars.

1.8 MINOR BULKHEADS

1. Outside corners of interior steel bulkheads in way of living and working spaces shall be rounded to prevent hazard to personnel.

2. The boundaries of gas or odour producing spaces shall be gastight and tested for gas tightness. The periphery of other divisional bulkheads should also be effectively light, dust tight.

3. Non-structural steel or joiner bulkheads surrounding wet spaces shall have all welded coaming extending above the deck covering.

1.9 SUPERSTRUCTURE

1. The boundaries of all superstructures shall be of weathertight construction. Casings, houses, bulkheads, and other surfaces shall be fair, without buckles, kinks, or other objectionable surface irregularities. Where trunks penetrate decks, the deck cuts shall have rounded corners.

1.10 STRUCTURAL CASTINGS, FORGINGS

1. All the finished forgings and castings shall have manufacturer identification markings and test certificates stating the results of mechanical test and details of heat treatment.

1.11 DRAIN PLUGS

1. Docking drain plugs shall be located to ensure proper draining of the compartments built into the hull. They shall be of stainless steel type 316 are to be fitted for convenience of draining all spaces. They are to be arranged so that the plug does not protrude outside the surface of the plating, and be fitted in pads or inserts at least 18 mm thick. Plugs are to be located in positions approved by Owner. The contractor shall provide a docking plan clearly outlining the chosen locations. All drain plugs shall have a means incorporated into them that allows the contents of the tank or compartment being drained to be identified and sampled without complete removal of the plug.

1.12 MAST

1. A mast shall be fitted to carry radars, antennae, navigating lights and signals. The mast and supporting structure shall be designed to sustain a wind load of 80 knots, the weights of the structure and equipment and the dynamic inertia loads due to ship motion.

2. The mast shall be outfitted with the necessary navigation lights in accordance with TCMS *Collision Regulations*.

3. The first mast fundamental frequency shall be kept a minimum of 25% above the highest of the following: shaft rate, blade rate and the 2-noded vertical mode of the hull frequency to ensure against the high amplitude motions associated with resonance.

4. Sufficient cleats for signal halyards shall be provided. Standing rigging should be reduced to a minimum.

5. A safe means of climbing the mast shall be permanently attached to the mast structure, and a harness provided. Man aloft procedures shall be developed and provided.

1.13 APPENDAGES

1. The propulsors shall be installed as per the manufacturer's instructions and shall have a manufacturer representative approve the final installation on each vessel. If applicable, a protection (propeller guard) will be fitted under the propellers constructed out of welded plates and shaped according to the directions and with the approval of the propeller maker. If applicable, the propulsors shall have the recommended sacrificial anodes installed as per the manufacturer's instructions.

2. If applicable, final location of the propeller guard, and the associated anodes shall be approved by the technical authority and the propeller manufacturer representative.
3. Bilge keels shall be fitted for roll reduction.
4. High purity zinc anodes are to be installed and distributed equally throughout the ship's underwater length. Anodes to be 12 kg minimum weight each.
5. The anodes are to be securely fixed to the hull, by bolting to flat bars which are welded to the hull, and clean of all paint or grease before the vessel is launched. Anodes are to be attached to the flat bars using mild steel bolts. A set screw is also to be fitted to ensure electrical contact.
6. The contractor shall supply calculations and drawings supporting the placement of anodes at the preliminary design stage.

1.14 CHAIN LOCKER(S)

1. Chain locker(s) shall be sized to accommodate the chains and to give at least 1-metre headroom when cables are stowed.
2. Chain locker(s) shall be fitted with perforated removable floor plates suitably stiffened at a height of 150 mm above the bottom of the locker. Access to the chain locker(s) shall be within the vessel fore peak by means of a hinged manhole. Chain lockers(s) shall be divided with a non-watertight centreline bulkhead with semi-circular holes in line with access manholes to act as toe and hands holes when inspecting the locker(s)
3. The bitter end connections shall be located at the top of the locker(s), in protected but accessible locations to permit emergency release of the chain. The bitter end connection shall be designed for shear failure under a runaway chain load equal to the breaking strength of the anchor chain. The bitter end connections shall be tested to at least 20 percent above the proof load of the cable chain.
4. All chain lockers shall not be deemed confined spaces.

1.15 MOULDING AND RUBBING STRIPS

1. The fendering for this vessel shall be suitable to move naval warships and submarines. These types of vessels require the tug load to be spread over a larger area of hull of the naval vessel than most commercial vessels. The fendering shall have sufficient softness, depth and footprint to prevent pressure indentation of warship hulls when the tug is pushing at full power. The fendering shall be non-marking. To accommodate movement of warships, fendering shall be 360°. The fendering system shall be retained in place by stainless steel bolts.
2. The contractor shall submit a fendering arrangement to the Technical Authority for approval during the Preliminary Design Review and the Critical Design Review.

1.16 DOORS, HATCHES, MANHOLES AND SCUTTLES

1. Closures shall be appropriate to the location, use and integrity of the space served, and shall be equivalent in strength and tightness to the adjacent structure. The weathertight doorsill height and weathertight hatch coaming height shall be appropriate to the locations of the closures.
2. All watertight and airtight doors, hatches, and scuttles and all drop-bolt type manhole covers shall be fitted with retained gaskets. The closures and the retaining devices shall be constructed to hold the gaskets securely in place. Gaskets material shall be suitable for service in contact with oil, seawater, and fresh water and shall not be painted. The closing appliances shall be selected from the TCMS *Approval Products Catalogue Index* (APCI) or shall conform to Regulatory Body requirements.

PART 2 SPECIFIC TECHNICAL REQUIREMENTS

SECTION 2 PROPULSION AND PLATFORM CONTROL

2.1 GENERAL

1. The Contractor shall be responsible for the overall engineering design, integration, testing and supply of the propulsion and electric plant including transmission, shafting, and machinery control system. The Contractor shall submit calculations and data to the Technical Authority that demonstrates that the design, the selected equipment and components will satisfy such intent.
2. The main propulsion machinery and *ISO 3046* defined essential auxiliaries (dependent and independent) shall be selected with all the components presently in service in marine environment as an integrated unit. The main propulsion system configuration shall be free of any critical torsional, longitudinal and whirling vibrations throughout the operating range. The Contractor shall conduct the required vibration analysis to support the proposed design. The analysis shall be carried out as required throughout the operating speeds and at speeds corresponding with 110% of rated full power.
3. All controls for operating the machinery, equipment, instruments, pumping systems, valves, cocks, air pipes, inlets, sounding pipes, switches, etc shall be permanently marked with engraved plates mechanically fastened clearly showing their purpose. All hand-wheels shall be marked to show the direction of closure.
4. Machinery guards shall be installed to protect persons on board from accidental contact with moving parts, hot surfaces and other hazards so as to reduce to a minimum any danger to persons on board. All rotating parts shall be securely guarded. Exhaust pipes and other hot surfaces within reach of personnel shall be properly insulated or

otherwise protected to prevent accidents or burns. Hot surfaces with temperature in excess of 60°C shall be cooled or insulated so as not to have a surface temperature that will exceed 60°C. Hot surfaces that could cause ignition shall be protected from all possible contact with combustible material. The exhaust pipes shall be of sufficient height or arranged to ensure that no exhaust gases can pass back into the vessel.

5. The design of systems and machinery layout shall provide designated access for all maintenance. Removal routes shall be provided for all major equipment. Lifting points shall be provided on equipment and the ship structure. Lifting points shall be tested and marked accordingly.

6. Means shall also be provided to sustain or restore normal operation of propulsion even with a failure of any one essential auxiliary.

2.2 MAIN ENGINE

1. The main propulsion system shall consist of twin diesel engines operating between 500 and 1000 rpm driving propulsion lines. The propulsion machinery systems with shafting and gearboxes shall have sufficient power to sustain the required bollard pull and the ship's maximum free running speed 12.0 knots at 90% of the maximum unrestricted continuous rating (MCR). The engine rating shall also be based on an engine Load Profile of 50% (to a maximum of 10 hours in a 24-hour period) at rated rpm and typical up to 2,000 hours/year.

2. The transmission shall be designed to accept the maximum running condition.

3. The main propulsion engines shall be marine diesels designed for normal operation on commercially available diesel fuel to *CGSB 3-GP-11c Naval Distillate Fuel*.

4. The diesel engine exhaust emissions using the Naval Distillate Fuel shall comply with the requirements of *MARPOL 73/78 Annex VI Regulations for the Prevention of Air Pollution from Ships and NO_x Technical Code*.

5. Exhaust Emission Measurements shall be performed during Factory Acceptance Test and sea trials for each ship.

6. The engines shall be compliant with current US Environmental Protection Agency environmental standards for Marine diesel engines. As a minimum the engines shall be EPA Tier II compliant.

7. Prior to detail design phase, the Contractor shall provide an Engine International Air Pollution Prevention Certificate and statistical data pertinent to the proposed diesel engines including the following:

ISO 3046-1 standard power rating, the specific fuel consumption, lubricating oil consumption

8. Reliability and maintenance data such as hours between oil and filter changes, and hours between overhaul, and mean time between inspections shall be provided.

9. The diesel engines shall be capable of operation on lubrication to *Military Specification MIL-L-9000 Lubricating Oil, Shipboard Internal Combustion Engine, High Output Diesel* and a single or multi-grade commercially available (API/SAE graded) equivalent lubricating oil. Each diesel engine shall have its own Original Equipment Manufacturer supplied pre-heater and pre-lube pump and its own lube oil, fresh water-cooling and seawater system. There shall be no interconnection between two engines lube oil, fresh water or seawater system, though the seawater systems may be connected to a common sea chest. Finally, if the engines are fitted with a charge/intake air cooler, they shall in turn be cooled via the engine fresh water circuitry.

10. The engine shall be provided with all accessories recommended by the manufacturer for continuous service at sea and shall be installed complete with all attached and unattached auxiliaries. The engine's crankcase evacuation system shall be of a design approved by the engine manufacturer and may be directed to the engine's air inlet downstream of the air filter.

11. The engines shall have power take offs suitable for the use of the firefighting pumps.

12. The main engines shall be suitable for operation in an unattended engine room.

13. The vessels shall be delivered with all the manufacturer's recommended spares.

2.3 MAIN SHAFTING AND BEARINGS

1. The shafting arrangement shall be approved prior to installation by the technical authority and the propeller manufacturer.

2. Propulsion shafting shall be forged carbon steel fitted with tapered and keyed removable couplings at each end. Shafting shall be of suitable diameter and strength to transmit the main engine full horse power at stated rpm and also necessary overstrength for possible shock when vessel is navigating in debris infested water. Suitable guards shall be fitted over open lengths of shafting. Shafting shall be approved by TCMS or classification society for the service intended.

3. Shafting shall be highly polished at bearings and turned smooth elsewhere. Removable couplings shall be bored to accommodate necessary number of bolts and carefully machined for proper fitting to shaft taper

4. Any hydrodynamic coupling shall be a constant oil filling type. If fitted, they shall be installed and approved in accordance with the propellers manufacturer's recommendations. There shall be a bearing mounted as close to the turbo coupling as possible.

5. The port and starboard shafting arrangements shall be identical except that the gearbox shall be configured to rotate the propellers as per the manufacturer's recommendation.
6. If fitted, cardan shafts shall be installed as per the manufacturer's instructions and shall have a minimum installed angle recommended by the manufacturer.

2.4 TORSIONAL VIBRATION CHECKS

1. The shipbuilder shall be responsible, in collaboration with the equipment suppliers, for checking the propulsion system to ensure that no torsional vibration damaging to the equipment exists within the operating range. The vibration calculations shall be submitted to the Technical Authority for examination during Preliminary Design Review and Critical Design Review prior to any of these items being approved for construction.
2. The arrangement of shafting, and the number and location of line shaft bearings shall be governed by the shaft alignment and vibration analysis.
3. A bearing analysis and calculation shall be completed prior to construction of the vessel; and the Technical authority shall approve the shafting arrangement. Each line of shafting shall be have a bearing mounted as closely as possible to the Turbo coupling. Shaft bearings shall be of the loose bearing spherical roller type, grease lubricated.

2.5 BULKHEAD GLANDS

1. A bulkhead gland shall be fitted for each propulsion shaft. The gland shall be steel provided with renewable bronze neck bush. Gland, cap, and bush shall be made in halves for easy removal. Suitable number of packing turns shall be provided to afford integrity in case of flooding. The whole unit shall be suitably assembled and bolted on a bulkhead plate made also in halves and suitably gasketed. A grease nipple shall be fitted on each gland. A grease gun shall be provided and clipped against the bulkhead in proximity of glands.

2.6 PROPELLERS

1. The propellers shall have proven performance in past ship builds to carry out the desired function. This vessel requires propeller thrust to be transmitted into the hull throughout 360 degrees and there shall be smooth, uninterrupted, and consistent thrust when changing the thrust vector throughout all 360 degrees while the ship maintains position. The tug shall have the ability to turn on its own position, 'on the spot', without creeping or scribing an arc through the water, independent of current/wind forces. The tug shall have the ability to move sideways, 'sidestepping', along a line of bearing, on any axis, with the operator having simultaneous and immediate control over the tug's heading, headway and sternway.

2. If vertical cycloidal propellers are selected, they shall be supplied complete with built-in horizontally offset gearbox built to accept the propulsion unit input.
3. All clearance and vibration analysis shall be submitted to the propeller manufacturer for approval prior to installation.
4. A manufacturer representative shall attend and supervise the installation and testing of the propeller units for each vessel.
5. The technical authority and the propeller manufacturer shall approve the propulsion related structure and all structural details prior to building.
6. If vertical cycloidal propellers are selected, the propeller flange shall be machined after the installation of the complete well, and according to the propeller manufacturer's instructions.
7. If vertical cycloidal propellers are selected, each propeller unit shall be complete with input gearbox of suitable ratio, rotor casing forming oil bath and cooler, blades with suitable seals, driving elements, control rod actuated with hydraulic servo motors for pitch and thrust direction, lubricating oil pressure pump, lubricating oil filter, pressure gauges, flow indicator, lubricating oil header tank, and integral piping. Suitable inspection covers shall be fitted. Similar, if selected, other types of 360 degree propulsors
8. The propulsion train (including individual blades) shall be of sufficient strength to absorb shock without damage, when navigating in waters infested with debris.
9. The vessel shall come with the propeller manufacturer's recommended spares.

2.7 CIRCULATING AND COOLING WATER SYSTEMS

1. All diesel engines shall be cooled by a closed circuit self-contained fresh water system in which the jacket water is circulated by means of an attached engine driven pump. Lubricating oil coolers shall be cooled by fresh water. The fresh water system shall be cooled by seawater circulated through jacket water heat exchangers. Fail-safe devices shall be provided to automatically control the fresh water-cooling temperature. Thermostatically controlled, immersion type jacket water heaters shall be provided to maintain coolant at a temperature recommended by the engine manufacturer when the engines are not running. Materials used in the fresh water system shall be compatible with the inhibitors concentration level as specified by the engine manufacturers. Test points shall be provided in the fresh circulating water system. Vents and drains shall be provided at high and low points of the systems and on pump casings. The discharge from these point shall be piped clear of equipment.
2. The Contractor shall submit heat balance calculations to support the component selection of the circulating and cooling water system.

3. Seawater circulated through jacket water heat exchangers should be supplied from a sea chest through a duplex intake strainer provided with isolating valves. A seawater strainer shall be installed for each engine between the sea valve and the circulating pump. The sea bay shall be capable of being de-iced. The strainer shall be located so that it is accessible for servicing and does not obstruct access for maintenance of other equipment. An emergency cross connection with the ship's seawater service system shall be provided. All parts of the cooling system in contact with sea water shall be of corrosion resistant material.

4. Jacket water heat exchangers shall be installed and provided with the necessary fittings so as to allow draining down, venting and complete access for cleaning and maintenance without disturbing other equipment. Suitable sacrificial anodes shall be fitted in all heat exchangers for two calendar years of continuous operation.

2.6 ENGINE STARTING SYSTEMS

1. The main engines shall be started by compressed air, either directly or by cranking motor. It shall be possible to start the engines either locally from the engine room or remotely from the wheelhouse. Means shall be provided to terminate the starting cycle when the engine has picked up speed. The installation shall be such as to prevent leakage of cylinder gases to the air start reservoirs through defective air start valves.

2. If recommended by the engine manufacturer, means shall be provided to prime the engine lubricating oil system as part of the starting cycle.

3. Block and oil pan heaters shall be provided based on the engine manufacturer's recommendations. The block heaters shall be capable of maintaining the engine jacket water at 10°C under the most adverse standby conditions in the climatic condition specified.

2.7 CONTROL SYSTEMS

2.7.1 General

1. The control system and alarm system shall be a distributed networked system. Each part of the machinery control system shall feedback to the consoles all necessary data. The consoles shall display all control and alarm information in a manner logical to the operator. The control system shall be electronic with interfaces arranged as required.

2.7.2 Control Consoles (Machinery Control Console MCC, Bridge Control Console BCC)

1. There shall be as a minimum the following control modules within both consoles;
Propulsion control and monitoring;
Electrical power generation and distribution control and monitoring;

Auxiliary systems (pump/valve automation, tank gauging etc) control and monitoring;
Propulsor System control and monitoring;
Alarms and fault detection;
Data and event logging with printing capability;
Running hours and hourly recording of engine minimum, maximum and average load; and
Winch and Tow equipment controls.

2. Machinery control and monitoring of each module listed above shall be conducted from an MCC, which shall be located in the Bridge and accommodate the chief engineer. The vessel's engineer shall control and monitor the propulsion, electrical, and auxiliary systems from this console. The main propulsion system shall respond to throttle control orders over the complete range of plant operation without the intervention of engineering watch personnel. Both main propulsion engines shall be controlled via a single throttle head connected to individual throttle control levers for each engine and propeller unit.

3. The BCC shall provide remote control and information display of the machinery plant and provide audible and visual alarm displays to indicate faults in machinery and related systems or equipment. The control consoles shall have, as a minimum, the following for:

a. Propulsion (BCC)

Key switch
Engine start
Engine control lever
Propulsion engine synchronization selection and indication
Engine stop button
Indication of engine rpm (tachometer)
Indication of engine lubricating oil pressure and temperature

Propulsion (MCC)

Engine stop button
Audible and visual alarm for engine lubricating oil low pressure
Audible and visual alarm for the diesel engines high crankcase pressure
Indication of engine cooling water pressure
Indication of engine cooling water temperature
Engine cooling water high temperature alarm
Indication of engine cooling water level
Indication of engine exhaust gas temperature
Hour meter
Propeller/shaft tachometer
Gearbox lubricating oil pressure
Audible and visual alarm for gearbox low lubricating oil pressure
Gearbox lubricating oil temperature with high temperature alarm.
Engine overspeed alarm and trip

b. Electrical (MCC)

- Generator remote start/stop button or switch
- Generator running light
- Prime mover engine tachometer
- Generator overspeed and emergency trip
- Generator overspeed and emergency alarm
- Prime mover engine oil pressure with low pressure alarm
- Prime mover engine cooling water temperature with high temperature alarm
- Hour meter and fuel consumed meters
- Generator shut down alarms.
- Instrumentation for controlling/monitoring electric supply (e.g., ammeter, voltmeter, frequency meter, circuit breaker, to the main switchboard).
- DC Power “On” light
- Battery charger charging voltmeter.

c. Others (BCC)

- Steering joystick control and monitoring
- Visual alarm for high tank content for the oily water tank and the black and grey tank
- Visual alarm for low tank content for the fuel oil tank, lubricating oil tank, and fresh water tank.
- Fuel oil tanks contents gauges and low level alarm
- Fresh water tanks content gauge
- Alarm reset
- Indicator light test (lamp test).

4. An integrated digital alarm and monitoring main engine, diesel generator, propeller units, switchboard, tank levels, fired detection, and general alarm system shall be fitted. All alarms shall be arranged in such a manner as to identify the particular fault condition (such as failure of the lubricating oil system) and its location within the machinery space. Where an alarm system could be adversely affected by an interruption in power supply, changeover to the stand by power supply shall be achieved without a break. The installation shall comply with all regulatory requirements for unattended machinery spaces.

Alarm display units shall be located at the consoles, engine room, chief engineer’s cabin.

2.7.3 Local Control

1. All machinery shall be capable of being controlled and monitored from a local position in the case of failure in any part of the control console. The necessary instruments, gauges, indicators, thermometers, instrument panels, mountings, and test equipment, shall be furnished locally for all machinery, equipment, apparatus, and piping systems as required for proper operation in accordance with the equipment manufacturer recommendation.

2. Engines, generators, pumps and auxiliary equipment shall be fitted with local control panels in accordance with the Regulatory Body. All local control panels shall contain the entire manufacturers standard and recommended instrumentation and shall include local start/stop, lockable switches to disable start for use during inspection or maintenance, and monitoring gauges (such as oil pressure and temperature, fresh water temperature gauges, seawater pressure and temperature gauges, and tachometer with running hour meter). When equipment is placed under local control, both remote starting and control console commands shall be automatically isolated.
3. The control consoles shall have a battery backup to permit equipment monitoring in the event of a power loss.
4. Control consoles shall be ergonomically designed to provide a clear presentation of ship's machinery status. The MCC shall be linked to a dedicated printer and provided with hard disk and removable disk drives for secure, non-volatile storage of the bell log, all alarms, warnings, and machinery parameters for at least six months.
5. All indicators shall be lighted and be capable of dimming to fully dark, with the exception of alarm indicators when alarmed. All indicators on the Bridge and the exterior shall be watertight and visible in full sunlight.

2.7.4 Engine Controls

1. The main engines shall be electronically controlled from the BCC and shall be integrated into the ship propeller controls and approved by the engine manufacturer, the propeller manufacturer and the technical authority.
2. Engine Wiring for connection to the bridge control console to be in harnesses.

2.7.5 Propeller Controls

1. Control of the propellers from the bridge shall be logical to the operators. Operation direction of handles must be identical with reaction direction of the vessel regardless in which direction the vessel is sailing.
2. For safe operation and emergency incidents the time needed for changing the thrust from full ahead to full astern or from port to starboard must not exceed 8 seconds under full load conditions. No undesired thrust vectors are allowed during change of thrust direction.
3. The propeller shall be electronically controlled and the installation of the controls and the controllers shall be approved by the propeller manufacturer.
4. The propulsion control system shall be provided with a UPS back-up supply to ensure engine control in the event of a power failure

2.7.6 Fire Detection and Bilge Level Alarms

1. An alarm system shall be installed to provide bilge level detection and fire detection. Bilge level and fire detection systems shall operate from a control and alarm panel located in the Bridge and shall be incorporated into the MCC . The bilge level and fire alarm system shall incorporate a selector switch for an unmanned ship condition which, in the event of an alarm, will cause the ship's horn to be sounded and activate the weatherproof flashing blue beacon on the top of the ship's mast until the alarm is acknowledged.
2. The system shall provide as a minimum the following features;
 - Audible and visual high and high-high bilge level alarms for each monitored compartment;
 - Audible and visual alarm for high temperature and smoke for the engine room; machinery space and any other monitored compartments as may be required by the Regulatory Body;
 - Remote discharge of fixed firefighting systems;
 - Indicator light on monitoring panel to indicate the alarm system is energized;
 - Manned/unmanned mode switch; and
 - Output to alarm via the ship's horn and blue beacon light in the unmanned mode.
3. Bilge level sensors shall be installed in each watertight compartments for high bilge level detection and the number of and location of sensors shall ensure bilge water is detected at all angles of heel and trim.
4. All alarm systems shall be compliant with a regulatory authority.

PART 2 SPECIFIC TECHNICAL REQUIREMENTS

SECTION 3 ELECTRICAL

3.1 GENERAL

1. Electrical systems and equipment installed on the vessels shall be designed and installed in accordance with the latest version of the following;
 - TP127 Ship Safety Electrical Standards;*
 - IEEE Std 45 Recommended Practice for Electric Installation on Shipboard;* and
 - The standards of a classification society
2. All electrical equipment, fixtures, cables, fittings, etc. shall be suitable for continuous operation in a marine environment and be manufactured in accordance with international or national standards. Electrical appliances shall comply with the standards of the Canadian Standard Association for equipment manufactured in Canada or other

national/international standard equivalent to the Canadian Standard Association standard for equipment manufactured outside Canada.

3. Primary controls and monitoring of the electrical power generation system shall be located at the BCC/MCC.

3.2 POWER SUPPLIES

1. The vessel shall be provided with the following:

Primary Power (450 volts AC, 3 phase, 60 Hz) shall be distributed through the main switchboard, distribution switchboards and distribution panels throughout the vessel. This shall be delta connected ungrounded.

Secondary Power that is converted, by transformers, motor generators, static frequency converters, etc. from primary power and distributed throughout the vessel to lighting, receptacles, small appliances, etc. at 120 volts AC, three and single phase, 60 Hz. This shall be delta connected and ungrounded.

Tertiary Power that is converted by transformers to 240 volts AC, 60Hz, as required.

24V DC Emergency Power as required for the safety of the crew and the survivability of the vessel. This shall be ungrounded, bonded to the hull at a single point.

12V DC Power as required. This shall be ungrounded, bonded to the hull at a single point.

2. All power consuming equipment, except equipment supplied by Uninterruptible Power Supplies or batteries, shall operate satisfactorily under all operating conditions when the input power is within plus or minus 5% of nominal voltage and the input frequency is within plus or minus 3% of 60 Hz.

3. Uninterruptible Power Supplies (UPS) shall be provided for essential systems, including: general alarm and public address systems, fitted VHF radio, fire detection/extinguishing and alarm systems, emergency lighting, and other vital systems such as machinery control and communications. The UPS shall provide power with a steady static voltage variation of less than ± 2 percent and a frequency variation of less than ± 0.25 percent. There shall be an automatic, no-break battery back up with minimum 15 minutes duration. UPS dedicated to the user system or equipment is preferred, except that a common UPS system may be provided to serve co-located equipment or systems.

4. Apparatus containing transistors, diodes and other solid-state devices that are susceptible to damage shall include protection against voltage transients or surges caused by load switching or fault or failures in the power systems.

3.3 GENERATORS

1. The vessel shall be designed with electrical power supplied by two identical, independent, diesel driven, three phase, 60 Hz, 450V AC ship's service generating sets. The rating of each generator set shall be such that one set can continuously supply the peak cruising load at sea with allowance for 20% future growth. The generators shall be compliant with current US Environmental Protection Agency environmental standards for Marine diesel engines. As a minimum the engines shall be tier II compliant.
2. The standby generator set shall be capable of automatically assuming the ship's service electrical load within 30 seconds after failure of the running generator.
3. Each diesel engine shall have a normal continuous capacity at its marine rating sufficient to meet the rating of its generator. The generator and its prime mover shall be on a common rigid frame that is suitable for resilient mounting on a foundation.
4. Each diesel engine driving the ship's service generators shall be capable of burning the same diesel oil and be lubricated by the same lubricating oil as the propulsion main engines. The generator engines should be the same manufacturer as the main propulsion engines. Anti condensation heaters shall be supplied integral with all generators. The engine shall be provided with all accessories recommended by the manufacturer for continuous service at sea and shall be installed complete with all attached auxiliaries.
5. Generators shall be capable of supplying a load 15% greater than their rating for one hour in every 12-hour period.
6. In support of the generator set selection, the Contractor shall provide statistical data pertinent to the generator set including the following:
 - ISO 8528-1 power rating, performance, specific fuel consumption, lubricating oil consumption.
 - Adjusted rating for unrestricted service and classification society type approval certificate.
 - Reliability and maintenance data such as hours between oil and filter changes, and hours between overhaul.
7. All generator sets shall be supplied with all manufacturers' certificates together with all standard accessories, spares and other recommended equipment.

3.4 ELECTRICAL POWER DISTRIBUTION SYSTEM

1. The Contractor shall provide and install the power distribution system with switchboards, transformers, panel boards, cabling, breakers and receptacles in accordance with the Regulatory Body approved One-line Diagram and all related drawings. The Primary Power Distribution system is the preferred supply for all equipment above 1 kW.

3.5 SWITCHBOARDS

1. The ship service generator and distribution switchboards shall be arranged for operation of generator circuit breakers and for distribution of power as required. The main switchboard shall be installed in an accessible and well-ventilated location with the access entrances, and operating and maintenance clearances generally in accordance with *IEEE 45* but not less than *TP127*. Switchboards shall be the dead front, floor-mounted type, steel constructed and surface coated. Insulated handrails installed horizontally or vertically shall cover the full length of the switchboard.
2. A non-conducting deck covering, mat or grating shall be provided on the deck at the front and rear of any switchboard, extending the entire length of the switchboard.
3. All bus bars shall be rectangular section, hard drawn copper, and all bus bar connections, studs, bolts, and similar connecting devices shall be silver-plated after machining to ensure minimum contact resistance over extended periods. Bus bars and all connections shall be marked either A, B, C for the three phases.
4. The switchboards shall be properly mounted in accordance with the manufacturer's recommendations. Ground fault indication shall be incorporated at each voltage level.
5. Switches for instrument transfer or control functions shall be of the rotary type and shall be provided with a positioning device to securely hold the switch in the selected position, unless the switch is required to be of the momentary type. Fuses shall be readily accessible. Terminal blocks shall be provided for terminating all external connections. Suitable lifting and handling equipment shall be provided for the removal of circuit breaker from the switchboard.
6. The switchboard shall have 10% of each rating/size of distribution breakers as spares with a minimum of two of each type. Facilities required for remote control and monitoring of the electrical equipment from the Machinery Control Console shall be provided in the switchboard.
7. Each generator control section of the switchboard shall contain the following, together with any other devices required for the proper control and protection of the generator:

- Generator set start/stop
- One AC ammeter
- One ammeter switch to select phase A, B, C
- One AC voltmeter
- One voltmeter switch to select phase AB, BC, and CA
- One polyphase wattmeter
- One reverse power relay
- Generator voltage and frequency adjust controls
- Breaker open/close controls
- One breaker closed light (blue)

One breaker open light (white)
Transformers, circuit breakers, fuses, transducers and relays as required.

8. The synchronizing section of the switchboard shall contain the following together with any other devices required:

One bus voltmeter energized via the mode switch
One bus frequency metre energized via the mode switch
One incoming frequency metre energized via the control/select switch
One synchroscope energized via the mode switch
Two synchronizing lamps (synchronized when dark, clear lens) energized via the mode switch
One synchronizing control/select switch to provide control of incoming generator or shore supply circuit breaker
One incoming voltmeter
One automatic paralleling device
One synchronizing mode switch to select the following parallel modes:
Ship Service Generator 1 to Generator 2
Ship Service Generator 2 to Generator 1
Ship service Bus to shore supply
Off.
Ship's service insulation monitoring for 450V, and 115 V systems
One switchboard lamp check switch
One synchronizing check relay to prevent paralleling unless all conditions are met.
One automatic paralleling energized indication light (white)
One synchro-check relay energized light (white)

9. The shore supply portion of the switchboard shall contain the following together with any other devices required:

One moulded case circuit breaker with motor operator, 3 pole complete with auxiliary contacts
Breaker open/close controls
Two indicating lights – circuit breaker open (amber) and closed (blue)
One shore power available light (white)
One phase sequence indicator
One AC voltmeter
One AC voltmeter switch to select phase AB, BC and CA
One AC ammeter, showing both incoming and outgoing current
Instrument and control transformers as required
Isolation transformers

10. The system shall be capable of paralleling any ship's service generator with shore power for a short period of time, to effect power transfer from ship's service to shore power or vice versa.

3.6 CONTROL CONSOLE

1. Facilities for the monitoring and control of the electrical plant shall be provided at the Machinery Control Console on the Bridge.

3.7 SYSTEM PROTECTION AND PROTECTIVE DEVICES

1. The Contractor shall perform and submit a short circuit fault current analysis of the system to select the appropriate circuit breakers for overload and short-circuit protection.
2. Loads on distribution panels shall be arranged to obtain as balanced a load as possible. The aggregate load connected to each of the three phases of a distribution panel shall be within 15% of each other. Each unit of equipment and all circuits shall be protected from short circuit current and thermal overloads.
3. Circuit breakers shall be the protective devices for power distribution circuits.
4. Circuit breakers shall be of the plug-in draw out type. Distribution circuit breakers shall be bolted on, moulded case type with adjustable trip settings.
5. Circuit breaker type distribution panels shall be provided for efficient distribution and protection of circuits. The panels shall have a degree of enclosure appropriate for the installation location. The panel shall be of a sheet steel cabinet construction with a full description and feeder designation number of each circuit on the inside of the door. Distribution panels shall be provided with slots for spare circuit breakers of at least 10 percent of the total circuits with a minimum of two.

3.8 ELECTRIC CABLES

1. All cable shall be low smoke, zero halogen and unarmored. All cables shall terminate in approved marine grade terminal blocks.
2. All cables shall be commercial marine quality and an approved TCMS product or approved by a regulatory body and IEEE.
3. A schedule of all cables fitted, listing type, voltage and temperature rating, number and size of conductors, current rating, identification number, and weight per metre shall be submitted to Technical Authority. All cables shall be designated by an identification number that shall be stamped onto non-ferrous metal tags or cable labels, securely affixed to each end of the cable run in each main compartment or subdivision and where passing through decks or bulkheads.
4. Cableways and cables shall be installed clear of machinery access routes and maintenance envelopes. Arrangement shall be provided for all cable penetrations of deck

and bulkhead-to ensure these penetrations shall not compromise structural and tightness integrity of the deck/bulkhead. A minimum of 10% spare space shall be left in all cableways and penetrations. This spare space shall be easily utilized.

5. Cable runs shall be grouped and segregated. AC cables and DC cables on separate cable trays unless suitably shielded.
6. To minimize electromagnetic interference, a minimum spacing of 450 mm shall be provided between cables of each group or if the minimum spacing is not practicable, additional approved shielding shall be provided, except where entering associated equipment or where cables cross at an angle of 90°.
7. Cables for deck machinery shall be run internal to the ship's hull and superstructure wherever possible.
8. Cables for exterior lighting, receptacles, etc shall be run inside deckhouses. Floodlights and searchlights shall be hard wired through watertight junction boxes.
9. A set of spare cables including two pair #16 and one 3C #14 cable shall be installed and routed from the engine room and the wheelhouse. Extra length to be neatly stowed and the conductor ends shall be protected by a waterproof covering.

3.9 MOTORS AND CONTROLLERS

1. All motors installed below deck shall be totally enclosed fan cooled while those installed on deck exposed to weather shall be watertight.
2. All motors exposed to the weather or where humidity exceeds 95% relative humidity shall be fitted with anti-condensation heaters that shall be automatically actuated when the motor is de-energized.
3. All motors shall be designed for 440 V 60Hz, 3 phase, rated for continuous duty with Class F insulation and equipped with anti-friction, factory sealed pre-lubricated ball bearings. Motors of 0.5 HP or less may be designed for operation on 115 volt, single phase.
4. Motor starters and controllers shall be mounted within line of sight of the auxiliary they serve. They shall be provided with local control and indicating lights. Local control shall be mounted in drip-proof enclosures to select any running or stopped condition possible for the driven unit. An overload-reset button shall be provided on the enclosure door of each motor controller unless the operation of the auxiliary necessitates remote reset. Indicating lights mounted in the enclosure door shall notify the operator of equipment status. A complete wiring diagram of each controller shall be permanently attached, with a flame retardant, transparent, oil resistant protective covering, to the inside surface of the control cabinet door.

5. Auxiliaries with remote control positions shall be provided with a “Remote-Local” control switch in motor starter/controller enclosure. In addition to the remote push button start/stop controls, remote motor running status indicators shall be provided.
6. All motors connected to power feeds from static power converters shall be rated for inverter use.

3.10 POWER CONVERSION EQUIPMENT

3.10.1 Transformers

1. All transformers shall be single phase, dry type, rated at least Class B, and installed in drip-proof enclosures. Transformer ratings shall be standardized as much as practical.

3.10.2 Static Converters

1. Static Power Converters shall be used, as required.

3.10.3 Uninterruptible Power Supplies

1. The Uninterruptible Power Supplies shall be designed for an input voltage of 450V, 60 Hz. The UPS shall be “maximized” (i.e. incorporating a drip shield, conformal coating printed circuit boards and using corrosion resistant finishes and fasteners). Batteries shall be sealed, suitable for deep discharge cycling and shall have sufficient capacity to provide the rated output for at least 15 minutes. The battery charging system shall be capable of restoring the batteries to the fully charged state in not more than eight hours.

3.11 115 VOLT RECEPTACLES

1. General-purpose receptacles, 15 amp for 115/1/60 power, duplex U-ground type, shall be provided as follows:
 - a) Each compartment, except hazardous areas in which outlets are prohibited, shall have at least one receptacle for every 8 square metres;
 - b) Accommodation cabins, sanitary compartments and mess room shall have at least one receptacle for each of the following:
 - Mirror,
 - Berth, and
 - For every 3 metres (linear) of bulkhead, or fraction thereof.
 - c) In addition to (a) above, maintenance stations, internal and external, shall have at least one receptacle;
 - d) Additional receptacles shall be installed as required for plug-in units such as toasters, coffee makers, microwave oven, entertainment equipment, test

equipment, portable tools, communication equipment, computers and all other electrical appliances.

2. The receptacles shall be Canada Standard Association approved. There shall not be more than 12 receptacles per circuit.
3. Receptacles on the upper deck, in the galley, wash places, propeller compartment, engine room, rope store and generator compartment shall be watertight. As a minimum, four exterior watertight power receptacles, two each side port and starboard located at the forward and the aft end of the superstructure on the main deck, shall be installed for general utilities purposes. Each of the four external watertight power receptacles should be on a separate circuit.
4. As a minimum, two exterior watertight power receptacles shall be provided on the wheelhouse exterior, one each port and starboard side. Each of the two exterior watertight power receptacles on the wheelhouse exterior should be on a separate circuit.
5. The final configuration and number of receptacles shall be agreed upon with the Technical Authority at the Preliminary Design Review.

3.12 LIGHTING

3.12.1 General

1. The ship shall be provided with an illumination system designed to provide lighting levels as specified by the *Illumination Engineering Society Lighting Handbook* or as specified elsewhere in this specification.
2. Lighting fixtures shall be fluorescent or compact fluorescent to the maximum extent possible. Fixtures shall be constructed of corrosion resistant materials. Fixtures shall be suitable for direct mounting to bulkheads or decks, without the need for vibration isolation mounts. Fixtures shall operate satisfactorily from 115 volts, single phase, 60 hertz, and shall use solid state ballasts capable of maintaining the fixture light output over a voltage range of $\pm 15\%$ and a frequency range of $\pm 10\%$. The minimum number of different fixture types shall be used, and care shall be exercised to minimize the quantity and number of spare parts and lamps to be carried on board. Fluorescent lamps larger than 20 watts nominal shall not be used. Fixtures shall be mounted in such a way that the light produced is not obstructed by any equipment, structure, or systems. Fixtures shall be marine grade.
3. All lighting shall be standard North American types, to fit common, commercially available sockets. All light fixtures shall be located in readily accessible areas to facilitate replacement.
4. Lighting shall be controlled locally by switches installed at the entrance to each space. All switches shall be located the same height above the deck. Where spaces have two or more entrances, switches shall be located at each entrance. Passageway lighting

shall be switched from the distribution panel. Specific task lights shall have integral switches. In addition, in areas where a variable lighting level is desired, each individual fixture shall be provided with an integral switch.

5. Additional fixtures required for the performance of specific tasks shall be provided as necessary.
6. Indicating lights, where required, shall to the maximum extent possible, be long life LED or other solid-state type.
7. Emergency lighting shall be provided using rechargeable batteries in the fluorescent fixtures. Such fixtures shall, upon power failure, automatically switch to battery power, energizing one of the lamps in the fixture. The battery shall be capable of maintaining the light for a minimum of 2 hours when fully charged, and re-charging shall require no more than 4 hours.
8. Red lighting shall be integrated with the normal fluorescent lighting in the stairwell and passageway to Bridge.
9. Where emergency lighting cannot be provided integral with the normal lighting, separate non-rechargeable, battery-powered fixtures shall be installed. These fixtures shall be energized upon power failure, and shall provide a minimum of 2 hours of lighting with fresh batteries.
10. Where required, switches to control lighting at hatches and doors shall be of the sealed, magnetic type. Switches shall be installed internal to the structure, and shall not restrict the clear opening.
11. Fixtures controlled by door and / or hatch switches shall be designed so that the frequent on / off operation shall not adversely affect lamp life.
12. Fixtures installed on the weather deck shall be watertight, and shall include shades to control light spillage. Fixtures shall be capable of being replaced without the use of special tools.
13. The contractor shall provide a lighting plan to be approved by the technical authority prior to build.

3.12.2 Illumination Levels

1. The general level of illumination (lux) for compartments and areas throughout the ship shall be in accordance with the requirements as outlined in the *CSA Towboat Crew Accommodation Regulations* unless otherwise stated in this specification.
2. The general level of illumination in other compartments and areas throughout the ship shall be as follows;

755 lux galley;

540 lux desks in cabins;
110 lux for storerooms, lockers, and fan compartments;
210 lux passageways and lobbies;
540 lux wokshop area and 1075 lux workshop bench;
540 lux for Bridge;
540 lux for machinery space(s), emergency switchboard compartment, and propeller compartment.

3. Illumination for the Bridge Control Console and Machinery Control Consol shall be greater than the minimum level necessary to maintain a visual gradient with the alarm, signal and indicating lights, to readily recognize the information cues from the normal operating positions. Glare reducing features such as anti-glare coating, individual light switch and removable hood shall be provided to monitor displays, if deemed necessary, to resolve glare problem identified during trials.

3.12.3 Specific Lighting Requirements

3.12.3.1 Wheelhouse/Bridge

1. All illumination in the wheelhouse shall be capable of being dimmed to black as a group. The bridge shall be equipped with red illumination in addition to the standard fluorescent fixtures for use at night.

2. The Chart Table shall be provided with supplementary dimmable lighting, one fixture for each 1.5 metres section of the chart table, complete with an amber filter to produce at least 500 lux at the table.

3.12.3.2 Accommodation

1. Principal illumination in all accommodation areas shall be fluorescent, all fixtures shall be flush mounted with the ceiling unless otherwise specified.

2. Each cabin shall be provided with a minimum of one fluorescent type overhead fixture for general illumination, controlled by a switch at the entrance, a desk light in way of each desk, a mirror light over each mirror and a berth light at the head of each bunk.

3.12.3.3 Machinery Space

1. All general lighting shall be fluorescent and augmented with incandescent units. drip proof fluorescent light fixtures shall be installed in all machinery spaces. Machinery space lighting shall be switched at the entrances.

3.12.3.4 Store Rooms and Storage Spaces

1. Lights illuminating store spaces shall be housed in drip proof guarded fixtures. Switches adjacent to access entry shall control the lighting for storage spaces.

3.12.3.5 Workbench

1. Workbench lighting shall be fluorescent with two adjustable incandescent type fixtures mounted at the workbench.

3.12.3.6 Exterior

1. Fixtures shall be placed to illuminate ladders, walkways, obstructions, abrupt changes in deck level and other hazards to personnel safety. Fixtures shall be shaded to prevent excessive light spillage.

2. Control for all exterior lighting shall be from the Bridge. All external lighting shall be suitable for operation at a temperature of minus 40°C at rated output. All externally mounted fittings shall be of salt-water resistant construction and watertight.

3. Deck lighting and exterior lights shall be watertight incandescent types with guards that shield the light's glare from interfering with navigation and visibility ahead. Fixtures shall be connected to the ship's service power via through-bulkhead fittings, such that the cabling runs internal to the hull.

4. Portable fixtures shall be provided to illuminate each gangway.

3.12.3.7 Floodlights

1. Six floodlights, watertight, corrosion resistant, and at least 500 w (quartz halogen) types shall be provided, mounted on the superstructure (3 fwd and 3 aft), to illuminate the forward and aft working decks. Four of the floodlights shall be fixed (2 fwd and 2 aft). Two of the floodlights (1 fwd and 1 aft) shall be remote activated from within the Bridge and be capable of 270° rotation. The operator shall have the ability to select which deck is illuminated. The lights shall be oriented and/or shaded so they do not shine or backscatter into the bridge.

2. One portable floodlight with 3-metre power cord and watertight plug shall be mounted on a portable boom that can be rigged to illuminate target recovery areas port and starboard as well as over the stern without interfering with the Deck Crane operation.

3. Stowage for the floodlights and portable boom shall be provided onboard. Covers shall be provided as per Section 6.7.4. Watertight receptacles shall be arranged for the floodlight supplies and control shall be from a convenient location, if practicable, from the conning position in the Bridge.

3.12.3.8 Searchlight

1. Two searchlights shall be fitted. Each searchlight shall be a minimum of 1000 W. All searchlight functions shall be individual and controlled via joysticks from a remote panel mounted on the MCC or BCC. The searchlights shall be capable of moving through

a minimum of 360-degree horizontal sweep and a minimum of 35-degree vertical sweep. The searchlights shall be mounted as high as practical. Search beam blockage from other mounted equipment or superstructure shall be minimized as much as practical. The searchlights should not weigh more than 30 kilograms.

3.12.3.9 Navigation lights

1. Navigation lights conforming to *TP1861 Standards for Navigation Lights, Shape, Sound Signals Appliances and Radar Reflectors* shall be installed and located to comply with Regulatory Body requirements. Navigation light circuits shall be independent of any other circuits. The navigation lights shall meet the requirements of TCMS Collision Regulations.
2. The following, as minimum, shall be included:
 - Anchor light;
 - Masthead lights;
 - Stern light;
 - Towing lights;
 - Sidelights; and
 - Not-under-command lights.
3. The vessel shall also be fitted with a blue flashing light. The blue flashing light shall interface with an integrated alarm panel to provide visible indication in the unmanned alarm condition.
4. A central control panel for all navigation lights shall be fitted at the BCC. The navigation lights panel controlling the functions of all navigation lights shall be solid state and modular design constructed. The panel shall have normal/alternate power supplies, with automatic transfer to the alternate. The light panel shall be provided with automatic tell tale indicators to give a visual and audible signal in the event of failure of any one light bulb element, and the visual indication shall remain until the fault is rectified, even though the alternate light bulb element is in use.
5. The Contractor shall be responsible for installation of the Navigation Lighting System and conducting tests on the Navigation Lighting System to confirm that the arcs of visibility of the installed lights meet the requirements of the Canada Shipping Act *Collision Regulations*.

3.13 EMERGENCY 24V DC DISTRIBUTION AND 12V DC DISTRIBUTION

1. This system shall be provided in accordance with TP 127E and IMO Res A.534 (13) *Code on Safety for Special Purpose Ships*.
2. The emergency electrical supply shall come into operation automatically in the event of main electrical power supply failure. Audio and visual alarm shall be activated at the Bridge Control Console and machinery space automatically.

3.14 BATTERIES AND CHARGING SYSTEMS

1. Batteries and Charging Systems shall be designed and installed for the following three groups of batteries:

- Group 1 Main engine starting (if selected by Contractor);
- Group 2 Generator set engine and fire pump engine starting; and
- Group 3 Emergency power supply.

2. Group 1 and 2 batteries shall be located as close as practicable to the engines concerned. Each set of Group 1 and Group 2 batteries shall be sized to have sufficient capacity to meet requirements for engine starting. Group 3 batteries shall provide power for the emergency 24 V DC system including the following items as minimum:

- All communication equipment
- Navigation lighting
- Emergency lighting
- Fire detection system
- Any other equipment as required

3. The capacity of the Group 3 set(s) shall be sufficient to maintain the voltage of the battery throughout the discharge period within $\pm 12\%$ its normal voltage or within the tolerance of the supply voltage for electronic equipment critical to safety of the vessel, whichever is the least. The Group 3 battery sets shall be installed outside the machinery spaces.

4. Batteries and their associated charging facilities shall be installed and adequately vented in accordance with *TP127*. Battery chargers, certified for marine application, shall be of constant voltage type, fully automatic, featuring float/boost charge arrangements and be selected/sized to suit the application. The battery chargers shall be equipped with, as a minimum, "on/off" switch, power "on" indicating light, voltmeter, ammeter, boost operation indicator, manual boost override, protection against overload and overcharging.

5. Each set of Group 1 and 2 batteries shall have no other connected loads and shall be provided with a dedicated battery charger.

6. One portable battery charger shall be provided for charging spare batteries of any size fitted on the vessel.

3.15 SHORE CONNECTION

1. Watertight shore connections conveniently located on the weather deck and readily accessible to shore cables from either side of the ship shall be provided to accept 450 V, 3 phase, 60 Hz power and to export power to a ship alongside. The shore connection boxes shall be at least 0.5 metres above the deck and shall be located in weather protected areas to ensure the portable supply cables do not impede weather deck walkways or interfere with deck activities on both the port and starboard sides.

2. The 450 V supply shall be provided with a 30 m interconnecting cable of suitable type for the ship-to-ship or ship-to-shore connections. Polarized plug receptacles on board and ashore shall be fitted on the cables. Shore cables shall be appropriately marked to indicate 450 V service. Stowage reels, weatherproof caps for the connectors and weatherproof stowage for the cables shall be provided on-board.
3. An indicating light (white) and a phase sequence indicator shall be provided on the connection boxes to indicate shore power bus energized. Nameplates shall be provided to clearly identify the connection boxes. A bilingual warning plate instructing personnel to isolate all supplies prior to working within the enclosure shall also be provided on each connection box.
4. The shore connection plugs shall be sized to suit the expected harbour load and shall be compatible with the existing shore power receptacles fitted at CFBs Halifax and Esquimalt. The 450V, 400 amp facilities have three, single phase Duraline receptacles.
4. A shore power cable, minimum 46m in length, and stowage shall be provided.

3.16 WINDOW WIPERS/WASHERS

1. The windows in the Bridge (wheelhouse) shall be provided with 120 Volt, heavy-duty window wipers of the vertical type. The wipers shall assure visibility in heavy rain or spray. Each wiper shall be provided with its own controller, and the controller shall have indication to show when the wiper is on.
2. One heated clearview shall be fitted facing forward on the bridge.
3. A window washer system shall provide a spray pattern of anti-freeze treated water that will remove film of salt spray to all the windows. The system shall be operable below minus 20°C.
4. All Bridge windows, excepting sky ports, shall be electrically heated. Each window heater shall be provided with its own controller, and the controller shall have indication to show when the heater is energized

3.17 NAMEPLATES, LABELS AND IDENTIFICATION

3.17.1 General

1. All electrical equipment, cables, and systems shall be readily identified and labelled. Labels shall be fully legible. All label plates shall be manufactured from laminated phenolic or photo engraved, anodized aluminium or equal. Plates may be secured using pressure sensitive adhesive providing a firm and permanent bond.
2. Bilingual warning plates shall be fitted to doors or other locations clearly visible to the operator prior to approaching the hazard. These plates shall be grey with red

characters. Lettering shall be minimum height of 12 mm. The word “WARNING” followed by a statement of the hazard and/or what action is to be taken shall be prominently displayed in both official languages.

3. All electrical equipment/apparatus shall be supplied with nameplates in accordance with *IEEE 45* on the equipment/apparatus. Nameplates for generator, bus-tie, feeder and branch circuit breakers shall include the circuit number and designation, the rating of the circuit breaker trip element, or fuse size, required. Identifying nameplates shall be provided for instruments, switch, fuses and any components not readily identifiable.

4. Identification plates shall be located on the doors or faces of all panel type enclosures. Information plates shall be visible at the appropriate operating stations.

5. Engraved inscriptions shall be clear and concise with a minimum amount of abbreviations. Standard abbreviations shall be used.

3.17.2 Circuit Designations

1. All circuits shall be identified using the circuit designations in *IEEE 45*. Where designations for systems are not available in *IEEE 45*, the Contractor shall submit proposals to the Technical Authority for approval.

PART 2 SPECIFIC TECHNICAL REQUIREMENTS

SECTION 4 NAVIGATIONAL SYSTEM

4.1 GENERAL

1. The vessels shall be fitted with navigation equipment, communication equipment, collision avoidance signals, and miscellaneous aids sufficient in all respects for the safe handling of the vessels.

2. Navigation equipment, communication equipment and collision avoidance signals shall be fitted to meet the requirements of the following regulations; *Transport Canada Navigation Safety Regulations, Transport Canada Collision Regulations, and Standards for Navigating Appliances and Equipment, 1983, TP 3668.*

4.2 BRIDGE LAYOUT

4.2.1 Bridge

1. The vessel will normally be operated by a single officer (the master or a watch officer) on the bridge. The bridge shall be spacious enough to accommodate at least (3)

additional watchstanders (pilot, lookout, engineer) to perform normal watchkeeping duties within the bridge interior.

2. The bridge shall be fitted with a Bridge Control Console (BCC) and a Machinery Control Console (MCC). The BCC shall be fitted with instrumentation and equipment applicable to the monitoring and control of the steering, navigation, and communication systems. The MCC shall be fitted with instrumentation and equipment for machinery control and monitoring. A separate Firefighting (FiFi) Control Console (FCC) shall be fitted.
3. The BCC and MCC consoles may be integrated but shall be arranged to allow both the master and the engineer to simultaneously operate and monitor the associated equipment respective to their duties.
4. The bridge shall be fitted with a chart table, and stowage for navigation publications and chart work items.
5. The vessel shall have bridge wings, a gangway or a deck that provides access to the port and starboard side of the bridge exterior, accessible through bridge doors.
6. All bridge consoles and equipment shall be ergonomically designed and arranged in a harmonious layout. A preliminary bridge arrangement drawing shall be provided by the contractor to the Technical Authority for approval during the Preliminary Design Review. The drawing shall include the location of all bridge consoles, equipment and items of outfit to demonstrate that the size of the bridge and the layout meets the requirements to support normal operations.
7. The BCC shall be carefully laid out to accommodate instruments and controls for maximum convenience, visibility, and accessibility. A detailed drawing of the layout of all consoles shall be submitted to the Technical Authority for approval during the Preliminary Design Review and the Critical Design Review.
8. Bridge equipment shall operate quietly. The most frequent source of high ambient noise levels are radar, gyro power supplies, ventilation fans, air conditioners, wiper motors and transformers. Consideration should be given to the reduction of noise by situating power supplies in an electrical cabinet/equipment space or in noise insulated cabinets.

4.2.2 Bridge Control Console

1. A BCC shall be situated at or near the centre of the bridge. It shall be placed so that the master, when standing at the centreline can, as the first priority, control the vessel's thrust and steering and, as second priority, operate and monitor the primary navigation and communications equipment.
2. While standing at the BCC, the master shall be able to keep sight of the ship or vessel under tow as well as the vessel's own working decks while working the tug in

either forward or astern modes. Additionally, from this position, the master shall be able to operate the vessel's propulsion controls, winch controls, primary radar and navigation systems, VHF radio communications, and ancillary controls.

3. The location and configuration of the BCC shall not force the master to circumvent a large unbroken bank of equipment to have rapid access to the bridge windows.
4. An MCC shall be fitted and arranged to allow the engineer to control and monitor the propulsion, electrical, and auxiliary systems for the vessel. The console shall incorporate all gauges, instrumentation, and alarms required to fully monitor ships propulsion system and auxiliaries.
5. The centreline pelorus shall be placed as far forward in the Bridge as is practical, allowing personnel unobstructed, 360-degree access. Visual bearings from the centreline pelorus shall be possible throughout a forward arc from as far aft as possible of one beam to the other. This continuous forward arc shall include at least 22.5 degrees abaft of each beam. There shall be no visual obstruction looking dead ahead from the centreline pelorus to the stem of the vessel, and to 90 degrees either side of dead ahead. Outside visibility shall be restricted only by window pillars. All equipment and fittings inside the Bridge shall be placed to minimize obstructing outside vision from the centreline pelorus.

4.2.3 Bridge Windows

1. The Bridge shall be enclosed with windows around its full perimeter to provide 360 degree visibility.
2. The windows shall be arranged to provide an unobstructed view in all directions from the BCC.
3. The Bridge windows shall be large and wide and have direct access not blocked by consoles, tables or other equipment.
4. Framing between bridge windows shall be kept to a minimum and not be installed immediately forward of the operator position. The windows shall be spaced closely together to provide, to the maximum extent possible, an unobstructed panoramic view.
5. To help avoid reflections in the interior, the bridge front windows shall be inclined from the vertical plane top out, at an angle of not less than 10° and not more than 25° in accordance with Transport Canada *Ship Safety Bulletin*.
6. All bridge windows shall be made of safety glass.
7. Sky ports shall be fitted to provide visibility above the tug.
8. To provide natural ventilation to the bridge, (2) of the windows, outboard (1) port and (1) starboard shall be of an opening type.

4.2.4 Navigation Chart Table

1. The chart table shall be located aft of the BCC facing aft.
2. Stowage for navigation publications and items for chart work shall be incorporated into the chart table.

4.2.5 Master's and Engineer's Chairs

1. Two adjustable, swivelling chair with sliding bases shall be provided, (1) in way of the master's position and (1) in way of the engineer's position, and fixed to the deck at the respective console locations. It should be of sufficient height to permit the master to see the stem of the vessel while seated.

4.3 NAVIGATING APPLIANCES AND EQUIPMENT

4.3.1 General

1. All navigating appliances and equipment fitted shall be in accordance with the International Electrotechnical Commission (IEC) or International Standards Organisation (ISO) technical standards where applicable. The Contractor shall supply, install, integrate and commission all the equipment specified and the associated hardware such as antennas in accordance with the recommendation and guidance of the respective equipment manufacturers. Due consideration shall be taken for the electrical and electronic equipment to be arranged and installed so that electromagnetic interference does not affect the proper function of navigational systems and equipment. Authorized representatives of the manufacturer of the particular equipment shall make all final checks and adjustments prior to the official ship's trials.

4.3.2 Gyro Compass

1. A gyro compass system with repeater shall be provided with a centreline pelorus. A numeric repeater shall be fitted at the following locations; the BCC to permit the helmsman easy viewing, on the forward Bridge bulkhead at deckhead level, and at the emergency steering position. The master compass, with manual latitude correctors shall be installed in the Bridge. The gyro compass system shall provide digital heading data to the ship's Electronic Chart Display and Information System (ECDIS) and other systems as required. The placement of the master steering repeater and the magnetic compass shall allow the master to use either display for steering operations.

4.3.3 Magnetic Compass

1. One illuminated standard magnetic compass, with dial size of at least 200 mm diameter, and one spare magnetic compass shall be provided. A registered compass adjuster shall properly adjust the magnetic compass and provide a correction card. The residual deviations shall be entered into the ECDIS system.

4.3.4 Navigational Radars

1. Two commercial marine navigational radars shall be installed with collision avoidance display, Automatic Radar Plotting Aids (ARPA) and alarm system. The radars shall be as follows; (1) radar 3cm X band operating at 9GHz and (1) 10cm S band operating at 3GHz. The radar system shall provide radar video and ARPA information to the ship's ECDIS. Radar displays shall be installed at the BCC.

4.3.5 Electronic Positioning Fixing

1. A Differential Global Positioning System (DGPS), satellite navigation shall be provided. The DGPS shall provide the vessel's position to the ship's ECDIS. A Global Positioning System (GPS) shall be installed capable of supplying a secondary input to the ECDIS. The DGPS shall be installed at the chart table.

4.3.6 Depth Sounder

1. One recording type depth finder with fore and aft transducers capable of providing accurate depth indication to a maximum depth of at least 350 meters with a high contrast LED display and at a recorder shall be provided. The echo sounder system with a shallow depth alert shall be capable of paper recording, and on-demand electronic recording and storage of data for the depth(s), temperature and position. The display shall be located in the BCC.

4.3.7 Speed and Distance Log

1. A speed and distance log system shall be installed. It will supply the ship's velocities in digital format and direction, with respect to the ocean bottom, at low ship's speed in relatively shallow water and with high resolution. Numeric displays shall be located in the BCC. The speed log system shall provide the vessel speed information to the ship's ECDIS.

4.3.8 Electronic Chart Display and Information System (ECDIS)

1. An ECDIS system shall be installed with DGPS input and radar overlay. The ECDIS system shall be compliant with the IMO IHO standard applicable at time of entry into service. The ECDIS system shall provide a real-time display of the vessel's position on the appropriate electronic chart. The real-time display shall be fitted in the BCC. The system shall interface with the autopilot, navigation inputs from DGPS, gyrocompass, speed log, echo sounder, automatic radar plotting aids, navigational radar, automatic identification system, and anemometer(s). Appropriate digital nautical charts to be supplied as indicated by the Technical Authority.

4.3.9 Automatic Radar Plotting Aids (ARPA)

1. An ARPA system shall be installed and the system shall provide interface with the ECDIS in order that information on a specific ARPA contract can be displayed on the ECDIS.

4.3.10 Automatic Identification System (AIS)

1. The vessel shall be fitted with an automatic identification system capable of providing to ships and to authorities information from the ship, automatically and with the required accuracy and frequency to facilitate accurate tracking. The AIS shall provide AIS information to the ship's ECDIS. Display for AIS shall be fitted in the BCC.

4.3.11 Autopilot System

1. An automatic pilot system shall be installed. The system shall be monitored by an off-course alarm addressed to the master, in case of malfunction. An overriding control device that shall allow change-over from automatic to manual control of the ship's steering without delay shall be provided at the BCC.

4.4 NAVIGATIONAL AND SIGNALLING EQUIPMENT, NON-ELECTRICAL NAVIGATION AIDS

1. The vessels shall be furnished and installed with lights and shapes, and sound and light signals conforming to *TP1861 Standard for Navigation, Lights, Shapes, Sound Signal Appliance, Radar Reflectors*. The wheelhouse shall be furnished with lockers for miscellaneous navigational aids such as charts and publication, binoculars etc. Stowage lockers shall be provided for documents and publication.
2. The vessels whistle shall be compliant with COLREGS and SOLAS and shall be capable of being operated from the Bridge. The whistle system shall interface with an integrated alarm panel to provide audible indication in the unmanned position. The whistle shall be operable during a power failure by compressed air or 24V DC.
3. One brass or bronze marine bell complete with mounting brackets, clappers, striking lanyards, and other miscellaneous hardware shall be installed. The bell shall be cast and engraved or etched with the name of the ship and the year of completion.
4. As a minimum, the following equipment shall be provided:
 - Four pairs binoculars, Power x Object Diameter 7x50, with double lanyard
 - One set of collapsible shapes;
 - One full set of International code flags suitable for the mast height carried in a stowage cabinet with a lockable door;
 - One depth sounding lead line;
 - One portable, splash proof loudhailer;
 - Fog horn;
 - Accessories as necessary to permit proper use of chart and the determination of position;

Clinometers shall be a bubble-in-tube type, one in the Wheelhouse and one in the Machinery Space.

5. Hoisting arrangements shall be provided for displaying the day shapes and international code flags.

4.5 SHIP'S ELECTRIC CLOCK SYSTEM

1. The ship's clocks should be non-striking, standard size marine clocks with analog scales and have quartz crystal workings. The electric clock system shall be provided consisting of a master control in the Bridge bulkhead mounted a second clock with shatterproof lenses provided in the Mess Room. The clock located in the Bridge shall be externally illuminated with a small red dimmable spotlight.

4.6 METEOROLOGICAL SYSTEM

1. The vessel shall be fitted with a Meteorological system as follows:
 - A wind speed and direction indicator shall be provided with direct indicating instrumentation mounted in the Bridge.
 - Exterior air temperature unit operating in the range of -55°C to $+50^{\circ}\text{C}$ with an accuracy of $\pm 1^{\circ}\text{C}$.
 - Barometers shall be non-recording aneroid type, one in the Wheelhouse and one in the Master's cabin
2. The ship's anemometer shall provide the wind speed and direction data to the ship's ECDIS display.

4.7 COMMUNICATIONS

4.7.1 Power Source

1. The radio communications equipment shall be located and installed in accordance with the most recent version of *Ship Station (Radio) Technical Regulations* and *Ship Station (Radio) Regulations* with the necessary source of electrical energy to the satisfaction of a radio inspector.

4.7.2 Exterior Communications

1. The vessel shall be equipped with ship station and radio equipment – Global Maritime Distress and Safety System (GMDSS) for Sea Area 1. As a minimum, the vessel's GMDSS shall consist of the following:

- (1) VHF radio installation capable of receiving and transmitting voice communications and communication using Digital Selective Calling (DSC) and each capable of dual-channel monitoring.
- (1) Radar transponder – Marine search and rescue - (SART) for Life Saving Equipment Requirement where applicable.
- (1) Emergency Position Indicating Radio Beacons (EPIRB).

- (1) NAVTEX receiver.
One Search and Rescue VHF radio direction-finding apparatus.
Antenna System.
2. GMDSS equipment shall be certified by Industry Canada and tested by a country to which the SOLAS convention applies, where applicable.
3. The exterior communications system shall consist of the following:
 - (1) VHF radio installation;
 - (1) MF/HF dual radio transceiver system.
4. All communications shall have a valid Industry Canada Technical Acceptance Certificate as required by regulations for maritime radio transmitters and receivers on ships.

4.7.3 Interior Communications

1. The interior communication systems shall be installed to provide voice transmission from the Bridge to appropriate stations around the ship. This system master control shall be located on the Bridge in a dedicated panel at the BCC. The Bridge shall have priority over the communication system.

4.7.3.1 Public Address System

1. The public address system can be a part of the Talkback Broadcast/Intercom System. The Public Address System with Bridge Control Console located on the Bridge shall be capable of providing adequate sound coverage to overcome ambient noise in the machinery room, accommodation spaces, stores, mess, fore deck area and aft deck area.

4.7.3.2 Automatic Telephones

1. An automatic telephone exchange system shall be installed consisting of a centrally located automatic switchboard connected to telephones at the following locations:
 - Bridge;
 - Mess; and
 - Master's and Chief Engineer's cabins.
2. A watertight telephone connection box shall be provided in a protected location accessible, port and starboard, for connection to shore telephone line.

4.7.3.3 Talkback Broadcast/Intercom System

1. An Upper Deck Broadcast System shall be supplied complete with volume control and sufficient out stations to co-ordinate operations aboard the vessel. Talkback loudspeakers and talkback stations with plug-in handsets shall be fitted at the Bridge with executes override and at main deck aft.

4.7.3.4 Loudhailers

1. A Siren/Loudhailers system shall consist of microphone and amplifier control unit shall be operable from the conning position with weatherproof horn type loudspeakers located forward and aft of the vessel on the deckhouse.

4.7.3.5 General Alarm

1. An audible general alarm shall be provided and integrated with the public address system.

4.7.3.6 Sound Powered Telephone

1. A Sound Powered Telephone System shall be installed as a backup for emergency communications between operational stations as follows:

Bridge;
Engine Room

PART 2 SPECIFIC TECHNICAL REQUIREMENTS

SECTION 5 AUXILIARIES

5.1 GENERAL

1. Essential auxiliaries shall be configured in duplicate with automatic transfer capability. The reliability of components, instruments and gauges selected for auxiliaries shall be proven and suitable for remote monitoring and control. Means shall be provided whereby normal operation of machinery plant can be sustained or restored even though one of the essential auxiliaries becomes inoperative.

5.2 PUMPS

1. All pumps shall be of a commercial marine standard, suitable for intended service and compatible with the specified piping system materials. Where two or more pumps of the same size and type are required for a particular service, they shall be identical.

2. Pumps shall be fitted with mechanical seals. Shafts of horizontal pumps must be oriented fore and aft. Internal parts of seawater pumps shall be of non-corrosive materials. Pumps handling black and grey water, fuel, and lubricating oils shall have drip pans installed to contain any possible leakage from the pump seals.

3. Instruments (gauges, thermometers, indicators and other instruments) for machinery, pumps, piping and mechanical systems shall be installed to ensure the safe and proper operation of equipment and systems. Instruments shall be waterproof to prevent damage from moisture and other corrosive elements. Instruments, gauges and their components shall not be adversely affected by vibration, temperature, impact or dust and shall be tailored to their particular applications. Instruments shall have isolation capacity to enable replacement while system is under pressure. Instruments shall be calibrated no more than three months prior to ship delivery. The calibration method and date of calibration shall be recorded.

4. All seawater pumps shall be fitted with sensors and alarms to indicate bearing temperature, dry-running condition, and vibration levels.

5. The vessel shall be fitted with an active pipework anti-fouling system consisting of a control panel, anodes, and all necessary wiring, suitably configured for the hull and pipe material selected. The Contractor may consider a Cathelco System as fitted on some DND ships.

5.3 PIPING SYSTEMS

1. No plastic pipe shall be used. Piping system material shall be in accordance with *ASTM F1155 Standard Practice for Selection and Application of Piping System Materials* and seamless piping shall be used. Materials for all system piping and the associated components shall be selected to minimize the effect of galvanic corrosion. All galvanized pipe spools shall be re-galvanized after fabrication. Cold galvanizing compounds shall not be used. The Contractor shall submit a piping schedule that provides details of components and isolation to minimize galvanic corrosion. System piping and associated components shall be designed to provide adequate flow to auxiliary equipment. The Contractor shall submit calculations to support proposed dimensions of all service lines. The calculations shall be delivered in a hard copy and an electronic format. Information such as pipe size, length, fluid flow and pressure drop, margins for corrosion, erosion, and mechanical shall be included. The maximum allowable velocities for various system fluids shall be in accordance with minimum values required by the Regulatory Body. The associated pipe diameter shall be based on pressure drop calculations as determined by the pressure and flow requirements of equipment. The use of regulators and/or restrictive devices, such as orifices, in lines servicing auxiliary components, such as heat exchangers, is acceptable providing such appurtenances do not impose undue restrictions, large pressure drops or destructive erosion conditions.
2. No piping shall pass through fresh water tanks, black water tanks, diesel fuel oil tanks and predominantly electrically equipped spaces, unless directly associated with and/or servicing such spaces.
3. Piping systems shall be installed to afford easy access to valves, manifolds, strainers, filters and other items incorporated in the systems requiring periodic servicing. Filters shall be fitted in parallel (i.e., duplex) for the purpose of enabling cleaning without disturbing the normal functioning of the systems. Filters/filter chambers shall be provided with suitable means for venting or depressurizing before being opened. Piping must be attached to resiliently mounted machinery using flexible hoses. All hoses shall be as per *SAE J1942 Hose and Hose Assemblies for Marine Applications*.
4. Piping shall be fabricated and installed so as to provide good alignment and to avoid undue stress on equipment to which it is connected. Pipe bends should have a radius not less than four times the pipe nominal diameter. All piping shall be led as directly as practical with a minimum of bends commensurate with required piping system flexibility, and with a minimum number of joints. However, pipe runs that are directly between two watertight bulkheads shall have a minimum of one bend to allow for ship flexure. Joints shall be used where absolutely necessary for ready removal for maintenance. Pipe runs shall be designed to ensure no interference with normal access routes and equipment maintenance envelopes. All piping carrying fresh water (including chilled water) and seawater shall be provided with drain plugs as necessary to afford proper drainage by gravity for maintenance. Care shall be taken to avoid air pockets in pipelines that may prevent proper operation of the system or component. Where air pockets or where air entrapment due to turbulence or component construction may result in the system becoming air locked, mechanism such as petcocks shall be installed as

necessary to bleed the systems or components. Necessary joints shall be either welded or brazed sleeved joints. All mechanical joints shall be shielded as required in way of electrical equipment and where flammable fluids may impinge on hot surfaces. Threaded pipe joints are not permitted in any size, with the exception of machinery or gauges supplied with threaded couplings. All piping systems shall be flushed and blown clean after installation to remove foreign matter, welding spatter, pipe scale and dirt.

5. Valves shall be suitable for the intended application and shall be readily accessible for inspection, operation, maintenance and removal. Where possible all valves should be grouped in manifold form. Valves that are frequently used and not readily accessible shall be fitted with extension spindles. Valves fitted under floor plates should be positioned for ease of operation.

6. Piping systems shall be identified in accordance with the following requirements:

Piping systems consist of any pipe, line, or conduit used for the transport of fluids. Valves, fittings, operating accessories, pipe coverings, and pipe installations shall be considered as part of a piping system. Supports, brackets, or other non-operating accessories are not considered parts for application of colour codes.

Exact identification of fluids in any piping system and the direction of flow is required and shall be made by means of titles in both official languages, in accordance with ASME A13.1. These titles shall be prominently displayed adjacent to the direction of flow indicator. It is recommended, where the view is unobstructed, the titles be lettered in the two lower quarters of the pipe or covering. Lettering in this position is unlikely to be obscured by dirt collection or mechanical damage. Titles shall be clearly visible from operating positions, especially those adjacent to control valves. It is recommended that titles applied by use of upper case letters and Arabic numerals whenever applicable.

Manufactured colour code tapes and title markers shall be a pressure sensitive material with protective overcoating and having conformability and dead stretch properties. The tapes and markers shall be suitable for temperature ranges from -40°C to +150°C; be resistant to abrasion and wear; be waterproof, fungus, and weather resistant; and be in accordance with the detailed requirements of this standard.

Valve label plates shall be in accordance with ASTM F992 Valve Label Plates and shall be securely attached to all valves.

7. The hot fresh water system and water heater shall be insulated. Cold fresh water, chilled water and firemain piping in engine room(s) and accommodation spaces shall be insulated to prevent sweating. Insulation on piping shall be arranged to permit easy removal and replacement of insulation around valves without disturbing pipe insulation.

8. The Contractor shall install insulation and lagging to hot metal surfaces in areas susceptible to personnel contacts. Sheathing shall be provided on insulation in areas where the risk of damage to the insulation is high such as high traffic area and insulation adjacent to plumbing fixtures. The temperature of the shielding shall be less than 55°C under normal operating conditions.
9. All deck-filling openings shall be arranged and located to permit use when the vessel is docked on either side.

5.4 VENT AND SOUND

1. All tanks shall be provided with venting, overflow, sounding arrangements, and level indication. All cofferdams and void spaces shall be provided with venting arrangements. All deck fill, sounding tubes and vent openings shall be clearly marked. At least two vents shall be fitted per tank. Vent pipes shall be flush with the inside top of the tank.
2. Sounding pipes shall be installed as near vertical as possible, and shall be anchored at their lower end and adequately supported over their length.
3. Sounding pipes terminating above the weather deck shall be in protected locations the height from the deck to the point where water may have access below is to be at least 760mm on the freeboard deck and 450mm on the superstructure deck. All pipes shall be clearly identified as to tank number and contents.
4. Tank level indicators shall be provided to serve the following tanks:
 - Fuel Oil Tanks
 - Fresh Water Tanks
 - Lubricating Oil Tanks
 - Ballast Tanks
 - Oily Waste Holding tanks, Waste Oil tanks
 - Black Water Holding Tanks
 - Grey Water Holding Tanks
5. Individual readouts shall be provided in the Machinery Control Console,. In addition, all tanks must also be equipped for local sounding. High level alarms sensors shall be provided for fuel storage and service tanks, waste oil tank, lubricating oil storage tank, waste water holding tanks and ballast tanks. High and low level control sensors shall be fitted with the oily waste holding tank. The high and low level sensors may be integrated into the appropriate tank level-indicating unit.
6. Sight glass level indicators shall be provided for all pressurized tanks, such as, chilled water expansion tanks, potable water hydro-pneumatic tank(s) and freshwater cooling system expansion tanks, if fitted.

7. Vent outlets shall be located to afford maximum protection from mechanical damage and ingress of seawater. Outlets shall not be closer than one (1) metre to any ventilation inlet, porthole or door. Corrosion resistant flame screens shall be fitted to fuel oil tank vent outlets. Vent terminals for void spaces and ballast tanks shall be fitted with ball check closures and fresh water tanks with insect screen can closure.

5.5 FUEL OIL SYSTEM

1. The vessel shall be fitted with a fuel oil system covering storage, transferring, treating/cleaning, supply/use and discharge of the appropriate fuel in accordance with engine manufactures recommendations.

2. Fuel shall be embarked through a simplex coarse strainer at a single filling station, complete with saveall, located on the main deck readily accessible from both sides of the vessel. This saveall may be joined/shared with the saveall required for the lube oil filling station if the two are co-located. The deck connection shall be externally threaded. The closing cap shall be of brass.

3. The fuel system arrangement shall be as follows: An electric motor driven transfer pump shall be provided to transfer fuel from any of the fuel oil storage tanks via a duplex filter/water separator to any of the settling/service tanks or a deck connection to defuel. Another electric motor driven service pump shall be installed to transfer fuel through a second duplex filter/water separator from any of the settling/service tanks to the header tanks for the main propulsion equipment and to larger day tanks for the auxiliaries. The fuel pressure to the main engines will be regulated through a header tank. The day tanks would be provided with level controls to automatically engage/disengage the service pump to maintain a maximum/minimum fuel level. The day tanks shall be fitted with visual level indicators. A manually operated fuel oil transfer pump shall be provided and fitted in parallel with the motor driven transfer pump. The transfer pumps, both manual and electric, shall also be capable of transferring fuel from the storage tanks via a duplex filter/water separator to the service tanks. Settling/service tanks shall be as large as can reasonably be accommodated to give the maximum settling time and there shall be at least two settling/service tanks provided to allow for either tank to be in use while the other tank is having its contents cleaned by recirculation. This fuel system arrangement shall be approved by the engine manufacturer and shall only be changed on the recommendation of the engine manufacturer, with the approval of the DND technical authority.

4. Overflow arrangement shall be provided for all tanks. Service tank(s) shall be as large as can reasonably be accommodated to give the maximum settling time. There shall be two service tanks arranged such that either tank could be in use while the other tank is having its contents cleaned by recirculation. Fuel returned from auxiliary engines would be directed back to their respective day tanks with particular attention to fuel cooling.

5. Each storage tank and service tank shall be fitted with a filling pipe, sounding pipe, and two air vents with flame traps and means of water stripping. The monitoring of all fuel oil tanks and the remote control of the fuel oil transfer pump and service pump

during transferring and discharging of fuel oils shall occur from Machinery Control Console.

6. A complete fuel oil conditioning system, including fuel/water coalescers and filters shall be provided. All strainers and filters for fuel oil service shall be of all steel construction. Level of filtration shall be per the engine manufacturer's recommendations. It shall be possible to change filters with the engine running. The fuel oil service system shall be arranged to fully meet the engine manufacturer's recommendations.

7 All tanks shall have suitable access for internal examination and cleaning. Fuel distribution lines shall be provided with appropriate isolating valves from the respective tanks to the respective engine. These shall be normally closed valves, and open automatically as the initial action in the engine start sequence. All non-structural tanks shall be fitted with quick operating drain valves and shall drain to a suitable storage/collection tank. Where required, fuel oil return lines from the main engines shall be led separately to the online service fuel tank, with the fuel return line terminating within the tank as great a distance as possible from the engine intake suction and as close to the bottom as practical to permit maximum fuel cooling.

8 A fuel flow meter/counter shall be provided on the fuel oil filling line to indicate fuelling rate and quantity.

9. The tanks supplying fuel to the emergency diesel fire pump shall be of sufficient size to supply fuel for at least 18 hours at full load without replenishment.

10. The tanks supplying fuel to the emergency diesel electric generator shall be of sufficient size to supply fuel for at least 36 hours at full load without replenishment.

5.6 FIREMAIN, BILGE AND BALLAST SYSTEMS

5.6.1 Firemain System

1. The fire fighting system shall be fitted to deliver hydrants with sea water and the system shall consist of self-priming power driven fire pumps, strainers, appropriate piping, fittings, hydrants, and hoses. An international shore connection accessible from both sides of the vessel shall be fitted. Firemain system shall be provided with at least one pump located outside the Machinery spaces. Two identical pumps, one electrical and one diesel driven shall supply the firemain system. The electrical pump shall be designated as the main fire pump, and the diesel-driven pump as the emergency fire pump. The system shall protect machinery spaces, accommodations, working spaces and weather decks. Local and remote Bridge control for the fire pumps shall be fitted.

2. The firemain system shall be sized for two fire hoses operating simultaneously from any one firestation with a pressure at the hydrant of 125psi.

3. The firemain shall be kept in the normally dry condition with the fire pumps having flooded suctions or being of the self priming type. Cooling of auxiliary systems using firemain water is not permitted under any circumstances.

5.6.2 Bilge and Ballast System

1. High bilge level sensors shall be installed and alarms shall be relayed to the Integrated Alarm System to be displayed on the Machinery Control Centre alarm panel.

2. A dedicated bilge/ballast pump should be provided. The emergency fire pump shall be configured for emergency bilge and ballast pumping. Ball valves with locking pins shall be fitted to prevent inadvertent connection of the bilge main to the fire main suctions. A tally plate shall be fitted adjacent to each valve to identify operation and to caution users.

3. The bilge/ballast pump shall be piped to draw water from the sea, water ballast tanks, forepeak, and chain locker and engine room emergency suction. It shall be cross connected to the bilge pump suction manifold and provided with connection on deck for salvage operation. It shall discharge to the fire main, water ballast tanks, and overboard. The forepeak valve shall be fitted with an extended spindle.

4. The vessel shall be designed to operate in all loading conditions without using water ballast.

5. Each main watertight subdivision shall have at least one bilge suction and with a minimum of two suctions in the machinery spaces. An oily bilge water collection system shall be provided for the machinery spaces and the steering gear compartment. The bilge discharge system shall be arranged to bypass the oily-bilge collection system to permit direct overboard discharge in the event of an emergency. The Contractor shall demonstrate the efficiency of the oily water separator as installed in accordance with testing requirements of either the US Environmental Protection Agency (*EPA Method 1664 or IMO MEPC 107(49)*), whichever specifies the more stringent requirement and is in effect at the time of contract.

6. All overboard discharge valves shall be non-return.

5.6.3 Sea Chests

1. Suction sea chests shall be arranged and located so as not to take in air trapped under bilge keels or from emergence on the maximum expected roll of the ship in Sea State 5, at minimum operating draft, and to avoid pickup of effluent from overboard discharges.

2. Hull side sea suction grilles shall be fitted where applicable. The net free area of the grille should be at least twice the area of the sum of all suction pipes connected to the sea chest. The largest dimension of the grille perforation shall be smaller than the smallest suction pipe connected to the sea chest to prevent fouling of the sea chest

isolation valve. Inlet strainers shall be fitted on each suction line. Arrangements for de-icing and clearing of a fouled inlet grille of sea chests shall be provided.

3. All suction sea chests shall be fitted with vent lines from the top of the chest terminating at the weather with goosenecks. Sea chest anodes shall be sized for two years of continuous service.

5.6.4 Oily Bilge System

1. The Contractor should select the appropriate pollution prevention equipment from the TCMS Approved Pollution Prevention Equipment Catalogue. The Oily Bilge Water system shall be installed. The Oily Bilge Water system shall consist of a saveall at the fuelling station to contain leaks or spills during fuelling, an oily water collection tank, a dirty oil tank, bilge alarm, oil separator with oil content monitor, transfer pump and piping system. All oily bilge water and, oily water collection tank and dirty oil tank content shall be capable of being discharged either overboard via the oily water transfer pump and deck fittings at main deck (port and starboard), processed through an oily water separator, or transferred from the oily water collection tank to the dirty oil tank. Control of the transfer pump operation shall be available at each of the main deck discharge stations. Direct discharge overboard shall also be possible in an emergency.

2. Oily bilge water collection tanks shall be of sufficient size to support the continuous underway duration. Dirty Oil tanks shall be of sufficient size to receive bilge and fuel oil water separator effluent and additionally from main engine, generator and auxiliary equipment oil changes. The tanks shall be provided with a high level alarm in addition to the standard sounding tube. The oily water transfer pump shall be a self-priming type designed for this service and a manual pump, conveniently located for the operator to use, shall also be incorporated into the system. Oily Water Separators and Oil Content Monitoring Meters shall be fitted as required.

3. Overboard discharge piping from oil/water separators shall be fitted with at least two shut-off valves as close to the shell as possible.

5.7 LUBRICATING OIL SYSTEM

1. Lubrication oil shall be provided to diesel engines, gearboxes, prime movers for and generator sets as recommended by the manufacturers. The lubricating oil supply for each engine shall be completely independent and self-contained. The same type of lubricating oil shall be used for all the systems, if approved by the manufacturers. Should it be necessary to utilise different lubricating oils for any two systems, the alternate lubricating oil shall be approved by the technical authority and the equipment manufacturer.

2. Under normal conditions lubricating oil shall be supplied to the engine under pressure by a lubricating oil service pump. A second service pump shall act as a stand-by. Lubricating oil coolers, circulating/prelube pumps, purifiers, heaters, filters, tanks, valves, sampling cocks, piping, fittings, strainers, and instrumentation shall be

provided, as required, for main engine and auxiliary equipment. The filters must have elements conforming to engine manufacturer's specification and shall be conveniently located to facilitate filter change. A relief system shall be provided external to the filter casing to bypass oil around the filter if the filter becomes clogged. The lubricating oil systems for each diesel shall be supplied by or conform to the original engine manufacturer's specifications. An independent main lubricating oil system shall be supplied if required.

3. The lubricating oil transfer system shall allow transfer of oil from storage tank(s) to the diesel sumps. The minimum combined capacity of the storage tank(s) shall be sufficient for one complete oil change of all diesels and gearboxes plus 20%. If OEM requirements result in the use of multiple types of lubricating oil, separate clean lubricating oil tanks shall be appropriately sized and provided for each type of oil. The dirty oil drain system shall have separate dirty oil tanks for used oil. Transfer of oil from engine sumps to dirty oil tanks shall be via no-drip quick disconnect fittings on each engine with flexible suction hoses. The dirty oil tank shall be capable of holding all the oil removed from one complete oil change for all diesels, gear boxes, bearing(s) plus 20%. The dirty oil tanks shall be capable of discharge to shore by hand pump through a deck connection.

4. Tanks that supply make-up oils for engines shall be provided of the type, capacity and general location as recommended by the equipment manufacturers. All tanks in the system shall be provided with approved oil level indicators, sounding tubes, filling pipes, ventilation, manholes, cleanout holes, as required and all necessary connections and fittings. The storage tank(s) shall have a lockable drain valve and suitable drip tray under.

5. A filling station, complete with saveall, shall be provided on the main deck and shall have sufficient deck area to handle a standard 45 gallon drum and shall be fitted with a deck connection with screwed cap and flush deck plate. The filling line to the storage tank(s) shall be fitted with a fine mesh strainer with removable element and drain. This line shall incorporate a flexible detachable section between the mesh strainer and tank valve.

6. The lubricating oil storage tank shall have a rundown valve and distribution line terminating at a stop valve convenient to each main propulsion and generator engine. A length of quick connecting flexible hose terminating in a spring-loaded cock or nozzle shall be used to introduce oil into the engine sump. A low volume electric pump, with a hand pump in parallel, shall be provided for supplying oil to diesel sumps. This pump shall have the capability of draining and discharging oil from the storage tank(s) to shore.

7. The transfer system for diesel engines lubricating oil shall be segregated from other lubricating oil transfer systems.

8. The lubrication oil filling and transfer system shall be designed such that the transfer of used oil shall not be via the clean oil piping.

5.8 DIESEL ENGINES COMBUSTION AIR INTAKE AND EXHAUST

1. The ship shall be provided with efficient air supply and exhaust systems for the main diesel engine, ship's service diesel generators, and diesel driven fire pump. If the FiFi I pump is not driven off one of the main engines, sufficient air and exhaust systems shall also be provided for the engine required to drive this pump.
2. Combustion air intakes for the main diesel engine and diesel generators shall be supplied by a dedicated trunk from the exterior. The engine driving the FiFi I pump shall also be supplied combustion air from the exterior through a dedicated trunk if this engine is different from any of the main diesel engines. The prime mover of the fire pump shall use air from the space. Demisters shall be fitted to minimize seawater spray and precipitation ingress under all design conditions. The intake grills should be positioned, if practicable, to face astern. The trunk shall be provided with suitable drainage and access for cleaning.
3. Combustion air shall be conditioned to supply air in accordance with the engine manufacturer's recommendations in all Operating Environments, Part 1, Section 1.6.
4. The installation of the diesel exhaust system shall comply with the engine manufacturer's recommendations and the acoustic requirement. Each engine exhaust outlet shall be provided with stainless steel expansion bellows to the engine supplier's recommendation. Piping and silencers shall be secured in such a way as to permit thermal expansion and motion of the engines. The exhaust system shall be installed with supports to prevent excessive loading of the flexible connections and expansion joints, and effectively isolated from the ship's structure. Flexible sections shall be installed at the engine exhaust outlets to permit engine mounting/vibration isolator removal.
5. The exhaust gases from each engine shall exit through a seamless stainless steel spark arresting exhaust silencer complete with clean-out ports, drain pot, drain valve, and drain line. Stainless steel exterior spark arrestors shall be fitted if required by the engine manufacturer. In addition, exhaust tips are to be made from stainless steel.
6. The Contractor shall submit intake and exhaust pressure drop calculations to demonstrate that the proposed design shall conform to engine manufacturer's minimum and maximum pressure limits.
7. The hot surfaces of the exhaust system from engines to silencers and the silencer bodies shall be insulated with flexible insulating blankets. The exhaust system shall not run through habitable spaces and shall be designed such that it does not interfere with the launching and recovery operations of the Fast Rescue Craft. Arrangements shall be provided for soot collection and removal, and to prevent spray or rain water ingress into the exhaust system.

5.9 COMPRESSED AIR SYSTEM

1. A compressed air service system shall be provided for ship services to include but is not limited to:

A minimum of three air connections shall be fitted in the machinery space;
Three exterior air connections, one aft deck, one forward deck and one on the superstructure deck;
Sufficient air connections to reach all points in the vessel, exterior decks, and the mast using a 15 metre air hose; and
Local connections to blow down sea chests.

2. There shall be a minimum of two compressors and two receivers for ship service air.

3. For the air start diesel engines two compressors and two receivers for engine starting shall be fitted and one receiver for service air shall be fitted.

4. If pneumatic controls are used, there shall be a dedicated control air system with its own compressor and receivers and have a cross connection with the ship service air system. The control air compressor(s) should be of the oil free liquid ring type. The control air system shall provide clean dry air at a stable pressure to meet the requirements set by the manufacturer of the selected control system and mechanisms. The system as a minimum shall include the following features:

Pressure reducing station with pressure gauge
An efficient Micronics filter, and a dehydrator capable of reducing dew point to minus 25°C
Buffer tank of a minimum of 0.1 cu. metre capacity, complete with safety devices, drain valves and pipe, and pressure gauge
Low-pressure alarm complete with pressure switch, audible alarm and indicator lamp, remote pressure gauge with cock shall be located in wheelhouse.

5. Compressors shall be fitted of capacity sufficient to maintain 1.25 times the maximum system demand and to charge the air receivers from zero to working pressure within 15 minutes. The compressor(s) shall be equipped for automatic operation plus remote stop/start from the Bridge Control Console. Drains shall be led to an outlet near floor plate level.

6. The compressed air system shall include all the instrumentation and alarms required for safe operation and as a minimum shall include:

Compressor low oil level shutdown switch and alarm indicator
High temperature shutdown switch and alarm indicator
Low pressure alarm
Direct isolatable mounted pressure gauges for each receiver, main air supply header, each branch supply, before and after reducing station.

Temperature gauges installed on air delivery line from each compressor air cooler.

7. Lines, reducing valves, etc., shall be sized to accommodate pressure drops for periods of high demand.
8. The ship service air system shall be supplied from the ship service air receiver and shall distribute air to the equipment and locations as required.
9. Air outlets complete with shutoff ball valves, spring loaded, quick-connect valves complete with male at pipe and female at hose end, hose of 10 metre length minimum and spring loaded hand nozzles shall be provided at the following locations:

Machinery space;
Main deck at forward and aft ends of main deckhouse; and
Propeller compartment.
10. Where the requirements of class differ from those outlined above regarding service air and or control air systems, the higher of the two standards shall be implemented.

5.10 HYDRAULIC SYSTEM

1. The hydraulic system shall meet the standards as presented in this subsection or as required by class, whichever is higher.
2. The complete hydraulic system, including all hydraulic controls, pumps, tanks, magnetic and micronic filters, coolers, and interconnecting piping shall be the sole responsibility of a single sub-contractor. This sub-contractor shall liaise with all relevant equipment suppliers to ensure compatibility of equipment, supervise the installation, flush and clean the system, and deliver the complete system fully tested and operational.
3. The hydraulic system shall contain two identical variable displacement pumps with automatic demand regulated (pressure compensated) control, which shall be driven one off each main engine to supply an open loop system. The pumps shall automatically regulate flow to meet the demands of the hydraulic equipment installed onboard. Pump discharges shall be common to permit use of either or both pumps as required. Pump drives shall be through a gear increaser and mechanical hand operated clutch. Gear increaser shall be fully enclosed, self-lubricated and cooled, either by air, or sea water taken from the main engine sea water cooling system.
4. The system arrangement shall permit operation of any combination of hydraulic equipment installed onboard. The capacity and rating of the pumps shall be adequate to meet the full duty load of all combinations of installed hydraulic equipment.
5. Speed control of hydraulically operated equipment shall be by flow control regulation. Control valves for speed and direction of hydraulic equipment shall be fitted

in logical positions relative to the equipment being controlled and be well suited to the environmental conditions expected in the location of the control.

6. Adequate filtration protection consistent with the design of components shall be provided in the systems. Where circuit flow capacity is excessive for full flow filtration of the order of 10 microns nominal, proportional flow filters will be acceptable.

7. Adequate provision shall be made in all components and circuits for bleeding and venting of entrapped air. Where practicable, bleed, vent and drain points shall be returned to the fluid reservoir. In addition to this the system shall be designed to facilitate complete system flushing.

8. The hydraulic fluid reservoir shall be of adequate capacity to limit fluid temperature to 70 degrees Celsius under peak load conditions for 60 minutes continuous operation, at an ambient temperature of 40 degrees Celsius.

9. The reservoir shall be a fabricated structure of stainless steel designed to minimize contamination of the system by corrosion products. It shall be furnished completely with fluid level indicators, low level alarm, high oil temperature alarm, clean out doors, pump suction filters or strainers, filter protected filling arrangement, conveniently located drain facilities, and an air breather arrangement. Internal surfaces of the reservoir shall not be coated with any "permanent" type corrosion preventive compound. Internal baffles shall be fitted in the reservoir to minimize the effect of ship's motion in a seaway. The reservoir shall not form part of the ships structure.

10. All components of the hydraulic system and inter-connecting ports shall be legibly and permanently identified for ease of installation and maintenance.

11. Adequate protection shall be fitted in each leg of the systems to prevent damage to the systems or components thereof in the event of an overload condition. Provision shall be made to isolate each leg of the system to prevent creep or feedback, and to facilitate repair or maintenance of a sub-system without need for restricting the use of the remaining sub-systems.

12. Pressure regulating devices shall be adjustable within a range compatible with the system design and design of components within the system.

13. System design details, i.e. piping runs, sizes etc shall be sufficiently and clearly defined in system drawings to facilitate installation of the equipment and system. Piping shall conform to the current industry standards for commercial tugs. System and component cleanliness standards shall conform to the requirements of the equipment being installed. The fluid velocities shall be limited as follows:

- (a) Pump suction lines having no positive head, 1.2 m/s;
- (b) High pressure piping, maximum 6 m/s.

14. Hydraulic System and Components shall be designed for operation on fluid conforming to CGSB 3-GP-36M Petroleum Hydraulic Fluid, Inhibited.
15. Gauges shall be supplied and fitted to indicate system pressure at the outlet of each pump and each control station.
16. Stainless Steel fittings and piping shall be used throughout the entire hydraulic system.

5.11 HEATING VENTILATION AND AIR CONDITIONING

1. The HVAC system shall be designed under the following external ambient conditions

Factor	Maximum	Minimum
External Air Temperature	37°C	-32°C
External Relative Humidity	60%	0%
Wind	37.5 knots steady	
Sea Temperature	32.5°C (Note(i))	-2°C

Note(i): The maximum sea temperature is specified higher than the extreme conditions in Part 1, Section 1.6 in order to ensure adequate operating margin on: (a) motor HP; (b) condenser surface fouling.

2. The HVAC system shall be capable of maintaining the following internal environment for all manned spaces:

- A maximum temperature of 24°C with a maximum of 45% relative humidity in summer,
- A minimum of 18°C with a relative humidity no lower than 30% in winter, and
- A minimum of outdoor fresh air 0.008 m³ per second (8 litres/sec) per person.

The fresh air shall be equally distributed (+/- 20%), on a per occupant basis, to all manned spaces. Additionally, the HVAC system shall maintain the temperature of all manned spaces within ±2°C during normal operation.

3. Separate temperature and humidity control shall be provided for the bridge. If necessary, a complete or partial separate HVAC system may need to be provided to meet this requirement.
4. The HVAC system and all components shall be designed to have at least 10% reserve capacity above that required to ensure the maximum and minimum compartment temperatures described above are maintained. The central Air Handling plant shall be configured (physical arrangement, controls) to enable operation in a dehumidifying mode (i.e., cooling followed by reheat of the air flow, or other suitable dehumidification arrangement), under all external ambient conditions above minus 5 °C.

5. The heating system design shall ensure that when the vessel is connected to shore power in the cold ship condition, enclosed compartments containing mission critical equipment, or containing systems, equipment or stores that would be damaged by freezing, shall be maintained above 4°C.

6. HVAC system calculations shall be submitted to demonstrate compliance with the TSOR. The calculations shall include: (a) individual compartment heating and cooling summary sheets (for each compartment); (b) itemized list of all heating & cooling loads; (c) ventilation ductwork sizing/pressure drop calculations; (d) itemized list of all ventilation pressure losses; (e) The Contractor shall size ducts appropriate to noise requirements, airflow balancing requirements, and fan selection requirements. However the following limits shall not be exceeded:

Accommodation duct sizing-pressure losses shall not exceed: 2.5 Pa/Meter
Machinery spaces duct sizing-pressure losses shall not exceed: 6.5 Pa/Meter

7. Units used in all main documentation deliverables (manuals, systems drawings, equipment drawings, etc.) shall use ASHRAE standard S-I Units. Units shall be consistent throughout all documents (e.g., units for airflow shall be the same in the manual, the ship system drawing and the fan equipment drawing).

8. Units shall be consistent throughout all calculations. Units used in calculations may differ from those used in main deliverables. Where units differ, the calculations shall include an equivalence list of final derived design values, showing the specific conversion between the “calculated” and the “deliverable” values, as follows:

Design Value Equivalence List:				
Design Value Description	Design Value in “Calculation” Units	X conversion factor	= design value in “Deliverable” Units (unrounded)	Design value in “Deliverable” Units (rounded)

9. Air discharges shall be placed such that they do not blow directly on personnel.

10. Separate dedicated exhaust air systems, terminating outside, shall be fitted to the galley and washrooms.

11. Means shall be provided to remove and replace filters and screens efficiently without extensive disassembly. Facilities shall be provided to allow testing and balancing of the air distribution systems. Such facilities shall be clear of take-offs, bends and transitions. Exhaust trunks that routinely becomes oil/grease fouled internally (galley) shall be easily accessible and designed for opening in-situ and/or takedown to facilitate efficient cleaning.

12. Fresh air intakes shall be located such that exhaust gas from the funnel, exhausted ventilation air, gas from oil tank vent or crankcase vents, will not be drawn into any spaces.

13. Spaces not air-conditioned shall be heated and ventilated. Mechanical ventilation shall be provided to all non-air conditioned spaces, to maintain the required air changes not less than the requirements in the *CSA Towboat Accommodation Regulations*.

14. The Galley shall have a slight negative pressure to confine heat and odours generated therein. The Galley exhaust system shall be ducted directly to the weather.

15. Ducting shall be of galvanized steel. Galvanizing that is damaged during duct fabrication processes shall be repaired by painting with galvanizing paint on internal and external duct surfaces. Design Contractor shall design the ducts appropriate for the service, to include: noise requirements, internal pressure, ship motion, duct support arrangements, installed in exposed locations (accidental impact), etc. However, the following minimum thicknesses are specified: (a) weather exposed ducts shall be not less than 4 mm thick; (b) ducts within the ship, of single walled construction, shall be not less than:

Diameter or Longer Side [mm]	Minimum Wall Thickness[mm] (note 1)	
	Non-Watertight Duct	Watertight Duct
Fabricated Duct		
0-150	0.6	1.9
151-300	0.6	2.5
305-450	0.9	2.9
455-750	1.2	2.9
above 750	1.5	N/A
Spiral Wound Duct		
0-200	0.45	N/A
205-750	0.75	N/A
Note 1: Thicknesses are minimum for galvanized sheet steel. Greater thicknesses may be required to meet specific requirements of noise, internal pressure, ship motion, infrequent support, exposed locations (accidental impact), etc.		

All joints shall be made airtight and sealed by an appropriate sealing compound. All ducts shall be well supported. For horizontal runs, hangers shall be spaced no less than 2.5 m apart, and made of mild steel flat bar attached to the ship's structure. Ducts that are to be opened and/or taken down periodically for cleaning shall be appropriately designed (example: flanged joints).

16. Suitable insulation and vapour barrier shall be applied to the ducting and equipment, where necessary to ensure minimum acceptable heat loss/gain and to prevent

condensation. Drainage arrangements shall be fitted at low points where water is liable to collect. Condensate from HVAC equipment shall drain directly over-board. Metal sheathing shall be provided in areas where insulation may be subject to damage.

17. If a chilled water (CW) system is fitted, all material in contact with chilled water shall be copper, copper alloy or stainless steel. Carbon steel material or components shall not contact chilled water. The chilled water system shall be designed with permanent facilities to perform the following:

- Sample the fluid
- Add treatment additives to the fluid
- Drain all fluid
- Remove air from piping system high points
- Fill system from jetty
- Enable bypass flow around restrictive devices during flushing procedures
- Connect the CW system to temporary equipment for flushing at $2^{1/2}$ times design flow.

18. If a CW system is fitted, relevant supporting calculations shall be submitted, including:

- CW piping sizing/pressure drop calculations;
- Itemized list of all CW piping pressure losses.

5.12 MACHINERY SPACE VENTILATION

1. Mechanical ventilation systems and space heaters shall provide sufficient air supply to the machinery spaces and funnel casing to maintain the following temperatures within such spaces:

- Not to exceed 45°C in summer with all the machinery operated at full power.
- A minimum of 4°C in winter in the cold ship condition when the vessel is connected to shore power with engine heaters on.

2. A mechanical ventilation system shall be provided for the machinery spaces. The system shall consist of supply duct fans with suitable Weather Deck inlets and outlets. All necessary ductwork to supply the ventilation needs of the machinery space plus combustion air for the diesel driven fire pump. The design of the system should take into consideration the fact that engine combustion air is directly ducted to the engines as detailed in the section on Diesel Engines Combustion Air Intake and Exhaust.

3. Fresh air supply for the machinery space shall be taken from separate intakes designed for minimum entrance loss, located so as to promote maximum cooling and to avoid short-circuiting of exhaust air or stack gas. Demisters shall be installed at fresh air intake points.

4. The exhaust fans, if fitted, shall draw air from the top of the machinery space and discharge it direct to the atmosphere through louvered openings directed aft and protected from the weather. Automatic, non-return dampers shall be mounted in the discharge ducting of each exhaust fan operating in parallel.
5. Machinery spaces and spaces containing hazardous materials shall be capable of being ventilated to weather at a rate not less than 10 air changes per hour.
6. In cold ship condition, all spaces with operating machinery and spaces storing industrial fluids and chemicals shall be fan ventilated to weather at a minimum of 2 air changes per hour. Heating design shall accommodate this airflow in winter design conditions.

5.13 POTABLE WATER SYSTEM

1. The potable service system shall include potable water tanks (storage and pressure) with sight glass level indicators, an electric hot water heater and water pumps. Two filling shore connections located on main deck port and starboard shall also be fitted. The caps on the fill connections shall be padlocked and label plates "POTABLE WATER ONLY" in both official languages shall be installed at the fill valves and connections. Each of the filling connections shall be capable of filling all potable water tanks. Every outlet used for drinking and culinary purposes shall be provided with filter capable of removing suspended particles down to 1 micron. Cross connection between the potable water system and any other system (including jacket water) that could contaminate the potable water is not permitted. All components, pipes, tank coats, and other material that comes in direct contact with potable water, including any supplied hull filling hoses and fittings shall be *NSF/ANSI 61 Drinking Water System Components – Health Effects* compliant.
2. Two fresh water storage tanks shall be installed onboard with a total capacity of 20 tonnes, or that which meets the needs of all embarked personnel for the continuous underway duration, whichever is greater. Each tank shall be fitted with a clean out plate, fill connections, vents, drains, and connections to the external pump. Tank stiffeners shall be located outside the tank.
3. An electrically driven pump, complete with on/off pressure switches, shall draw domestic water from the fresh water storage tanks and discharge it to the cold fresh water distribution system and to a calorifier/hot fresh water distribution system. The systems shall be arranged to minimize airlocks and short cycling of the pump. Automatic air vents shall be provided as required at each deck level. Drain plugs shall be provided at low points in the system for drainage purposes.
4. Hot fresh water shall be supplied to all domestic fixtures, systems or units of equipment requiring usage at a temperature not less than 49°C. The hot water system shall be of the continuous re-circulating type with thermostatically controlled pump. Water heaters shall be equipped with heat sensitive devices to cut-off all power should

the internal tank temperature reach 70°C. The tank shall be fitted with a pressure relief valve.

5. All hot water lines and flanges shall be insulated to minimize heat losses and ensure personnel safety. Cold water lines and flanges shall be insulated to prevent condensation.
6. An electrically driven fresh water pump shall be fitted to transfer potable to other vessels. The pump shall be provided with a suction strainer, and shall deliver to a deck connection fitted with a stop valve and a 1-1/2" threaded fire type nipple, screw and cap with chain. The pump shall be capable of delivering 10 cubic meters per hour with a flooded suction and total head of not less than 45m.
7. An automatic system shall be provided for the potable water in the tank to be sampled and chlorine or bromine added if required to ensure that the quality meets the requirements of Health and Welfare Canada for potable water. Provision to monitor the trace levels of chlorine and bromine in the potable water system shall be provided.

5.14 BLACK, GREY WATER AND SANITARY FLUSHING SYSTEMS

1. The Sanitary Flushing System shall use fresh water under pressure to flush all urinals and water closets. The vessels shall be fitted with vacuum flush type water closets, an accumulator tank, individual black and grey water sewage collection tanks complete with level gauge, vent pipe, discharge system and discharge pumps. Soil, urinal and vent pipes shall maintain a fall of not less than 1 in 15 relative to the design water plane. The discharge pumps shall be capable of discharging the collected black and grey water, either directly overboard or to a shore facility via a standard IMO deck shore connection with the vessel docked on either side. The total capacity of the black water tanks and the grey water tanks shall be sufficient to accommodate 72 hours of continuous underway duration plus 20% assuming the water treatment plant is inoperable. The tanks shall be vented as high up the mast as practicable and fitted with a flame screen.
2. Both the Black water and Grey water collection tanks shall be provided with adequate access to enable maintenance and cleaning. The tank bottom shall also be sloped towards the discharge pump suctions to enable proper drainage when cleaning the tank. A suitable number of clean-out ports, no less than 40mm diameter, shall be arranged throughout the black and grey water piping systems to permit proper cleaning and flushing.
3. A seawater line with manual isolation valve shall also be provided to enable flushing and cleaning of the black water tank and grey water tank.
4. Black and grey water tanks shall be fitted with local level indicators and high level alarms (90% full), annunciated at the Machinery Control Console. The system shall be capable of being selected to discharge automatically when the grey water tank reaches

80% full capacity. Manual ball valves shall be provided to select the discharge path. Check valves shall prevent back flow from sea and connected system.

5. Both black and grey water tanks shall be non-structural and made from stainless steel.
6. A commercial grade sewage treatment plan shall be installed to treat both black and grey water before overboard discharge. The treatment plant shall be certified to meet or exceed the requirements laid out in IMO resolution MEPC.159(55). The treatment plant should be appropriately sized to treat all onboard black and grey water. The black and grey water storage tanks shall be used to handle surges in system demand as well as those times when the treatment plant is inoperable. The system shall draw from the black and grey water tanks via separate connections in each tank to reduce the risk of cross contamination of either tank.

5.15 FIRE DETECTION AND EXTINGUISHING SYSTEM

1. The vessels shall be installed and furnished with a fire detection system, fire extinguishing systems, portable fire extinguishers and associated equipment. The system shall meet the requirements of the following

*CSA Fire Detection and Fire Extinguishing Regulations; and
Classification Society Regulations.*

2. Fire stations shall be provided such that any part of the vessel can be reached from at least two fire stations via a single length of hose. A single length hose shall be defined as a hose up to 15.24 metres length.
3. Each firestation shall terminate with a stop valve with a NPSH male thread to accept 1-1/2 inch wye. Each firestation locker shall be designed to accommodate the following equipment supplied as GSM:

- One (1) - 1-1/2" wye (NSN 4210-21-583-1015)
- Two (2) - 1-1/2" hose to reach any portion of the ship (NSN 4210-21-904-1361)
- One (1) - 60 GPM inline foam eductor (NSN 4210-21-891-1203)
- Two (2) - 60 GPM nozzle (NSN 4210-01-497-1361)
- Two (2) - Spanner Wrench (NSN 5120-21-583-0740)
- Three (3) - 20 litre AFFF Can (NSN 4210-21-900-4823)
- One (1) - AFFF canister rack to hold three 20L AFFF canisters (Similar to Drawing Number 0350032)

4. The machinery spaces shall be installed with automatic fire detection and fixed fire-extinguishing systems appropriate for unattended machinery space operation. The fire detection system shall be a module of the MCC. The fixed fire extinguishing system shall be capable of being activated from outside the machinery space. The preferred media for the fixed fire extinguishing system in the machinery space is water mist. This

does not preclude CO₂, chemical or dual extinguishing systems. No Ozone Depleting Substance shall be used in any fire extinguishing system.

5. Where feasible, alternatives to the Ionisation Type smoke detector shall be used. The Contractor shall duly record any sealed radioactive nuclear substance contained in any detector in the Ship Hazardous Material (SHM) Database. Firefighting extinguishing compounds, except water, shall be identified in the SHM Database.

6. A carbon dioxide smothering system, if fitted, for the machinery spaces shall be arranged for total flooding of the space above and below floor plates. Visual and audible warnings displayed locally and on the Bridge, and the required release time delay shall be provided with any carbon dioxide smothering system. Appropriate warning signs shall be provided to ensure that all closures and ventilating systems are secured and personnel evacuated from stricken areas before carbon dioxide is released. A full discharge trial of the carbon dioxide smothering system shall be conducted on the first of class to measure CO₂ concentration levels.

7. Firefighting and control markings shall be in accordance with IMO Standards. Photo-luminescent pictograms shall be supplied.

5.16 PORTABLE FIRE FIGHTING EQUIPMENT

1. The following portable fire fighting appliances shall be provided as GSM. The Contractor shall identify and supply any additional equipment required to meet classification standards and shall provide sufficient storage space and racks as required.

2. Stowage shall be provided for the following items required for four (4) firefighters:

Bunker Suits (NSN 8415-21-910-8049 and NSN 8415-21-910-8064);
Fire Fighter (FF) Hoods (NSN 8415-01-268-3473);
FF Gloves (NSN 8415-21-904-6765 and NSN 8415-21-907-9913);
FF Boots (NSN 8430-21-880-9920);
FF Helmets (one (1) NSN 8415-21-862-7817 and three (3) NSN 8415-21-862-7825);
Self Contained Breathing Apparatus (SCBA)s including space for two additional spare bottles for each SCBA.

2. Stowage shall be provided for the following GSM equipment

Force Rescue Unit (NSN 4240-12-157-8070);
Fire Axe (NSN 4210-21-583-0757);
Thermal Imaging Camera and mounting bracket (NSN 5855-01-492-6913 and NSN 5855-01-499-3870);
Band-it Clamp Kit (NSN 5120-21-639-9913);
Smoke Clearing Fan (NSN 4140-01-333-2224);
Water-gel Blanket (NSN 4210-01-365-7631)

4. All Contractor supplied portable extinguishers shall be CSA marine-labelled, certified types with mounting brackets. The quantity, size, type and location of all extinguishers shall meet the requirements of the classification society.

5.17 FiFi I REQUIRMENTS

1. The tugs shall be built for early stage fire fighting and for support of rescue operations onboard or close to structures or ships on fire. These tugs shall be designed with passive and active protection systems, giving them the capability to withstand higher heat radiation loads from external fires.
2. In order to meet the requirements above the tugs shall be built to and obtain the class notation FiFi I as granted by the classification society. Any equipment or systems beyond those described in this TSOR necessary to meet this requirement shall be included.
3. In addition to the equipment and design requirements of the FiFi I classification, these tug boats shall also be capable of discharging foam from their two fire monitors at the rates and capacities defined by the classification society for FiFi III class. The sole difference with respect to this Foam Monitor System shall be that only two monitors will be fitted in total and these two monitors will be capable of discharging either sea water or foam.

5.18 SPILL CONTROL AND DISPOSAL KIT

1. The Contractor shall furnish a storage locker to accommodate hazardous material spill control and disposal kits. The locker shall be not less than 1.22 metres W x 0.61 metres D x 1.98 metres H with adjustable shelving. The locker shall be located in the superstructure and near access to the weather deck and close to wash space. The spill control and disposal kit locker shall not be located in the same area as the HAZMAT locker.

5.19 NUCLEAR MONITORING EQUIPMENT

1. The vessel shall have a shelf with securing rail to accommodate the portable Nuclear Monitoring Equipment (NME). The shelf shall be not less than 0.30 metre wide x 1.0 metre long and fitted in close proximity to the chart table.
2. A locker shall be fitted to accommodate NME equipment, suits, hoods and masks. and (2) strong boxes 1.0 metre W x 1.0 metre D x 2.0 metre H. The locker shall be fitted with shelving and a lock. The locker shall be located in close proximity to the Bridge.

PART 2 SPECIFIC TECHNICAL REQUIREMENTS

SECTION 6 OUTFIT AND FURNISHING

6.1 HULL SYSTEMS

6.1.1 Mooring Systems

1. The vessel shall be provided with fibre mooring lines and spares. Mooring fittings such as bollards, chocks and cleats shall be in accordance with industry standards such as ASTM.
2. One heaving line shall be provided for each hawser and spring line. Rat guards shall be provided for each hawser and spring line.
3. Chocks, bitts, cleats, and chain and rope stoppers of the appropriate size and numbers shall be installed for optimum line handling arrangement clear of interference and will not chafe on any object or sharp edge. Cleats and chocks shall be arranged to support RHIB operation when along side on the port and starboard side.
4. Bollards shall be double and of the full-height type to enable crew to work lines while standing. Four bollards shall be fitted, two on the forward working deck and two on the aft working deck.
5. A minimum of eight stainless steel fairleads suitable for synthetic line shall be fitted, four on the port and four on the starboard gunwales on the fore deck.
6. Initial provisioning of strops, shackles, fenders, and shot mats shall be provided.

6.1.2 Deck Winches, Controls and Towing Arrangement

1. Towing equipment and arrangement shall be designed, tested and approved in accordance with classification society requirements, as applicable.
2. The towing equipment arrangement shall be submitted to the Technical Authority for approval during the Preliminary Design Review and the Critical Design Review.

6.1.2.1 Winches

1. All winches shall be fitted with spooling gear.
2. All winch cables to be fitted with tow hooks capable of absorbing the maximum bollard pull with a minimum safety factor of six. The tow hook shall have an automatic release and be provided with a built in shock absorber.
3. Deck winches shall be situated as to maximize towing efficiencies and maintain a clear working deck and incorporate features into the minimum number of units.

4. All deck machinery shall have one power source and be of proven manufacture for the towing industry.
5. All winches shall have a quick release mechanism controllable locally as well as remotely from the Bridge.
6. An encapsulated staple, configured for use with the winches provided shall be fitted on the forward and aft working decks. The encapsulated staples shall be of a highly polished material such as stainless steel to prevent abrasion to synthetic lines.

6.1.2.2 Foredeck

1. The foredeck shall have a Hawser winch with self-tensioning control capable of holding 76 metres of synthetic line rated for the vessel's maximum rated bollard pull with a minimum safety factor of six.
2. The hawser will have a fitted staple suitable for use with synthetic lines.
3. The Hawser winch, staple and fairleads shall be situated to allow the hawser to be deployed forward at the centre line and to each side of the vessel.

6.1.2.3 Aft Deck

1. The aft deck shall have a Hawser winch with self-tensioning control capable of holding 183 metres of synthetic line capable of operating at the tugs maximum rated bollard pull with a minimum safety factor of six in the indirect towing mode.
2. The Hawser winch will have a secondary drum capable of holding 76 metres of synthetic line capable of operating at the tugs maximum rated bollard pull.
3. The Hawser winch will have a fitted staple for each hawser suitable for use with synthetic line.
4. The aft deck shall also be fitted with a towing winch capable of holding 610 metres of wire rope capable of operating in a standard astern towing configuration sized to the vessel's rated bollard pull.
5. The towing winch shall be fitted with automatic spooling gear, towing pins, aft roller and cable clamps.
6. A towing pin shall be fitted at the centerline.
7. Units shall be multi-drum, waterfall or single purpose.

6.1.2.4 Winch Controls

1. All winches shall have both local and remote controls.
2. The primary control shall be from the bridge. Command transfer shall be from the wheelhouse only. Winch abort/reset buttons and line tension control with display to be located in wheelhouse only.
3. Local controls shall be watertight and safely located in the vicinity of the winch.
4. Winch controls shall be situated where there is an unobstructed line of sight to the tow in the primary towing direction when operating the controls.
5. Winch control levers to be clearly labelled and direction of travel to be logically oriented. Control stations for winches to feature the following functions; winch speed and direction controls, power brake lever, air clutch push-buttons, abort/reset push-buttons (wheelhouse only).
6. Compressed air shall be provided for the tow hook release, towing winch brake, and pneumatic winch controls.

6.1.3 Anchor Handling and Stowing Systems

1. The vessel shall be provided with two certified stockless anchors (one stowed) and chain cables. The length of chain cable for one anchor shall not be less than 192 metres.
2. Anchor arrangements shall provide that the anchor and anchor cable shall not foul or damage the hull, hull appendages, or equipment when weighting, dropping or riding at anchor. Facilities and washdown point shall be fitted for washing anchor and chain.
2. A suitable windlass operated anchor handling system shall be provided. The anchor and anchor cable size shall be as per classification requirements.
3. The anchor chain and arrangement shall permit the anchor chain to be broken at each shackle, at 28 metre intervals, and enable the tug to moor to a Canadian Navy buoy.
4. The windlass control system shall be configured for local control. The anchor shall have an emergency manual release and recovery system in event of a windlass failure.
5. The anchor windlass shall be tested under normal working conditions to demonstrate satisfactory operation for braking, clutch functioning, power lowering, hoisting, and proper riding of the chain through the hawse pipe, over the wildcat, through the chain pipe, and stowing in the chain locker. In addition, the anchor windlass shall be tested in accordance with *SNAME T&R Bulletin 3-47 Guide for Sea Trials 1989*.

6. Hawse pipes shall be provided for the anchors. The hawse pipe design shall ensure positive starting of the anchors and overhaul of the chain upon release under all ordinary conditions of list and trim. The ends of the hawse pipes shall be suitably finished.
7. Chain pipes shall extend from the windlass bedplate to the approximate centre of the chain locker, with large bellmouths on bottom and deck bolsters as supplied or recommended by the windlass manufacturer on top. Suitable arrangement or bonnet/cover plate shall be provided to stop water on deck flooding the chain lockers.
8. Construction of the hawse pipes and chain pipes shall be of ample thickness, size, and form for efficient anchoring, suitably rounded edges shall be provided to prevent chafing. The hawse pipes shall be of ample diameter and length to house the anchor stock and shackle.
9. Chain stoppers shall be so positioned as to ensure easy working of anchor cables. Suitable arrangement shall be provided to ensure that the anchors consistently trip and seat home firmly.
10. Anchor pockets shall be provided and constructed so that no parts of the anchors protrude beyond the fair hull lines when the anchors are fully housed.
11. Stowage spaces/racks shall be provided to accommodate hawsers, mooring and towing lines, and equipment (such as cable jack, sledge hammer, pry bars, cable bags, portable fenders, rat guards, fire axes) to support anchoring, mooring/berthing.

6.2 HULL FITTINGS AND FIXTURES

6.2.1 Eye Plates/bolts

1. Eye plates and eye bolts shall be installed in quantity, location and capacity as necessary to support lashing down, rigging and stowing portable items, lifting machinery for maintenance and repair, provide attachment to rigging lines and facilitate shipping of stores. All eye plates and eye bolts shall have the safe working load plainly marked upon and shall be tested to at least twice the safe working load with no visible signs of permanent set in the eye plate or support.
2. Eyes or anchor points shall be provided in quantity and location as necessary for a fall-protection system to support person work aloft and access to unguarded structure in accordance with the *Marine Occupational Safety and Health Regulations*.

6.2.2 Chains, shackles and loose gear

1. Chains, rings, hooks, shackles, swivels, pulley blocks, slings, and all other equipment used in hoisting shall be tested, marked and certified.

6.2.3 Plumbing Fixtures and Accessories

1. All trim for fixtures and all accessories shall be chrome plated cast or forged brass or stainless steel and shall be of matching design for uniformity.
2. Fixtures that are liable to damage by excessive bolt tightening shall be mounted with concussion washers between fixtures and metal supports. Grab rods shall be provided at all showers and water closets.
3. The following plumbing fixtures and accessories shall be provided:
 - a. Drinking water fountain
Drinking water fountain conforming to Marine Occupational Safety and Health Regulations shall be provided in way of the Mess area.
 - b. Fixtures and Fittings
Washbasins, showers and service sinks shall be provided with hot and cold fresh water.
Cut-off valves shall be installed to permit adjustment of water supply.
Washbasins shall be stainless steel and shall be provided with self-closing and washerless faucets.

Washbasins, unless otherwise specified, shall be provided with the following accessories:

Soap dish;
Toilet shelf with edge rails;
Coat hook;
Towel rack;
Toilet cabinet of stainless steel construction equipped with stainless steel shelves with edge rails and a mirror on the door. Doors shall have secure catches.
 - c. Showers

Shower outfits shall include a pressure temperature compensating mixing valve and a push button or level-operated control valve. The following shower accessories shall be installed unless otherwise specified:

Soap dish, unless intergral with shower stall unit;
Shower Curtain;
Shower curtain rod, tie-back and tie-back hook;
Grab rail.
 - d. Sinks

Each sink or set of double sink shall be installed with a faucet and a soap dish. Sink in commissary space and in way of laundry area shall be fitted with soap dispenser and a paper towel dispenser.

e. Water Closets

Water closets (vacuum type) shall be vitreous china. A toilet paper holder and grab rail shall be installed at each water closet. A toilet seat, hinged, open front type, shall be provided for all water closets.

6.2.4 Locks, Keys, Keyboards and Key Cabinets

1. Locks shall be provided for all doors, hatches, manholes, scuttles, and lockers where specified. Identical keys shall be used for all furniture locks in cabins, different keys shall be used for furniture assigned to each person and three key sets accordingly furnished. Locks for desks, key cabinets and bookcases in cabins shall be the same as locks for the furniture in the corresponding cabins.
2. Key cabinets:
 - a. A lockable Key Cabinet shall be permanently mounted on the Bridge and contain one copy of all keys provided with the vessel.
 - b. A lockable Duplicate Key Cabinet shall be permanently mounted in the master's cabin and contain two copies of all keys provided with the vessel.
3. A Lock and Key Plan shall be developed. Individual metal key tags and key rings shall be provided for all keys. Each key tag shall bear the compartment name and /or item identification.

6.2.5 Ratproofing

1. Wherever practical, ratproofing shall be accomplished by the nature of the construction rather than the use of additional fittings, plates and screens. Enclosed inaccessible spaces shall be eliminated. Inaccessible void spaces shall be ratproofed.
2. Circular openings shall not exceed 25 mm diameter and the side dimensions of square openings shall not exceed 25 mm. Openings in louvers and parallel-sided opening such as around doors and expanded metal bulkheads shall not exceed 10 mm in width. Deck gratings and portable flats in storerooms shall be constructed and fitted so that no openings are wider than 10 mm. Ventilation openings requiring ratproofing shall be fitted with ratproof screens.

6.2.6 Brow/Gangway

1. The Contractor shall provide a safe means of access between the vessel and shore or between other vessels berthed alongside. The tug shall have at least one point of through-access on each of the port and starboard sides of the gunwales to enable the placement of the brow. The brow with a clear width of at least 760 mm shall have a length of about 2/3 of the maximum breadth of the vessel, with non-skid walking surface,

railings, and rollers at one end. Eye plates and fittings will be provided for safety nets beneath the brow. The brow as rigged shall comply with the *CSA Safeworking Practices Regulations*. Landing platform or series of steps or similar structure shall be provided, if required, to ensure safe access to deck.

Access points in gunwales for embarkation/debarkation shall be an inward opening gate capable of opening to 180°. The gate shall be fitted with a means of securing it in an open position.

The brow shall be secured onboard in a location where it will not interfere with any operation.

6.2.7 Cathodic Protection System

1. The vessels shall be fitted with a cathodic protection system to protect the submerged hull, propulsion system, appendages, bilges, sea chests and ballast tanks against corrosion and electrolysis. The number of sacrificial anodes shall be as recommended by the manufacturers. Anodes shall not be painted and shall be protected from the effects of paint spraying. Anodes shall be sized for 4 years continuous operation.

6.3 RAILS, STANCHIONS AND LIFE LINES

1. Coated wire lifelines shall be fitted. All stanchions shall be galvanized steel. Stanchions and lifelines will not interfere with the deployment of the RHIB. Lifelines shall be fitted as necessary to allow for proper handling of the anchor, Jacob's Ladder and brow.

2. Closed link chain and stanchions shall be provided around all low coamings or flush hatches, and elsewhere as necessary for protection of personnel.

3. Rails and stanchions for antenna platform subject to radio frequency radiation shall be of non-metallic material.

6.4 SCUPPERS AND DECK DRAINS

1. All piping drain systems shall be installed complete with the necessary valves, fittings, and appropriate hardware for proper operation, including a sufficient number of flanges or unions to facilitate removal. Scuppers and internal deck drains shall not be interconnected. If during construction it is found that water tends to collect in any parts of the decks, the Contractor shall be required to provide additional efficient drainage arrangement above the arrangements included in the approved drawings.

2. All scupper valves shall be arranged to open and close in a fore and aft direction at the ship's side and shall be located for easy access for the maintenance. Gate valves shall be located outboard of each scupper. Neoprene water spouts (common known as "Pigs ears") of appropriate shape shall be fitted to the overboard discharge ends of scuppers and drain pipes.

3. All drainpipes shall be led as directly as possible. They shall be pitched to not less than 20 mm per metre when draining aft, 33 mm per metre when draining forward and 42 mm per metre when draining athwartship. They shall be provided with a sufficient number of accessible cleanout connections not less than 40 mm diameter for clearing the drainpipes by use of plumber's snake, or with steam or water hose. Deck and fixture drain lines shall be arranged so as to provide positive drainage when the ship is under design conditions of list, up to 5° port and starboard, and trim at sea or in port.
4. The weather deck and weather areas of the deckhouse and Bridge top shall be self-draining. Runoff from the decks above the main deck shall flow through leaders to the weather deck below. The drainage system shall be sufficient to drain all decks, without progressive accumulation of water. Scuppers and drains shall be led directly overboard.
5. Space drains below the Main Deck shall be grouped and lead to common overboard discharges. When it is not practical to drain overboard by gravity, space shall be provided with drain wells as required, or discharge to drain wells below. Drain wells shall be drained by the bilge system.
6. The galley sinks shall drain to a grease trap that shall be readily accessible for cleaning and the grease trap shall be provided with a vent to the weather.
7. Drains from lavatories, showers, and sinks shall have traps and accessible cleanout connections. Deck drains shall be provided for efficiently draining all interior compartments particularly galley, store rooms and washrooms. The chain locker shall drain into a sump tank constructed below the chain locker.
8. Strainers shall be provided for all deck drainage.
9. Equaliser pipes shall be provided to eliminate unsymmetrical flooding as necessary to meet requirements for stability control.
10. Grey water which originates from interior deck drains, galley sinks, lavatory sinks, showers, laundry and HVAC heating/cooling units should be directed into a suitably sized grey water collection tank. The grey water tank with a vent to the weather shall be fitted with a clean out plate accessible from within the compartment.
11. A pump, piping and controls shall be provided to allow discharge of the grey water tank over the side. When grey water tank reaches 80% full capacity, the contents shall be discharged automatically. An alarm shall be energized in the Bridge Control Console when the grey water tank reaches 90% full capacity. Manual ball valves shall be provided to select the discharge path. Check valves shall prevent back flow from sea and connected system.

6.5 SIDELIGHTS AND WINDOWS

1. Windows and sidelights shall be so constructed to preserve the watertight/fire-rated integrity of bulkheads and the structure in which they are fitted. All glass shall be heat-treated.

2. Sidelights shall be at least 450 mm diameter with deadlights hinged up and means of retaining deadlights in “up” position shall be rigid and secure.
3. To reduce reflections, the Bridge front windows shall be inclined from the vertical plane top out at an angle of not less than 10° and not more than 25°. Suitable safe external access arrangements, with appropriate fall arrest protection, shall be provided to enable cleaning in event of failure of the window washing and de-misting systems.
4. Where port lights and or windows are fitted, adequate save-all arrangements shall be provided to prevent water or condensation dripping into the compartment.

6.6 LIFE SAVING EQUIPMENT STOWAGE AND HANDLING

6.6.1 General

1. The vessels shall carry life saving equipment for a complement of ten in accordance with TCMS *Life Saving Equipment Regulations*. Life jackets, ships rescue boat, Ship Abandonment Suits, and life rafts shall be provided by the contractor. The Contractor shall furnish Transport Canada approved lifesaving appliances, survival craft VHF radiotelephones, distress signals and SARTs as required and the necessary chocks, cradle, seating and support.

6.6.2 Life Rafts

1. Sufficient life rafts shall be fitted in accordance with regulations. The Contractor shall install and fit the life rafts in self-launching cradles and provide the webbing and hydrostatic quick release gear as required for the life rafts.
2. Life rafts shall be stowed in open area on deck and clear of rigging with sufficient clearance to allow safe boarding. The life rafts shall be kept clear of all vents, discharges, gangways, and ladders, or adequately shielded to prevent damage to the lifesaving equipment.
3. Arrangement shall be such that the lifesaving appliances launching operator shall have a clear view to watch all the operations.

6.6.3 Rescue Boat

1. A rescue boat shall be provided as per requirements of CSA. The deck adjacent to the launching/recovering system shall have sufficient area available for the launching/recovering of a SOLAS certified rescue boat, embarking and disembarking personnel, transferring stores and conducting boat troubleshooting.

2. One rescue boat with outboard motor shall be provided by the Contractor. The Contractor shall provide chocks, cradles, gunwale guards and all necessary fittings and support for the stowage of the rescue boat. A stowage rack shall be fitted on the after deck for two 20 litre fuel tanks and possess a quick release mechanism to jettison the fuel containers in an emergency. The Contractor shall provide a weatherproof removable storage cover for the rescue boat.
3. The Contractor shall provide lifting slings and the associate fittings including hoisting shackles, webbing, quick release device (such as Cranston Eagle Hook) to facilitate the safe and quick launch and recovery of the rescue boat. Handling lines, cleats and/or stoppers shall be provided as necessary for rescue boat launching, retrieval and handling along side port and starboard. A suitable snatch block shall be secured to the head of the davit/crane and another suitable snatch block shall be secured to an eye on the deck to provide a good lead for a diver recovery line.
4. The ship shall be fitted with an electro- hydraulic crane of an extending boom davit type which complies with SOLAS standards, capable of launching and recovering the boat from either side of the vessel. The crane shall be able to reach the main working deck, have sufficient reach to deploy fuel spill response equipment over the gunwales, enable the tug to pick up and release temporary naval buoy moorings of up to 2200 lbs and be capable of loading and off-loading light cargo when the tug is alongside dock. The crane controls shall be fitted in a position such that the operator can clearly view the rescue boat at all times during the launch and recovery. The crane shall have an emergency manual mode to support rescue boat launching and recovery of the rescue boat in event of a power failure.
5. The davit/crane shall be to “Offshore Crane Specification API 2C” for handling manned boats for Sea State 3 operation and shall have a minimum rated safe working load (SWL) at least 1000 kg with a minimum of two removable lifelines attached to the head of the boom. Lifelines shall have a minimum factor of safety (FOS) of 10.
6. The RHIB launching davit/crane shall be tested and certified to ensure the rescue boat shall be safely launched and recovered in accordance with *TP 7322 – Standards for Rescue Boats*.
7. The davit/crane Structure Design Factor shall have a minimum factor of safety (FOS) 4.5, the quick release device shall have a minimum FOS 12. The Falls length shall take into consideration ship's lightest draft and 10 deg trim and list of 20 deg. The wire shall be rotation and corrosion resistant and shall have a minimum FOS 10. The davit/crane shall be equipped with an Anti-Two Block.
8. With the fully loaded craft, the lowering speed (S) shall be $0.4+(0.02 H)>S<1.30$ m/s, H is the height from davit head to water line at the lightest sea going condition. The hoisting speed shall have a minimum speed of > 0.3 m/sec at the safe working load.
9. The davit/crane shall be designed and tested to demonstrate compliance with the following criteria:

- a. Static Proof Test
 - (i) 2.2 times the maximum working load, except winch brakes.
 - (ii) Device to be placed at the full outboard position, proof load shall be swung through an arc of approx. 10 degrees to each side of the vertical in the fore and aft plane.
 - (iii) Test shall be done in the upright position, and then in positions simulating shipboard condition of list of 20 degrees both inboard and outboard.
- b. Dynamic (Working Load) Test
 - (i) Safe Working Load shall be moved from the full inboard to the full outboard.
 - (ii) Repeat test (i) with ship under a combined condition of 20 deg. inboard list and 10 deg. trim.
 - (iii) Repeat the tests in (i) and (ii) with a mass equal to 1.5 times the Safe Working Load without persons.
- c. Winch Test
 - (i) Device winch shall be wound to the maximum number of turns, a static test load of 1.5 times the maximum safe working load shall be applied and held on the winch brake for 1 minute, and then lowered for one complete revolution of the winch barrel shaft.
 - (ii) Upon completion of test under (i), a test load of 1.1 times the maximum safe working load shall then be lowered at maximum lowering speed through a distance of at least 3 metres and stopped by applying the brake sharply, the test load shall drop no more than 1 metre after applying the brake.
 - (iii) The test under (ii) shall be repeated a minimum of three times. If the winch design incorporates an exposed brake, at least one of these tests shall be carried out with the brake wetted, but in this case the stopping distance may be exceeded.

6.6.4 Life Jackets

1. Life Jackets shall be provided by the Contractor. The Contractor shall provide stowage “float free” boxes, similar to inflatable life raft stowage canister with hydrostatic release, for the life jackets located close to the designated embarkation stations.

6.6.5 Life Buoys

1. The Contractor shall provide Transport Canada approved ring type life buoys as required complete with self-igniting lights and lifelines. The life buoys shall be fitted in accessible positions and shall be capable of being readily cast loose.

6.6.6 Ship Abandonment Suits

1. Ship Abandonment Suits, shall be provided by the Contractor. The Contractor shall provide a locker for stowage of the Abandonment Suits.

6.7 RIGGING AND CANVAS

6.7.1 Rigging

1. Standing rigging shall be reduced to a minimum. Stays and guy wires shall be arranged to produce minimum interference with radio frequency antenna systems. All rigging and pertinent fittings shall be provided to produce a thoroughly workable installation complete for the service intended and as necessary to facilitate maintenance and repair.

2. Masts, yards, spreaders, and gaffs, with platforms and brackets shall be provided as necessary for all navigation, communication, and signal equipment. They shall be of steel pipe and plate and be designed to be completely self-supporting with all equipment in place. Running rigging shall consist of four signal halyards of braided nylon with non-metallic blocks connected to the mast by galvanized shackles. Cleats shall be provided port and starboard for securing halyards. Flag lockers shall be provided adjacent to the halyards.

6.7.2 Protective Covers

1. Suitable shaped protective covers shall be provided for rescue boat, searchlights, hawser, wire rope reels, fire monitors, AFFF canisters and other equipment requiring protection on weather deck. All protective covers shall be made of commercial marine grade coated nylon cloth, coloured to match the ship. Lacing grommets, Velcro fastenings and chaffing pieces of leather to be fitted where required.

6.7.3 Portable Ladders

1. The vessels shall be furnished with a Jacob's Ladder that can be lowered over the side of a vessel and it will reach the waterline with at least two rungs submerged when secured from the highest point of the main deck edge at the vessels lightest operating condition.

2. A suitable arrangement shall be provided to permit the pilot to embark/disembark between the tug and warships while both vessels are underway at 5 knots or less and the tug is against the warship's side. The hull and superstructure arrangement of the tug shall permit the pilot to embark and disembark by stepping from one vessel to another, where possible, instead of via a pilot boarding ladder.

6.8 LADDERS, HANDRAILS, GRABRAILS, FLOORPLATES, AND GRATINGS

6.8.1 Ladders

1. Ladders shall be installed as necessary to provide access to all compartments, passages, and all operating parts of machinery and systems. All ladders shall be inclined except where not feasible due to access location or the machinery arrangement. Ladders in frequent use shall lean fore and aft. All ladders shall be of steel construction.

6.8.1.1 Inclined Ladders

1. Ladders and stairs shall be provided in all areas where they are required for access. Rise/run shall be approximately 225 mm x 260 mm. The rise of each step shall not exceed 230 mm. The external and machinery space sloping ladders shall have handrails on each side.

2. Interior stairways, lifeboat, and life raft embarkation ladders, and pilot ladders shall be according to regulations.

3. Inclined ladders shall be bolted to the structure so as to allow relative motion between supporting fastenings at head and foot. Where they are attached to deck coamings, the coamings shall be cut away to eliminate tripping hazards, as long as Regulatory Body and strength requirements are not exceeded.

4. All interior accommodation stairs shall be constructed with treads of flanged plate, and stringers. The stringers shall be arranged toe out. Treads on interior stairways shall be covered with resilient deck material similar to that on adjoining decks. Safety treads with integral nose moulding, of heavy duty, non-skid surface, shall be applied over complete surface of all stair treads.

5. A landing of similar non-slip material shall be provided at top and bottom of each stairway.

6. Treads shall be located at the head and foot of all inclined ladders, both sides of entrance doors having coamings, and approximately the entire area of each step on inclined ladders. Sheet metal shields shall be fitted on the underside of ladders over machinery and equipment and in living spaces. The shields shall be securely fastened to prevent vibration but shall be readily removable for cleaning and preservation.

6.8.1.2 Vertical Ladders

1. Vertical ladders shall be provided access to or on masts, signal and navigational lights, ducts and in compartments for access to manholes and for escape. The spacing of foot rungs shall not exceed 300 mm apart. All vertical ladders shall be bolted in place.

2. Where conditions preclude the installation of vertical ladders such as escape trunks from machinery spaces, ladders may be constructed of separate rungs and welded to the bulkheads or other structures.

6.8.2 Handrails

1. Handrails and bulkhead grabrails shall be provided around all elevated platforms and gratings, walkways, switchboard, and moving parts of machinery.
2. Storm rails made of 30 mm steel pipe shall be fitted at 1050 mm above deck on sides and ends of all houses, to bulkheads in all exterior passage, casings, and stacks where crew have access as necessary.
3. Except in way of electrical equipment, such as switchboards, where hardwood shall be used, handrails shall be 25 mm pipe and shall be galvanized in locations where subject to corrosion. Handrails supported from bulkheads or other surfaces shall have a clear hand space of at least 63 mm. Handrails shall be fitted at 1050 mm above the deck to corridor bulkheads of interior passageways and elsewhere, as necessary. Grabrails of similar construction shall be fitted in the Bridge and accommodation areas as deemed necessary to aid personnel in ascending and descending or stepping from ladders. Corrosion resisting grabrails shall be provided in shower stalls.
4. Guard rails shall be provided in the machinery space as required for safety of operations.

6.8.3 Floor Plates and Gratings

1. Floor plates shall be aluminium or galvanized steel perforated grating.
2. Gratings shall be constructed of 6063-T6 aluminium alloy except that machinery space gratings shall be corrosion-resistant steel.
3. Where aluminium gratings are used, proper insulation shall be provided between the aluminium/steel interface.
4. Portable or hinged sections of floor gratings shall be fitted in areas where access is required below them for periodic inspection of equipment, maintenance, and cleaning. Where access is required for operation of valves or other controls, hinged sections shall be used.
5. Gratings shall be provided for hatches anywhere lifelines or life rails are not provided. Gratings located over moving machinery shall be provided with screens made of the same materials as the grating. Grating panels shall be supported by angles or bars spaced not to exceed 0.6 metres in the direction of the crossbars. The maximum acceptable unsupported span for any grating shall be 1 metre in the direction of the bearer bars. All grating panels shall be secured to the supporting framework by clips or bolts to ensure positive locking and ready disassembly. Clips and bolts shall not extend above the surface of the grating.

6.9 NON STRUCTURAL BULKHEADS, DOORS, PARTITIONS

1. Fire Protection shall be in accordance with *TP 11469 Guide to Structural Fire Protection*. Joiner linings and bulkheads shall be installed in accordance with the conditions described in the schedule attached to the Product Certificate of Approval.
2. Doors, weather tight, gas tight, fire rated doors and joiner doors (B-0 rated) shall be selected from TCMS Approved Products Catalogue Index, where practicable. Doors shall be fitted with all necessary stainless steel locks, bolts, holdback hooks etc. Kick-out panels and ventilation louvers may be fitted as required. Doors to washplaces and heads shall have locks provided with interior latching arrangements.
3. Weathertight exterior doors shall be fitted with coamings and shall have suitable holdback arrangements.
4. All interior doors shall have a coaming height of 50 mm and shall have non-rattling holdbacks. Rubber faced bumpers should be provided to protect walls and furnishing.

6.10 PAINTING AND PRESERVATION

1. The paints used in a given coating system shall be from the same manufacturer where practicable. Each coat of paint shall be compatible with the coat of paint that it will cover, including pre-construction primers that are to be retained as part of the final coating system. All surface preparation requirements, pre-treatment and coatings applications shall be per the manufacturer's instructions and shall be only be carried out within ranges of temperature and humidity conditions as specified in the manufacturer's instructions.
2. The Contractor shall submit a painting schedule for the vessels based on *CFTO D-23-003-005/SF-002 The Preservation and Painting of HMC Vessels* to the Technical Authority for comment. The Contractor shall have National Association of Corrosion Engineers (NACE) Level II engineers to certify the quality control/inspection records of pre-surface preparation, surface preparation, film thickness per coat, final inspection and temperature humidity and dew point during painting and drying.
3. To comply with Environment Canada Regulations, tributyl (TBT) antifouling paint shall not be used to protect the vessels. Only anti-fouling coatings registered under the Pest Control Products Act may be used.
4. Exposed weather deck surface shall be coated with non-skid coating. Self-adhesive non-skid shall not be used.

6.11 DECK COVERING

1. The following deck coverings shall be installed:

Area	Finish
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Bridge, mess, cabins	Non-slip, seamless deck covering on dex-o-tex underlay
Washroom, Galley	Non-slip, seamless deck covering on dex-o-tex underlay
Tank Top	Deck coating non-slip
Switchboards, UPS, control consoles	High dielectric strength rubber matting
Exterior Deck	Non-slip painted deck

2. Deck coverings (including cove base) shall be provided per the manufacturer's instructions for the intended marine environment. The Contractor shall submit Schedule of Deck Coverings with samples of coverings from which the Technical Authority can make specific selections.

3. Steel decks shall be dry, clean and free from rust, grease, oil and other extraneous matter prior to receiving deck coverings. Primer coating shall have been applied. Deck covering shall not be laid until after all connections to decks for fastening machinery, equipment, furniture, etc. are installed. Deck covering shall not be painted to hide stains and discoloration. Preparation of surfaces and use of underlayment to receive deck coverings shall be per the manufacturer's instructions. Deck coverings in wet spaces where tiles are fitted shall be sloped to ensure proper drainage to scuppers.

4. All deck coverings shall be thoroughly cleaned after finishing and “sealed” as recommended by deck coverings manufacturer. After installation the deck shall be thoroughly and completely covered to prevent any indentation or wear prior to delivery of the vessel.

5. High dielectric strength rubber matting shall be provided in front and rear of all switchboards, control consoles, group control boards, and over deck areas on which personnel stand when servicing or turning energized electrical equipment or when shock hazards exist.

6. All deck coverings shall provide a durable, seamless waterproof surface that provides a good foothold and can be easily maintained.

6.12 INSULATION

1. Insulating materials shall be selected from TCMS Approved Products Catalogue Index, where practicable. The Contractor may consider the lightweight, fire restricting SOLIMIDE Polyimide Foam that is used on some DND ships. All insulation material shall be installed in accordance with the conditions described in the schedule attached to the Product Certificate of Approval.

2. Where insulation material is installed in more than one layer, each following layer shall be staggered and hard against the preceding layer, bedded and jointed with adhesives per insulation material manufacturer's recommendations.

3. Horizontal surfaces or decks over water tanks or fuel oil settling tanks shall be provided with equivalent insulation having sufficient load bearing characteristics as within accommodation and service spaces.
4. Insulation of vent and air conditioning ducts and piping shall be fitted as required. All living, working, and public spaces that have a common boundary with heat producing spaces shall be insulated on the heated side. Boundary surfaces of all spaces which are heated or air-conditioned, and which are exposed to the weather or are adjacent to unheated spaces shall be covered with thermal insulation.
5. Fire rated insulation shall be fitted for fire protection safety within accommodation areas, control consoles, and service areas.
6. Acoustic insulation may be required in Bridge and similar spaces to meet the noise requirements. Acoustic insulation shall not be fitted to surface where fire-rated insulation has been specified.
7. Sheathing shall be attached to all insulated surfaces. Portable sections of sheathing shall be provided where required for accessibility in way of wiring, ducts, piping, air conditioning controls, filters at unit air conditioners, and other accessories.
8. Where sheathing and insulation are subject to damage, the sheathing shall be of galvanized sheet metal. Galley spaces shall be sheathed with satin finish stainless steel.
9. All Storerooms shall have vertical wood sparring and deck gratings where deemed necessary.

6.13 NAME PLATES, NOTICES, AND MARKINGS

6.13.1 General

1. The Contractor shall provide hull designation and markings to the vessel's hull, decks, bulkheads and equipment. The Contractor shall provide a fire control plan and other safety drawings in both official languages permanently exhibited for ship staff. Confirm boards to be provided.

6.13.2 Draft Marks

1. Draft marks shall be provided prior to launching. The exact position of all draft marks shall be shown on the ship's docking plan and the trim and stability manual. Draft marks shall be fitted port and starboard at 200 mm intervals. The lowest mark shall be in increments of 200 mm from the underside of the keel and the draft mark shall extent at least 600 mm above the deep departure waterline (EOL). Draft marks shall be installed in accordance standard provided by Canada. The draft marks between the light waterline and the deep departure waterline shall be of welded plate. Draft marks shall be painted white.

6.13.3 Pennant Numbers

1. The ship's pennant number, provided by Canada, shall be centre-punched in outline and painted in black on both sides of the ship in accordance to standards provided by Canada. Depending on the stern configuration, the pennant number may be required on the transom.

6.13.4 Nameboards

1. Nameboards shall be located on the superstructure port and starboard in accordance with standard provided by Canada.

6.13.5 Maple Leaf Insignia

1. The Contractor shall provide two official eleven-point Red Maple Leaf Emblems cut from aluminium plate conforming to standard DND Drawing No. G-R-9-H02-0020051-01 and install the emblem in accordance with *MARCORD NA-02 Maple Leaf Emblem Wearing By HMCS Ships and Auxiliary Vessels*.

6.13.6 Builder's Data Plaque

1. The Contractor may install a Builder's Data Plaque at location agreed by the Technical Authority.

6.13.7 Label Plates

1. Aluminium label plates made by metal photo process shall be provided for:

All compartments, lockers, cupboards, berths, hatches, scuttles and manholes throughout the ship. Nameplates shall be located in a prominent position.

All galley equipment

All ventilation equipment including air-conditioning machinery, fans, valves, supply and exhaust vents, fire dampers etc.

All mechanical machinery/equipment, valve hand wheels, and gauges.

2. Lettering shall be clear and concise with a minimum of abbreviations. Standard abbreviations shall be used.

3. Label plates and markings for compartments, warning, ventilation, lifting appliances, piping, electrical cables etc shall be conformed to the Industry standard such as IEEE, ASTM etc. Label plates and markings for compartments, warning signs, exits, means of escape, life-saving appliances, fire fighting and control and safety related items/equipment shall be in both official languages, English and French.

PART 2 SPECIFIC TECHNICAL REQUIREMENTS

SECTION 7 PYROTECHNICS LOCKER

7.1 PYROTECHNICS LOCKER

1. The vessel shall comply with the Canadian Forces, Transport Canada, TP 7319E-*Standard for Pyrotechnic Distress Signals and Similar Devices*, CFP 153, and SOLAS requirements for required pyrotechnics.
2. The Contractor shall provide a locker for stowage of pyrotechnics and arrange the associated seawater piping and drainage system to the locker. The locker shall be watertight and constructed similar to NSN 2090-21-920-7059 (DND Drawing No. 0069323). The locker shall conform to the requirements of *C-09-153-003/TS-000 Explosives Safety Manual Volume 3 –Ships* and *National Defence Security Policy Chapter 28 Small Arms and Ammunition*. The approximate outer dimension of the locker should be 1.20 metres long by 0.56 meters wide by 0.72 metres high.
3. The actual dimension and shelving/rack arrangement of the pyrotechnics locker shall be designed to allow for the following minimum compartment sizes:
 - One (1) compartment with dimensions of 0.90 metres long by 0.12 metres wide by 0.61 metres high
 - One (1) compartment with dimensions of 0.33 metres long by 0.34 metres wide by 0.61 metres high
 - Two (2) compartments with dimensions of 0.26 metres long by 0.33 metres wide by 0.61 metres high
4. The pyrotechnics locker shall be installed on the weather deck as close as practical to the Bridge.

7.2 HAZARDOUS MATERIAL LOCKER (HAZMAT)

1. The Contractor shall provide a locker for the storage of hazardous material such as paint and inflammable liquids.
2. The locker shall be approximately 0.5 m³ and be located in way of the weatherdeck.
3. The HAZMAT locker shall be designed in accordance with standards provided by Canada and connected to a CO₂ system.