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SECTION 042 GENERAL ADMINISTRATIVE REQUIREMENTS

042.1 TERMS AND DEFINITIONS

042.1.1 The term "these specifications" refers to the document entitled, "Homeland Security Cutter – Light (HSC-L) Specification".

042.1.2 The term "section" refers to a part of these specifications designated by a single 3-digit number. Reference to sections of these specifications is made by calling out the appropriate 3-digit Expanded Ship Work Breakdown Structure (ESWBS) number.

042.1.3 The term "herein" shall mean within this entire specification and the Statement of Work.

042.1.4 The term “as shown on the drawings” shall mean that there is additional information on the contract drawings, contract informational drawings and the project peculiar documents.

042.1.5 The “Contractor” is the firm holding a prime contract with the Government for design or construction of the HSC-L.

042.1.6 The phrase “be approved” or “for approval” used herein shall be interpreted to mean approval from the Government Contracting Officer or Contracting Officer’s Representative (COR) in accordance with the terms and conditions of this contract.

042.1.7 The term "days" shall mean calendar days unless otherwise specified herein.

042.1.8 "Exterior location", "Weather location" and other similar terms shall mean exposed to the elements and left unprotected by the vessel’s interior environment.

042.1.9 FCC is the Federal Communications Communication.

042.1.10 GFP means Government Furnished Property- It includes both Government Furnished Equipment and Government Furnished Information - Items and information in the possession of, or acquired by the Government and delivered to, or otherwise made available to, the Contractor. These items are included in Schedule A and Schedule C of the contract.

042.1.11 "Interior location" and other similar terms shall mean protected by the vessel's interior environment.

042.1.12 Standards Bodies are entities that establish standards for the industry such as IEEE, ASTM, ABYC, NFPA, ISA, etc.

042.1.13 USCG is the United States Coast Guard.

042.1.14 The term "approved waiver request" shall mean: Any non-conformance, found to depart from specified requirements during or after manufacture, which is considered usable as is or after rework by an approved method.

042.2 GENERAL

042.2.1 These specifications describe the requirements for a Homeland Security Cutter- Light including the general features, functions, performance, and arrangements, but not necessarily the details of the design. Together with the contract drawings and contract informational drawings, hereafter referred to as “the drawings,” and other referenced documents, they define the vessel as to principal dimensions, arrangement, and power.

042.2.2 Material and equipment under these specifications shall be new and unused. Equipment shall be current production models with existing equipment and repair parts support. Materials or equipment referred to by trade or brand name or manufacturer's model or by Federal/National Stock Number represent, to the best knowledge of the Government, current production models on 5 January 2026.

042.2.3 Where a commercial manufacturer's type, model, or other designation is referenced herein, together with the term "or equal", such identification is intended to be descriptive, but not restrictive, and is used to indicate the applicable characteristics as they existed on 5 January 2026.

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042.2.3.1 If the term "or equal" does not appear after the requirement of a commercial manufacturer's type, model, or other designation, it shall be read as only the specific commercial manufacturer's type, model, or other designated material or equipment will suffice.

042.2.4 Approval shall be obtained from the Contracting Officer prior to the use of other than referenced document(s) in lieu of the requirements of the primary reference cited. This includes superseding documents if applicable. Later versions of product specifications may be used upon notifying the Contracting Officer and are approved unless specifically rejected within 45 days. Proposals for substitutions for primary and the above sub-tier references shall be made by letter from the Contractor to the Contracting Officer. To ensure that sufficient information is available to permit evaluation of alternatives, the Contractor shall furnish descriptive information necessary to substantiate that the alternative offered is cost effective and meets the performance, life, safety, interchangeability, maintainability, and reliability of that prescribed by the referenced document(s).

042.2.4.1 Equivalent equipment - Where equipment is specified herein by a reference document, the Contractor may propose equivalents to these references.

042.2.4.1.1 In order for the proposed item to be acceptable, an equipment equivalency certificate shall be prepared and approved.

042.2.4.1.2 The equivalency certificate shall include, and approval will be based on, the following equipment attributes:

042.2.4.1.2.1 Meet or exceed the performance requirements specified herein, and possess similar:

042.2.4.1.2.1.1 Dimensions.

042.2.4.1.2.1.2 Weight.

042.2.4.1.2.1.3 Power, HVAC, cooling water, and other support services.

042.2.4.1.2.1.4 Suitability for marine service.

042.2.4.1.2.1.5 Material.

042.2.4.1.2.1.6 Reliability and Maintenance features.

042.2.4.1.2.1.7 Vendor furnished training.

042.2.4.1.2.1.8 Vendor furnished service.

042.2.4.1.2.1.9 Data requirements.

042.2.4.1.2.1.10 Maintenance and support costs, expected life, and crew workload.

042.2.4.1.2.1.11 Environmental and Safety characteristics including airborne noise and vibration.

042.2.4.2 To the extent that the above similarities are not met, the Contractor shall explain why they are not essential to the proper functioning and support of the equipment.

042.2.4.3 The equivalency certificate shall identify support, auxiliary, or subsystem equipment or material that would be changed or modified as a result of acceptance of the equivalent equipment.

042.2.4.4 The equivalency certificate shall identify discrepancies with the requirements of these specifications that would result from the acceptance of the equivalent equipment.

042.2.4.5 Unless otherwise specified, measurements, calculations, and mathematical data shall be presented in U.S. Customary units of measure. In addition, written data produced in support of this effort or required as a deliverable, shall be in the English language.

042.2.4.6 If the Contractor proposes to modify a product to make it conform to the specified requirements, they shall include in their proposal a clear description of such proposed modifications and clearly mark any descriptive material accordingly. The Contracting Officer will be the final judge of the suitability of the item submitted.

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042.3 REFERENCED DOCUMENTS

042.3.1 Definitions

042.3.1.1 "Contract drawings" are drawings which delineate design features of the vessel. No departure from a contract drawing shall be made without approval of the Government.

042.3.1.2 "Informational drawings" are drawings identified as "Informational Drawing" which illustrate design features of the vessel. An Informational drawing does not necessarily depict, nor is it intended that it depicts, features and details of the systems and structures to which it relates. It serves the purpose of providing information which, when utilized in conjunction with applicable specification requirements, contract drawings, project-peculiar drawings, and other information, will result in an acceptable design. Departure from specific details may be made without approval, provided an acceptable design results. Informational Drawings will not necessarily be updated or revised to reflect future modifications or changes to these specifications.

042.3.1.3 "Expanded Ship Work Breakdown Structure" (ESWBS) is a method of ship weight and system classification defined by NAVSEA 0900-LP-039-9010. Reference to ESWBS or SWBS in these specifications shall mean the Expanded Ship Work Breakdown Structure.

042.3.1.4 "Industry standards" are documents promulgated by recognized non-Government organizations (such as ANSI or ASTM) that establish engineering and technical limitations and applications for items, materials, processes, methods, design, and engineering practices.

042.3.1.5 "Primary references" and "sub tier references": Any referenced document which is directly cited for use or application by an identifying number or name in these specifications or in any contract drawing, is a primary reference for each particular use or application for which it is so cited. Any document which is cited in a primary reference, or in a document referenced therein, is a subtier reference. A document which is a subtier reference in one application may be a primary reference in another application when it is cited directly

042.3.1.6 Where any primary or sub-tier reference uses language such as: “recommends, should, or similar,” this shall be interpreted as a “shall” requirement in the reference document itself.

042.3.2 In the event that the Contractor discovers any error or inapplicability in the identification of reference documents, the Contractor shall notify the Contracting Officer within 5 days of that discovery.

042.4 EFFECTIVE ISSUE

042.4.1 The effective issue of a reference document refers to that issue of a reference document which forms a part of these specifications. Whenever first tier references are identified within these specifications by revision or amendment, that issue shall be the effective issue for the particular use or application cited. These specifications do not prescribe effective issue requirements for sub-tier references. Sub-tier references shall be those in effect on the date of the first tier referenced document version used. The effective issue of references not specifically identified by issue or amendment shall be that in effect on 5 January 2026 unless otherwise specified. The effective issue of contract drawings, informational drawings and project peculiar documents is the revision listed in Table I. Where no revision is indicated, the original issue is intended.

042.5 ORDER OF PRECEDENCE

042.5.1 Order of Precedence of requirements within the Expanded Ship Work Breakdown Structure Sections of the Homeland Security Cutter- Light (HSC-L) Specification is as follows:

042.5.1.1 Requirements within a SWBS Section applicable to the entire HSC-L (for example, SWBS Section 070 - General Requirements for Design and Construction) state the broadest requirements and apply to systems and equipment, unless otherwise specified in the more detailed SWBS Sections, in which case the detailed SWBS Section requirements apply.

042.5.1.2 Specific requirements within a lead, 1-digit SWBS Section (for example, a SWBS Section which includes the general or common requirements for a number of similar systems, such as SWBS Section 500 - Auxiliary Systems, General) are the next broadest category of requirements, and shall

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apply to systems and equipment in its grouping as well as other ship systems where applicable, unless otherwise specified in detail system SWBS Sections.

042.5.1.3 Specific requirements within a 2-digit SWBS Section (for example, a SWBS Section which includes the details of a particular system such as SWBS 530, Fresh Water Systems) are the next broadest category of requirements and shall apply to systems and equipment in its grouping, unless otherwise specified in detail system SWBS Sections.

042.5.1.4 Specific requirements within a detailed, 3-digit SWBS Section (for example, a SWBS Section which includes the details of a particular system such as SWBS 533, Potable Water Systems) are the most detailed requirements. Requirements in these detailed system SWBS Sections apply for the system covered in the detailed SWBS Section.

042.5.1.5 The omission in one SWBS Section of details covered in another SWBS Section shall not be considered a conflict.

042.5.1.6 In the event that two or more requirements of equal precedence are found to apparently conflict, the Contractor shall formally identify the conflict to the Government for clarification, or correction of the specifications, as appropriate.

042.5.2 Order of Precedence of Documents

042.5.2.1 In case of conflict between the Specification and referenced documents, the following order of precedence applies:

042.5.2.1.1 Contract Drawings.

042.5.2.1.2 HSC-L System Specification

042.5.2.1.3 Primary references

042.5.2.1.4 Sub-tier references.

042.5.2.1.5 Informational Drawings.

042.5.2.2 The order of precedence only applies in the event there is a conflict between requirements.

042.5.2.3 In the event that requirements are found to apparently conflict, the Contractor shall formally identify the conflict to the Government for clarification, or correction of the specifications, as appropriate.

042.5.3 The following drawings form a part of these specifications to the extent specified herein.

042.5.3.1 Contract Drawings

Drawing Number	Title	Revision
085	HULL LINES & OFFSETS	
101	SECTIONS AND BULKHEADS	
110	SHELL PLATE ARRANGEMENT	
114	SKEG DRAWING	
130	DECKS & PLATFORMS	
150	DECKHOUSE STRUCTURE	
167	STRUCTURAL & NONSTRUCTURAL CLOSURES	
256	MACHINERY COOLING SYSTEM	
259	DIESEL EXHAUST DIAGRAM	
301	ENGINE START SYSTEM DIAGRAM	
420	NAVIGATION SYSTEM BLOCK DIAGRAM	
506	VENTS, SOUNDS, FILLS & OVERFLOWS	
512	HVAC DIAGRAM	
514	CHILLED & HOT WATER DIAGRAM	
521	SEAWATER SYSTEM DIAGRAM	
528	PLUMBING DRAINS & SEWAGE VACUUM/TRANSFER DIAGRAM	
529	BILGE SYSTEM DIAGRAM	

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532	AUXILIARY FRESHWATER COOLING DIAGRAM	
533	POTABLE WATER SYSTEM DIAGRAM	
541	FUEL SYSTEM	
555	FIXED FIREFIGHTING DIAGRAM	
561	STEERING SYSTEM	
562	RUDDER DRAWING	
573	WORKING DECK ARRANGEMENT	
582	MOORING, TOWING & ANCHORING ARRANGEMENT	
601	GENERAL ARRANGEMENTS	
625	WINDOW SCHEDULE	
635	INSULATION SCHEDULE	

042.5.3.2 Informational Drawings

Drawing Number	Title	Revision
079	STABILITY ANALYSIS	
083	MASTER EQUIPMENT LIST (MEL)	
096	WEIGHT ESTIMATE	
180	STRUCTURAL FOUNDATIONS	
201	MACHINERY ARRANGEMENT	
300	ELECTRICAL LOAD ANALYSIS (EPLA)	
301	ELECTRICAL ONE-LINE DIAGRAM	
401	TOPSIDE ARRANGEMENT & DETAILS	
512	HVAC HCLC	
640	SPACE ARRANGEMENT	
N/A	PLACEMAT	

SECTION 070 GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION

070.1 GENERAL

070.1.1 This section contains general technical requirements for the design and construction of a Homeland Security Cutter - Light. The information contained in this section sets forth general requirements for design, workmanship, and installation unless otherwise specified herein. The cutter shall incorporate proven technology.

070.1.2 Equipment, machinery, and materials shall be suitable for extended exposed stowage and reliable operation in the marine environment.

070.1.3 The Contractor shall comply with Original Equipment Manufacturers (OEM) installation instructions and recommendation of components unless there is a conflict with the contract requirements, in which case the USCG will adjudicate the conflict.

070.2 PRINCIPAL DESIGN FEATURES

070.2.1 **Physical Constraints**

070.2.1.1 Draft – Not to exceed 7 feet at Full Load ATON end of service life condition. Draft is measured from the bottom- most extremity including propeller(s), appendages, and hull in the full load condition.

070.2.1.2 Air Draft – Fixed height not to exceed 20 feet above the Minimum Operating Condition waterline.

070.2.2 **Propulsion Plant Architecture**

070.2.2.1 The vessel shall have 2 main propulsors.

070.2.2.2 The vessel and its systems shall operate on the following fuels:

070.2.2.2.1 NATO F-76 fuel in accordance with MIL-DTL-16884;

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070.2.2.2.2 Marine Gas Oil conforming to ISO 8217 Grade DMA with a maximum sulfur content of 0.5 mass % and a maximum Fatty Acid Methyl Esters content of 0.5 vol. %; and

070.2.2.2.3 ASTM D975 Grade Number 2 Ultra Low Sulfur Diesel with a maximum sulfur content of 15 ppm.

070.2.3 **Speed, Range and Endurance**

070.2.3.1 Speed: The vessel will be capable of maintaining speed of at least 10 knots in seas with significant wave height of less than one foot, while outfitted for Full Load ATON.

070.2.3.2 Range: The vessel will be able to travel 720 nautical miles (nm) in seas with significant wave height of less than one foot, at 10 knots with a ten percent (10%) fuel reserve.

070.2.3.3 Endurance: The boat will be capable of conducting unreplenished icebreaking for at least three days to include: fuel, potable water, waste water, food, and solid waste.

070.2.4 **Seakeeping, Dynamic Stability and Maneuverability**

070.2.4.1 At speeds and loading conditions in significant wave height of one foot, the vessel shall be able to maintain a straight course ahead.

070.2.4.2 The vessel, while using no more than 1/3 of the engine's available power, shall be capable of maneuvering astern in a straight course and perform backing turns.

070.2.4.3 The vessel will be capable of surviving in seas with a significant wave height of six feet, while outfitted for Full Load ATON.

070.2.4.4 The vessel will be capable of transiting in seas with a significant wave height of three feet, while outfitted for Full Load ATON.

070.2.4.5 The vessel will be capable of anchoring in 40 knot winds, in a depth of water that is at least five times its draft.

070.2.4.6 The vessel will enable the operator to maintain station, utilizing propulsion and steering, for the purpose of servicing floating ATON, in seas with a significant wave height of three feet.

070.2.4.7 The vessel will be capable of completing a 180 degree turn in waterways as narrow as 140 feet without using ground tackle.

070.2.5 **Service Life and Annual Hours of Operation**

070.2.5.1 The vessel shall be designed to operate at a planned 700 hours per year.

070.2.5.2 The vessel shall be designed for a minimum service life of 30 years.

070.2.6 **Accommodations**

070.2.6.1 Accommodation shall be provided as shown in the contract drawings.

070.2.7 **Mission Profiles**

070.2.7.1 Individual sorties may have considerably different percentages depending on the mission conducted, per Table 070-1.

Table 070-1: Mission Profile

Percentage of Mission Speed Condition	
33%	Transit
17%	Icebreaking Full Power
17%	Icebreaking Half Power
33%	Anchored

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070.2.8 **Towing**

070.2.8.1 The vessel shall be capable of towing a vessel of at least equivalent displacement astern, while outfitted for Full Load ATON.

070.2.8.2 The vessel shall be capable of being towed by another vessel while outfitted for Full Load ATON.

070.2.9 **Ice Breaking**

070.2.9.1 In level ice with a flexural strength of 110 lb/in^2, the HSC-L will be capable of:

070.2.9.1.1 Breaking ice of 12 inches thickness at a continuous speed of 3 knots ahead.

070.2.9.1.2 Turning 180 degrees in level ice of eight inches thickness by conducting a star maneuver.

070.3 LOADING CONDITIONS

070.3.1 DEFINTIONS: Loading condition definitions shall be in accordance with the Society of Allied Weight Engineers Recommended Practice No. 12C, modified as follows:

070.3.1.1 "Full Load ATON Condition" (or "Maximum Operating Condition"): The vessel is complete and ready for service in every respect equivalent to a departure condition for ATON work. Including: light ship condition, plus full fuel, fresh water, lube oil, crew and effects, stores and maximum ATON cargo load (16,340 lbs), including two 5x11 buoys, sinkers and associated equipment. (SAWE Condition A).

070.3.1.2 "Full Load Icebreaking Condition": The vessel is complete and ready for service in every respect, equivalent to a departure condition for icebreaking work. It is light ship condition, plus full fuel, fresh water, lube oil, crew and effects, stores, with Zero ATON load or ballast.

070.3.1.3 "Minimum Operating Condition" (Min Op): The vessel is complete and ready for service in every respect with the assumed loading that may occur at the end of normal operations and arrival back to port. It is light ship condition, plus 10% fuel, 10% fresh water with the 90% weight of water moved to the black/grey water tank location, lube oil, crew and effects, and no ATON load or associated equipment. (SAWE Condition F)

070.3.1.4 "Full Load End of Service Life (EOSL) Condition": shall include the full load condition (SAWE Condition A) plus service life weight and KG allowances.

070.3.1.5 "Minimum Operating EOSL Condition": shall include the Min Op condition (SAWE Condition F) plus service life weight and KG allowances.

070.3.2 Loading Condition Limits:

070.3.2.1 Absolute trim limits shall be no more than 0.5 ft down by the bow and 1.0 ft down by the stern in any operating condition.

070.3.2.2 Absolute list limits shall be no more than 1/2-degree port and 1/2-degree starboard for any loading condition. ATON loads shall be assumed to have net zero transverse center of gravity and shall not be shifted to correct lightship list angle.

070.4 OPERATING ENVIRONMENT

070.4.1 The vessel shall be capable of operating in fog, heavy snow, heavy rain, and topside icing conditions.

070.4.2 The vessel's equipment and systems shall be designed to operate without degradation for the following temperatures:

070.4.2.1 Minimum Ambient Air Temperature of –20°F dry bulb

070.4.2.2 Maximum Ambient Air Temperature of 95°F, dry bulb

070.4.2.3 Ambient seawater temperature between 28°F and 85°F, wet bulb

070.4.2.4 Ambient freshwater temperature between 32°F and 85°F, wet bulb

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070.4.2.5 Equipment and machinery shall operate with dynamic roll of as much as 22.5° and dynamic pitch of as much as 10° (both single amplitude)

070.4.2.6 Equipment and machinery in exposed locations shall not be installed in areas where it would operate outside its specified limits

070.4.3 The following values shall be used for design of the vessel, per Table 070-2:

Table 070-2: Design Accelerations

Location	Height (m, ABL)	Design Lateral Acceleration (g)	Design Vertical Acceleration (g)	Design Longitudinal Acceleration (g)
Hull and Buoy Deck	1.3-1.8 m	0.4	1.9 (down), 0.1 (up)	0.2
Pilot House	2.7m	0.2	2.0 (down), 1.0 (up)	0.15
Mast/ Pilot House Top	9.4m	1.5	1.4 (down), 0.6 (up)	0.35

070.5 WORKMANSHIP

070.5.1 All cuts shall be neatly and accurately made with edges cleaned for welding.

070.5.2 All sharp edges exposed to personnel or equipment shall be dressed or ground to avoid injury to operating or maintenance personnel or damage to equipment.

070.5.2.1 Internal corners shall be filleted and external corners shall be rounded off.

070.5.2.2 Ragged edges or sharp projections which are hazardous to operating personnel, or detract from the finished appearance shall be removed.

070.5.3 All finished welds are to be uniform and free from defects such as slag inclusions, porosity, incomplete penetration or undercutting.

070.6 LIFTING POINTS AND EQUIPMENT REMOVAL

070.6.1 Padeyes of rated capacity shall be installed to permit removal of machinery components from the vessel.

070.6.2 Lifting points shall be fitted so that parts may be lifted and moved with the minimum disconnection of piping, cables, ventilation ducts, and other installed equipment.

070.7 SPECIAL TOOLS

070.7.1 Special tools necessary for maintenance shall be provided.

SECTION 071 ACCESS

071.1 GENERAL

071.1.1 The design and arrangement of the vessel shall, under operational conditions, provide for safe and convenient access to all spaces, and for safe and convenient service, maintenance, and operation of controls, systems, machinery, and components. Access shall be provided to pockets, through swash bulkheads and non-tight structures within tanks and elsewhere to permit inspection, care and preservation of the structure.

071.1.2 Primary and secondary egress routes from spaces with fixed fire suppression systems shall be equipped with access that opens outward.

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071.1.3 Unless otherwise specified clear headroom shall not be less than 6 feet 6 inches. Machinery, piping, lighting fixtures, wireways, ducts, operating rods, brackets, tracks and other items shall be kept clear of normal routes of access. For exceptions, which shall be subject to approval, suitable guards or padding shall be installed.

071.1.4 Ingress and egress of internal spaces shall be free of trip or snag hazards that may impede the safe evacuation of the space.

071.1.5 The vessel shall have access to support routine maintenance and inspections.

071.1.5.1 Access shall be arranged to be clear of piping, wire ways, ducts, and other obstructions.

071.1.5.2 Equipment accessed for routine maintenance completed daily or underway, such as dipsticks and strainers, shall be located so they are readily accessible.

071.1.5.3 Equipment shall be arranged so that each component shall be accessible and removable independent of another component.

071.1.5.4 Access shall allow compartment inspection while underway without the use of tools.

071.1.6 Access shall be provided to allow any diesel engine to be moved to a location for removal by vertical lift without:

071.1.6.1 Disassembly of the engine, except engine-driven accessories;

071.1.6.2 Removal or disassembly of other major equipment; and

071.1.6.3 Cutting of shell structure.

071.1.7 Access shall be provided to bilge areas. Bilge access points shall provide access to the lowest point of the bilge to ensure it can be reached for maintenance, checked for water content, completely dewatered, and wiped clean of any residue.

071.1.8 Access to fuel tanks, fuel hoses, and fittings shall be provided for repair and maintenance without removing any permanent structural component.

071.1.9 Access shall be provided to tanks, cofferdam, and voids (not including Skeg), through watertight closures and fasteners that can be opened and re-secured with non-
powered hand tools. Such openings shall be sized and placed to allow visual inspection of the interior of the space.

071.1.10 The diesel engines shall be arranged such that the maintenance access needed to perform required annual (or more frequent) routine service is present without removing the engines or removing or disassembling any other equipment, machinery, or structure.

071.2 CONSOLE DESIGN

071.2.1 Console design shall provide for replacement of components to mitigate impacts of expected obsolescence, particularly of electronics. This may include incorporation of features such as hinged or bolted console faceplates, equipment racks, or bolt-on sub-assemblies

071.2.2 Equipment within the console shall be arranged so any equipment can be removed without removing any other equipment.

SECTION 073 NOISE, VIBRATION AND RESILIENT MOUNTS

073.1 DEFINITIONS

073.1.1 “A-Weighted Sound Level (dB(A))”: The frequency weighted sound pressure level obtained with the sound level meter set to A-weighting.

073.1.2 “Hazardous Noise”: Hazardous noise is any sound that exceeds 84 dB(A).

073.1.3 “Speech Interference Level (SIL)”: Speech Interference Level is the arithmetic average of the sound levels measured in the 500, 1000, and 2000 Hz octave band center frequencies.

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073.1.4 "Transit": The propulsion plant maintaining sustained speed, normal ship service equipment and lighting, HVAC fans at maximum setting, buoy handling machinery secured, steering equipment in operation.

073.1.5 "ATON": The propulsion plant idling, normal ship service equipment and lighting operational, HVAC fans at maximum setting, buoy handling machinery in operation, steering and bow thruster equipment in operation.

073.2 AIRBORNE NOISE

073.2.1 Steady state airborne noise acceptance levels for each category of spaces are as shown in Table 073-1. Airborne noise category assignments for spaces are specified in Table 073-2. Spaces not listed in Table 073-2 shall have the same airborne noise category as a listed space that supports similar functions.

073.2.2 Acceptance levels shall not be exceeded at any measurement location with machinery and equipment operating simultaneously.

073.2.3 Transit and ATON operating conditions shall be assessed separately.

073.2.4 Compartments and deck areas with hazardous noise levels (i.e., any area 84 dB(A) or above) shall have a warning sign at each entrance indicating the presence of a noise hazard with indication of the appropriate hearing protection required in accordance with ASTM F1166.

073.2.5 Areas that exceed 96 dB(A) shall be labeled "DANGER, NOISE HAZARD AREA – DOUBLE HEARING PROTECTION MUST BE WORN" at each entrance. Labeling shall comply with ASTM F1166.

073.2.6 Airborne sound insulation properties for acoustic insulation within the accommodation area shall be in accordance with ABS Guide for Crew Habitability on Workboats, Section 5.2.

Table 073-1: Maximum Steady State Airborne Noise Acceptance Levels for Boat Spaces (dB)

Airborne Noise Category	Octave Band Center Frequencies (Hz) (Note 1)								
	32	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
A-12	77	71	65	62	(SIL LEVEL 54)			53	52
B	87	81	75	72	69	66	65	63	62
D	99	94	89	84	79	79	79	79	79
F	110	105	100	95	(SIL LEVEL 65)			80	80
G (Notes 2-4)	115dB(A)								

NOTES:

(1) A 2 dB excess is allowed in any one octave band except where SIL levels apply. A-weighted noise level measurements are measured for information only.
(2) Noise limit applies underway.
(3) Double hearing protection required in spaces that exceed 96 dB(A).
(4) Maximum allowable dockside noise level in Category G spaces, with diesel engines, propulsion system, and thrusters secured is 84 dB(A).

Table 073-2 Typical Airborne Noise Categories for Boat Spaces and Topside Location

Category	Compartment
A-12	Pilothouse
B	Crew Berthing
	Water closet
	Water closet and shower

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D	Galley Space (Note 1)
	Passageways
	Workshop (Note 1)
F	Buoy Deck, Working Deck (Note 2)
G	Main Machinery Room, Auxiliary Machinery Room.

NOTES:
(1) Measured when installed equipment is in operation.
(2) Measured under conditions that are representative of the mission performed at that location.

073.3 MECHANICAL VIBRATION

073.3.1 The propulsion system vibration acceptability levels for torsional and lateral vibration of conventional shaft line systems shall be in accordance with the following:

073.3.1.1 The lateral natural frequencies of the propeller-shafting system shall be at least 115% of the design shaft rotational frequency.

073.3.1.2 The requirements of ANSI S2.27 Annex A for hard turns to port and starboard at sustained speed shall apply

073.3.1.3 Torsional stress limits for diesel engine crankshafts shall be determined in accordance with ABS Marine Vessel Rules.

073.4 HULL STRUCTURAL AND MAST VIBRATION

073.4.1 The vessel and all vessel components, including outfit items, shall be free of vibration that could damage the vessel structure, machinery, or systems; endanger vessel personnel; or interfere with operation or maintenance of vessel machinery and systems. No structural component or equipment shall exhibit a natural frequency between 70 and 140 percent of driving vibrations of the propulsion system and genset including, but not limited to, engine firing rate or propeller blade rate.

073.4.2 Vibrations outside the limits allowed in this section resulting from the excitation of a resonant frequency local to any equipment and machinery by the propeller or other exciting force shall be corrected by local stiffening of structure, installation of suitable mountings, modification of components, or other effective means.

073.4.3 Mast Vibration

073.4.3.1 Masts shall be free of global or local resonances that would be excited during normal operations.

073.4.3.2 As a minimum, the following resonance avoidance bands shall be used as mast vibration design criteria:

073.4.3.2.1 A frequency band defined by the propeller blade rate up to 115% maximum shaft rpm

073.4.3.2.2 For rigidly mounted variable speed engines, a frequency band defined by the largest diesel engine first and second order excitation frequency from 85% engine idle speed to 115% rated engine speed.

073.4.3.3 Mast vibration shall not exceed a broadband RMS velocity of 0.6 in/sec.

SECTION 074 WELDING AND FABRICATION

074.1 GENERAL

074.1.1 Workmanship and quality of construction shall meet the limits as outlined in IACS Recommendation No. 47 Shipbuilding and Repair Quality Standard.

074.1.2 Welds in structures attached to side shell, such as transverse bulkheads, decks, frames, web frames and side shell stringers, shall be of double continuous welds.

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074.1.3 Welding, brazing, and soldering shall be performed by certified personnel using approved procedures.

074.1.4 Gas Metal Arc Welding (GMAW) that applies short circuiting arc transfer technique shall not be used unless the process and application are specifically approved by the USCG.

074.1.5 Low hydrogen electrodes shall be used for shielded metal arc welding (SMAW).

074.2 WATER AND OIL STOPS

074.2.1 Water and oil stops shall be welded type and shall be used for all tight structures to prevent fluids and gases from travelling along faying surfaces of plate and stiffeners.

074.2.2 Snipes/holes shall be provided on both sides of tight boundaries approximately 6 inches from intersections but shall not be located directly under a structural supporting member.

074.2.3 Snipe/holes of limited height and length with restricted welding access shall have single V-groove welds.

074.2.4 The height of snipe/holes shall be no less than 3/16 inch.

074.3 NON-DESTRUCTIVE EVALUATION

074.3.1 Non-destructive evaluation shall be performed by certified inspectors using approved procedures

074.3.1.1 Visual testing (VT) shall be performed on 100% of welds including the root side wherever possible.

074.3.1.2 Dye penetrant testing (PT) or magnetic particle testing (MT) shall be performed on 100% of shell and deck plating butt welds, and 50% of all shell and deck plating longitudinal seam welds.

074.3.1.3 Radiologic testing (RT) or ultrasonic testing (UT) shall be performed on 100% of butt welds in sheer strakes, bilge strakes, keel strake, and deck stringer strakes within +/- 20 feet of amidships.

074.3.1.4 Radiologic testing (RT) or ultrasonic testing (UT) shall be performed on 100% of vertical keel web and flange and 10% of bottom and deck girder webs and flanges within +/- 20 feet of amidships.

074.3.1.5 Radiographic testing (RT) or ultrasonic testing (UT) shall be performed on pipe butt weld joints as shown in Table 074-1. ABS MVR 4-6-1/5 Table 1 shall be used to determine pipe class.

074.3.1.6 Dye penetrant testing (PT) or magnetic particle testing (MT) shall be performed on 100% of fillets welds on class I pipe.

Table 074-1 Extent of Pipe Examination

Pipe Class	Nominal size, D wall thickness, t	Extent
I	D > 2.5 in (65 mm) t > 3/8 in (9.5 mm)	100%
II	D > 3.5 in (90 mm)	10%
III	All	None

SECTION 075 MECHANICAL FASTENERS

075.1 GENERAL

075.1.1 Mechanical fasteners shall be made of 316 series stainless.

075.1.2 Exhaust fasteners shall be ASTM A193 Gr B16 (bolts) and ASTM A194 Gr B7 (nuts).

075.1.3 Where fitted bolts for machinery foundations, couplings, etc. must be stronger than 316 series stainless steel, 4140 meeting the material, processing, and mechanical requirements of ASTM A193 Gr B7 may be used.

075.1.4 In the absence of manufacturer or vendor requirements, SAE J2270 and SAE J2280 ASME B31.1, and ASME Boiler and Pressure vessel code as applicable, shall be used for selection, inspection, test, and installation for fasteners.

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075.1.5 SAE J429 Grade 8, AISI grade 4340, ASTM A574 alloy steel fasteners, and other high strength fasteners over 34 HRC (Rockwell Hardness C) shall not be zinc coated since this coating can cause hydrogen embrittlement.

075.1.6 Cadmium plated fasteners of any type shall not be used.

075.1.7 K-Monel (Alloy UNS N05500) shall not be used in seawater in applications where it will be in contact with alloy 625 (Alloy UNS N06625) because this couple is susceptible to galvanic corrosion.

075.1.8 Where nuts will become inaccessible after assembly, nuts shall be installed and secured in a manner that allows re-assembly and prevents loosening of fasteners due to shock and vibration.

075.1.9 Contractor supplied nuts shall be self-locking and of the plastic insert type or all-metal-locking nuts of the distorted type to prevent loosening of fasteners due to shock and vibration, except for blind applications. Plastic insert type nuts shall not be used in high temperature applications. Alternate locking methods such as a double nut or mechanical locking device may be substituted. Locking methods shall prevent unacceptable losses in preload for the designed life of the application. Any maintenance required to maintain appropriate fastener preloads must be specified.

075.1.9.1 Through bolts used in propulsion machinery foundations and shaft couplings shall utilize a double nut installed with the thin (jam) nut on the inside of a full-size nut. Alternately these fasteners shall be positively retained using locking tabs or by drilling and pinning. Joints shall not be slip-critical; fasteners loaded in shear or for alignment of equipment or shaft flange centering shall be fitted.

075.1.10 Contractor installed mechanical fasteners with nuts shall extend past the nut by one thread at a minimum but no more than one diameter of the fastener. Antisieze or a suitable thread lubricant as specified by the equipment OEM shall be used on all fasteners except those that are required to use a thread locking compound.

075.1.11 Mechanical fasteners in working deck traffic areas shall be flush or countersunk to eliminate tripping hazards.

075.1.12 Welding or similar thermal processes shall not be performed within 12 inches of fasteners which are heat treated.

075.1.13 Rivets shall be limited to when part of OEM supplied equipment.

SECTION 076 RELIABILITY, MAINTAINABILITY AND AVAILABILITY (RM&A)

076.1 GENERAL

076.1.1 The Contractor shall select and install commercial systems and equipment having reliable service life histories and meeting industry standards recognized by the Regulatory Bodies for the vessel.

076.1.2 In the absence of definitive Regulatory Body requirements, systems and equipment that have single points of failure that degrade the performance of organic mission and safety critical systems shall be provided with compensating features and increased design margins.

076.1.2.1 Single failure point is defined as the failure of an item, which would result in failure of the system and is not compensated for by redundancy or alternative operational procedure.

076.1.2.2 The single failure definition does not apply to the failure of fixed piping, manually operated valves, and duplex strainers.

076.1.3 Material, furnishings and equipment shall be selected by the following criteria where equipment installations are not specified herein:

076.1.3.1 Space functionality

076.1.3.2 Ability to withstand marine environment

076.1.3.3 Safety

076.1.3.4 Durability/reliability

076.1.3.5 Maintainability.

076.1.4 Equipment selection should consider existing availability within the Federal Government logistics support infrastructure such as the USCG, Defense Logistics Agency and Navy Supply System.

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076.1.5 At the time of vessel delivery, all equipment and IT hardware, aside from those elements specified herein, shall have at least 5 years remaining before the Original Equipment Manufacturer's (OEM) end of support date including application software and embedded software within systems and operating systems.

SECTION 077 SYSTEM SAFETY

077.1 GENERAL SYSTEM SAFETY REQUIREMENTS

077.1.1 The vessel shall be designed to protect personnel from hazardous non-ionizing radiation, per IEEE Std C95.1.

077.1.2 Risk mitigation features to avoid personnel injury, platform damage, and equipment damage during equipment handling, transportation, maintenance and testing operations shall be incorporated in accordance with the system safety design order of precedence identified in MIL-STD 882.

077.2 HARDWARE SAFETY REQUIREMENTS

077.2.1 Systems installed on the vessel shall have positive interlocks or controls to prevent accidental energizing.

077.2.2 Equipment shall include provisions to prevent accidentally pulling out of drawers or rack-mounted equipment components.

077.3 SOFTWARE SYSTEM SAFETY REQUIREMENTS

077.3.1 General Requirements

077.3.1.1 Software developed, modified, or reengineered by the Contractor shall:

077.3.1.1.1 Contain only instruction sequences that are intended to be executed during normal or exception handling process.

077.3.1.1.2 Prevent data from being written in read-only memory spaces.

077.3.1.1.3 Have only one possible path leading to the execution of Safety-Critical Computing System Functions. Safety-Critical Computing System Functions are any computer, electronic or electromechanical system to which failure may cause injury, death, or catastrophic or critical property damage.

077.3.1.2 The Contractor may use the Department of Defense Joint Software Systems Safety Handbook for guidance.

077.3.2 System Design Requirements

077.3.2.1 Software developed, modified or reengineered by the Contractor shall be designed to ensure that safety-critical functions are not degraded under peak load conditions.

077.3.2.2 Vessel software computer systems that provide Safety-Critical functions shall be configured with safeguards and interlocks to prevent inadvertent activation. The interlocks shall be overridden only with manual intervention.

077.3.3 Safe State Design Requirements

077.3.3.1 Software developed, modified or reengineered by the Contractor shall:

077.3.3.1.1 Revert Safety-Critical software to a safe state when the associated safety critical function is terminated.

077.3.3.1.2 Upon integrity verification failure, revert safety-critical function software to a safe state.

077.3.3.1.3 Have at least one safe state identified for each logistic and operation phase.

077.3.3.1.4 Detect failures in associated hardware devices and revert to a safe state as appropriate.

077.3.3.1.5 Return the system to a known safe state upon detection of a failure of the safety kernel (when implemented).

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077.3.3.1.6 Perform a test during the initialization state that verifies that the system is in a safe state.

077.3.3.1.7 Perform graceful transition to a safe state.

077.3.3.2 Software shall power-up in a safe state.

077.3.4 Safety-Critical Function and Data Requirements

077.3.4.1 Software developed, modified, or reengineered by the Contractor shall:

077.3.4.1.1 Provide safeguards to protect safety-critical operational media, memory, data, and safety functioning from being modified by an unauthorized operator or program.

077.3.4.1.2 Prevent self-modification of operational code.

077.3.4.2 Any independent safety monitoring program shall:

077.3.4.2.1 Only be directed, delayed or inhibited by an authorized operator.

077.3.4.2.2 Reside in memory to prevent being overwritten by the computing system.

077.3.5 User Interface Requirements

077.3.5.1 Software developed, modified, or reengineered by the Contractor shall:

077.3.5.1.1 Indicate to the operator the occurrence, resulting system configuration, and status for any exception that terminates an operational sequence that contains a safety critical function.

077.3.5.1.2 Allow an authorized operator to cancel current processing with a single action. The action may consist of pressing two keys, buttons, or switches at the same time.

077.3.5.1.3 Provide safety-critical operator displays, legends and other interface functions which are clear, concise and unambiguous and, where possible, be duplicated using separate display devices.

077.3.5.1.4 Require two or more unique operator actions, in the proper sequence, to initiate any safety-critical function or sequence of functions.

077.3.5.2 Software shall continue to display an unsafe situation alert until required actions are completed.

077.3.5.3 Software shall provide safety-critical alerts which are readily distinguished from routine alerts.

077.3.5.4 Software shall, upon detection of an erroneous entry or operation, provide an operator alert which indicates the error and corrective action.

077.3.6 Interface Design Requirements

077.3.6.1 Each safety-critical signal shall have its own unique source or message.

077.3.6.2 Software developed, modified, or reengineered by the Contractor shall:

077.3.6.2.1 Ensure the validity of the safety-critical data prior to use.

077.3.6.2.2 Provide a method of checking the integrity in each message, including an indication of message length.

SECTION 078 MATERIALS

078.1 GENERAL

078.1.1 All structural steel shall be in accordance with ABS Marine Vessel Rules (MVR), with guidance from Part 6 -1-4 Strengthening for Navigation in Ice, First Year Ice Class IC .

078.2 MISCELLANEOUS REQUIREMENTS

078.2.1 Unless otherwise specified, the term “stainless steel” or Corrosion Resistant Steel (CRES) shall be Type 316 or 316L.

078.2.2 Wood in any form shall not be used.

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078.2.3 Materials that contain asbestos and refractory fiber materials (also termed ceramic fiber and aluminum-silica material) shall not be used.

078.2.4 For chemicals listed in NAVSEA Hazardous Material Avoidance Process, T9070-AL-DPC-020/077-2 (provided as GFI):

078.2.4.1 The prohibited chemicals listed in Appendix A, Table A-1, shall not be used.

078.2.4.2 Restricted chemicals listed in Appendix A, Table A-2, shall be documented to identify quantity, application, and location used.

078.2.4.3 Restricted chemicals listed in Appendix A, A.2 "NAVSEA LIST OF TARGETED CHEMICALS (N-LTC) APPLICATION EXCEPTION NOTES" do not need to be documented.

078.2.5 Bedding compounds such as polysulfide and polyurethane sealants may be used. Where waterproof adhesive bonds are required, a polyurethane compound shall be used.

078.2.6 Chlorinated polymers (e.g., PVC, CPVC) shall not be used, with the exception of internal OEM equipment components.

078.3 ELECTROLYTICALLY DISSIMILAR METALS AND CORROSION PROTECTION

078.3.1 Direct contact of electrolytically dissimilar metals is prohibited. Electrolytic corrosion shall be prevented by insulating dissimilar materials from each other.

078.3.2 Equipment containing mercury shall not be installed on the vessel.

SECTION 079 STABILITY AND BUOYANCY

079.1 DEFINITIONS

079.1.1 Design Waterline (DWL). The projected waterline (draft) of the ship when loaded to its designed capacity at end of service life, typically the Full Load condition.

079.1.2 Forward Perpendicular (FP). The longitudinal reference point located at the intersection of the design waterline with the stem. The FP location shall be agreed upon in preliminary design and not varied regularly.

079.1.3 Aft Perpendicular (AP). The longitudinal reference point located at the rudder stock. The AP location shall be agreed upon in preliminary design and not varied regularly.

079.1.4 Virtual KG (KGv). The KGv is the load condition's vertical center of gravity (KG) plus the virtual rise in KG due to maximum free surface effects of liquids plus the inclining experiment tolerance.

079.2 GENERAL

079.2.1 The vessel shall be in accordance with the Procedures Manual for Stability Analysis of U.S. Navy Small Craft, NSCSES 6660-99, except as modified by this section.

079.2.2 The skegs shall be considered buoyant.

079.2.3 The vessel shall be designed and constructed to withstand the following hazards:

079.2.3.1 60 knot beam winds, with a 25 degree roll back angle in the intact condition.

079.2.3.2 48 knot beam winds combined with rolling, and the required amount of topside icing.

079.2.4 Topside Icing weight and center of gravity shall be calculated as follows:

079.2.4.1 The ice density shall be 56.20 lb/ft3.

079.2.4.2 3" of ice on surfaces forward of the pilothouse (including the forward face of the house).

079.2.4.3 1.5" of ice on surfaces aft of the forward face of the house.

079.2.5 Lifting heavy weights over the side with the maximum lifting moment of the crane.

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079.2.5.1 Righting arm A1 Area for lifting of heavy weights shall be limited by angle of unrestricted downflooding or angle at which 12 inches of available freeboard is not submerged.

079.2.6 Towing another vessel astern.

079.2.6.1 Towing heeling arms shall be calculated with the heeling arm equation of 46 CFR 173.095.

079.2.6.2 Towing Heeling arms curves shall be evaluated against the righting arm curve of the vessel using the same criteria for high-speed turning.

079.2.7 Flooding of any single subdivision below main deck.

079.2.7.1 Lesser extents of asymmetric tank damage shall also be considered.

079.3 DETAIL REQUIREMENTS

079.3.1 The vessel, at delivery and at the end of service life, including service life weight and KG allowances, shall satisfy the intact and damage stability criteria for the operating trim range for every operating condition between and including the Full Load ATON and Minimum Operating Condition.

SECTION 088 HUMAN SYSTEMS INTEGRATION

088.1 GENERAL

088.1.1 The system design shall reflect Human Systems Integration processes that ensures the effective utilization of manpower, minimizes life cycle costs, supports effective training, and can be operated, maintained, and supported within the crew's physical capabilities and skill sets in accordance with ASTM F1337.

088.2 HUMAN FACTORS ENGINEERING

088.2.1 Human Engineering design criteria for the vessel, systems, subsystems and equipment used in operations and for maintenance shall be in accordance with ASTM F1166, unless otherwise specified.

088.2.2 The vessel shall be designed to accommodate 5th percentile female to 95th percentile male in accordance with the North America anthropometric data sets in ASTM F1166 for operational, maintenance, and damage control tasks while wearing personal protective equipment (PPE) and arctic/ cold weather clothing and using the required tools.

088.2.3 Controls and displays shall be placed such that the crew can perform the mission essential tasks during operating conditions requiring seated and/or standing positions, where applicable (ex. coxswain, crane operator, etc.).

088.2.4 Ladders, Stair Ladders, and Stairs shall be in accordance with MIL-STD-1472 Section 5.11.8.

088.2.5 Visibility from helm locations shall be in accordance with ABYC H-1, Field of Vision from the Helm Position with the following modification:

088.2.5.1 A properly seated crewmember in the helmsman position shall not have a blind spot greater than one vessel length from the Pilot house over the bow while the vessel is at rest in calm water at Minimum Operating Condition.

088.3 WORKFORCE AND PERSONNEL

088.3.1 The vessel missions shall be capable of being performed by no more than 6 crew.

088.3.2 Bridge watch-station tasks shall be capable of being performed by one person for open water transit (i.e., coxswain/helm tasks) and 2 persons for ATON operations (i.e., coxswain/helm tasks and crane operator tasks).

SECTION 096 MASS PROPERTIES

096.1 GENERAL

096.1.1 Definitions shall be in accordance with the Society of Allied Weight Engineers Recommended Practice No. 12C modified as follows: .

096.1.1.1 "Transverse lever": Transverse levers to starboard are positive in sign convention.

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096.2 WEIGHT AND STABILITY LIMITS

096.2.1 The displacement of Full Load ATON Condition at delivery shall not exceed the Full Load Condition displacement at delivery of the Allocated Baseline Weight Estimate adjusted by the values agreed upon for Contract Modifications and changes to Government Furnished Material.

096.2.2 The KGv of Full Load Condition at delivery, including free surface corrections and a 0.20-foot margin for the stability test margin, shall not exceed the Full Load Condition KGv at delivery of the Allocated Baseline Weight Estimate adjusted by the values agreed upon for Contract Modifications and changes to Government Furnished Material.

096.3 MARGINS

096.3.1 Weight and KG margins shall be applied to lightship condition, per Table 096-1:

Table 096-1: Weight and KG Margins

Margin Name	Weight	KG	Notes
Contract Modification (CM)	.7%	.5%	Government Controlled Margin
Government Furnished Material (GFM)	0.3%	0.2%	Government Controlled Margin
Service Life Allowance (SLA)	7.5%	5.0%	Government Controlled Weight Allowance

096.3.2 Weight margins shall only be applied at the vessel LCG, so as not to affect trim, and on centerline (TCG=0). Weight shall start at vessel vertical center of gravity and raised vertically to provide the moment required for the required KG Margin.

096.3.3 Margins shall only be depleted to compensate for an increase in the Light Ship weight or increase to the variable loads. Conversely, a decrease in the Light Ship weight or variable load shall result in a corresponding increase in the appropriate margin account.

096.3.4 Government controlled margins, CM, GFM, and the service life allowance, shall be carried through to delivery and shall only be consumed at the direction of the Contracting Officer.

096.3.5 Design and Building margin will be contractor managed.

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SECTION 100 GENERAL REQUIREMENTS FOR HULL STRUCTURE

100.1 GENERAL

100.1.1 This section addresses requirements for hull structure including loading conditions, permissible stresses, definition of the hull girder structure, hull structural material, openings, fairness and smoothness.

100.1.2 The structure is defined as the hull bottom, sides, deck, and deckhouse including longitudinal stiffeners, keelsons, girders, foundations, transverse frames, stringers, bulkheads, and hull appendages.

100.1.3 The hull, mast, and deckhouse shall be welded steel construction.

100.1.4 There shall be no "hard spots" or sharp-cornered notches. Cuts, and inserts in primary structure shall have radiused corners. Concentrated loads shall be dispersed by means of inserts, brackets, and gussets.

100.2 MAIN REQUIREMENTS

100.1.1 The structure design shall be as shown on contract drawings.

100.1.2 The structure has been designed to ABS MVR Part 6-1-4, Structural Requirements for First Year Ice Class. The vessel shall be built to Ice Class IC.

100.1.3 Where ABS MVR Part 6-1-4 is silent, the structure shall be designed and built in accordance with ABS MVR Part 3.

100.1.4 Structures not covered by ABS MVR or herein shall be designed such that allowable stresses are not exceeded, and there is no failure from elastic stability. The nominal allowable tensile strength, Fb, shall be 80% of the material yield strength (FS=1.25) when using combined static and dynamic loadings. Fb shall be 60% of yield (FS=1.67) when using static loadings. For materials whose yield strength is lowered by hot work, the as-welded yield shall be considered. Loads shall be combined as appropriate to represent worst case loading conditions shall include sea-state accelerations, docking, towing, side impact loads (fendering), dry docking, heavy seas and other operational loads. Design accelerations are provided in Table 070-2.

100.1.4.1 Shear stresses: Where there is no danger of failure from instability, allowable limits for shear stresses shall be 53 % of the material yield strength (FS=1.88) when using combined static and dynamic loadings. Shear stress shall be 40% of yield (FS=2.50) when using static loadings.

100.1.5 Design Loads on Exposed Structures shall include:

100.1.5.1 Wind loads shall be 30 lbs. per square foot.

100.1.5.2 Ice loads shall be 7.5 lbs. per square foot.

100.1.6 Girders shall be continuous through transverse structures.

100.1.7 Interference of plating butts and seams with longitudinal stiffeners, bulkheads, decks and structural members and fastenings that attach to shell plating shall be avoided.

100.1.7.1 Butts shall be at least 3 inches, but no more than 12 inches from transverse structure.

100.1.7.2 Seams shall be at least 3 inches from longitudinal elements of the structure.

100.1.7.3 Full penetration welds shall be provided for butts and seams of the keel, bottom shell, side shell, working deck, and transom. Welded joints in the keel, keelsons, girders, engine foundations, and bottom longitudinal(s) shall be full penetration welds at the webs as well as the flanges.

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100.1.7.4 Flanged Plate sections are prohibited.

100.1.8 Lapped brackets and connections, except lapped collars, are prohibited in primary longitudinal and transverse structure.

100.1.9 Structural details shall be designed to maintain continuity and minimize stress concentrations. Abrupt changes in section shall be avoided.

100.1.10 Thickness differences between connecting plates of more than 1/8 inch shall be tapered at a slope of 4 to 1.

100.1.11 Plate inserts shall have corner radii no less than one tenth the minimum dimension of the insert but need not exceed 12 inches.

100.1.12 An ABS Type Approved, Basic Ice Condition Monitoring System (ILM) that meets the ABS Guides Ice Loads Monitoring Systems (2021) shall be installed.

100.1.13 Openings and Penetrations:

100.1.13.1 Penetrations are defined as holes in a vessel with an area of less than 2 ft^2. Openings are defined as holes in a vessel with an area of greater than 2 ft^2.

100.1.13.2 Structural penetrations details shall be in accordance with NSRP 0490.

100.1.13.3 There shall be no penetrations in stiffener or girder flanges.

SECTION 114 HULL APPENDAGES

114.1 GENERAL

114.1.1 Hull appendages shall be as shown on the drawings.

114.1.1.1 All appendages shall be attached to shell plate using double continuous fillet welds.

114.1.1.2 Where access is not feasible, one side full penetration weld with backing shall be provided.

114.1.2 Rudders shall have ice horns installed to prevent damage to rudders, stocks, seals, and bearings while navigating and backing and ramming in ice.

114.1.3 Fendering System shall be as shown on the drawings.

SECTION 160 SEACHEST

160.1 GENERAL

160.1.1 Sea chests shall be as shown in the drawings.

160.1.2 Plating of any sea chest shall not be less than the adjacent shell plating.

160.1.3 Strainer plates shall be fitted on sea chests.

160.1.4 Sea chests shall be located clear of seams and butts in shell and inner bottom plating, and clear of welded joints wherever practicable.

SECTION 167 HULL STRUCTURAL CLOSURES

167.1 GENERAL

167.1.1 Doors and hatches shall be as shown in the drawings.

167.1.2 Doors and hatches shall be marine grade and have an equivalent strength, tightness, and fire rating as the structure in which they are installed.

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167.1.1 At least one manhole in each tank or void shall be in the highest practicable point in the uppermost level of the tank or void.

167.1.3 Doors, structural and non-structural, shall have hold open fittings and bumpers. Positive latching devices shall be provided for doors that open outward to hold them open.

SECTION 170 MASTS

170.1 GENERAL

170.1.1 Masts and vertical appendages that may be used shall be retractable by 2 crew members in 10 minutes using existing onboard equipment and shall support the following items:

170.1.1.1 Required navigation lights including Restricted Ability to Maneuver (RAM) lights.

170.1.1.2 Day shapes, including RAM shapes,

170.1.1.3 National Ensign (15 in. by 24 in.),

170.1.1.4 USCG ensign (12 in. by 18 in.),

170.1.1.5 Floodlights, as required,

170.1.1.6 Navigation and C4IT systems as specified herein.

170.1.2 The ensigns shall not interfere with any electronics or lights. Fittings and foundations shall be constructed to prevent tearing of ensigns or their rigging.

170.1.3 Masts and vertical appendages shall be weathertight and designed to withstand the loads from ice accretion and wind.

SECTION 180 FOUNDATIONS

180.1 GENERAL

180.1.1 Major equipment such as diesel engines and gears, diesel generator, steering and the crane shall be as shown in contract drawings. Remaining foundations shall be designed for all equipment 100 lbs or more.

180.1.2 Foundations shall withstand design loads and distribute such loads into the structure, while maintaining accurate alignment of the equipment.

180.1.3 Foundation design shall consider the following:

180.1.1.1 Weights and dimensions of machinery and equipment, including liquids at operating levels.

180.1.1.2 Loads resulting from vessel operating motions and attitudes.

180.1.1.3 Vibration of machinery including main engine, drivetrain, and propeller.

180.1.1.4 In exposed locations, loading caused by ice accretion and wind.

180.1.1.5 Drainage or absence of pockets to prevent liquid retention.

180.1.1.6 Clearance for servicing equipment without dismantling other components.

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SECTION 200 GENERAL REQUIREMENTS FOR PROPULSION PLANT

200.1 GENERAL

200.1.1 Rated Power Definition. The Rated Power is the maximum power output at which the engine is designed to run continuously at its rated speed (rpm). The Rated Power shall be adjusted for Ambient Reference Conditions using the methods in ISO Standard 3046-1.

200.1.2 The propulsion system's diesel engines shall be identical to each other, including the direction of rotation, except for placement of controls and external components.

200.1.3 The starboard propeller shall have right-hand rotation and the port propeller left-hand rotation.

200.1.4 Propulsion system components shall be current, in-production models that have been operated by the owner of the vessel after acceptance in commercial marine, naval service, or U.S. Government marine service for at least two years with at least 500 operating hours at a rated power greater or equal to that being offered.

200.1.5 The propulsion system shall be in accordance with ABS MVR Part 4 and Part 6-1-4 Ice Class IC.

200.2 PROPULSION SYSTEM

200.2.1 The arrangement of the propulsion system and components shall be as shown on the contract drawings. The propulsion system consists of two diesel engines coupled to reduction gears. The reduction gears shall drive propellers.

200.2.2 Propulsion systems' and genset(s)' equipment and components shall be designed, tested, and installed in accordance with OEM's requirements and recommendations. Equipment and components shall comply with uses designated by the manufacturers' warranty so as to not void the manufacturers' warranties.

200.3 FAST LUBE OIL CHANGE SYSTEM (FLOCS)

200.3.1 The vessel shall come equipped with Fast Lube Oil Change System (FLOCS) connections for removal of lube oil from the propulsion diesel engines, reduction gears, and gensets.

200.3.2 The FLOCS connections shall consist of a flexible suction hose, not less than ½" inner diameter, Aeroquip 2661-12 or equal, connected to the lube oil sump drain connection(s) and a 3/4-inch male quick disconnect, positive shut-off coupling on the other end of the hose.

200.3.3 The FLOCS suction hoses shall be of sufficient length for the quick disconnect, positive shut-off coupling to extend above the engine compartment cover, and to an area accessible for its use.

200.4 ARRANGEMENT AND INSTALLATION

200.4.1 A lube oil sampling port shall be installed in each propulsion plant component lube oil circulation system with an operating volume greater than five gallons and accessible during operations.

200.4.2 Upon final installation of diesel engine equipment foundation bolts, a suitable torque seal indicator shall be applied to each foundation bolt and nut.

200.5 VIBRATION

200.5.1 The propulsion system and genset(s) shall operate without restriction and shall have no barred speed range(s).

SECTION 202 MACHINERY CONTOLS AND MONITORING

202.1 GENERAL

202.1.1 The Machinery Controls and Monitoring shall meet the requirements in 46 CFR Subchapter F Parts 58, 61 and 62, 46 CFF Subchapter J, and ABS MVR Part 4 Chapter 9 for rules to meet ABCU notation.

202.1.2 The vessel shall not have a computerized central control system for monitoring and control of auxiliary machinery.

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202.1.2.1 Required remote control and monitoring shall be through monitoring devices and controls directly connected to the machinery from the pilothouse.

202.1.3 Propulsion control system shall be provided by either the propulsion diesel engines manufacturer or the propulsion reduction gears manufacturer.

202.2 FAILSAFE

202.1.1 "Failsafe" means that upon failure or malfunction of a component, subsystem, or system, the output automatically reverts to a pre-determined design state of least critical consequence.

202.1.2 All automatic control, remote control, safety control, and alarm systems must be failsafe.

202.1.3 The failsafe state must be evaluated for each subsystem, system, or vessel to determine the least critical consequence.

202.1.4 Where failsafe states differ from these requirements; an equivalent level of safety shall be requested.

202.3 PROPULSION CONTROL LOCATION TRANSFER AND INDEPENDENCE, AND OVERRIDES

202.3.1 The main control station shall be in the engine room. Two secondary stations shall be in the Pilothouse at the forward and aft console.

202.3.2 The main control station shall have the capability to take control from any secondary station at all times and blocking any unauthorized control from any secondary station.

202.3.3 Transfer of control from one station to another shall be possible only with acknowledgment from the receiving station.

202.3.4 Propelling thrust shall not alter significantly when transferring from one location to another.

202.3.5 Pilothouse Control of Propulsion Machinery:

202.3.5.1 Controls for speed and direction of thrust shall be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propulsion machinery.

202.3.5.2 The propulsion machinery is to be provided with an emergency stopping device in the pilothouse and independent from the bridge control system.

202.3.6 Vital systems that are automatically or remotely controlled shall be provided with a safety control system.

202.3.6.1 Safety trip controls must not operate as a result of a failure of the normal electrical power source, unless it is the failsafe state.

202.3.6.2 For automatic starting, the number of consecutive attempts that fail to produce a start should be limited to no less than 8 starts.

202.3.7 Monitoring and Alarms:

202.3.7.1 Manual control locations (remote manual and manual alternate control locations) must be provided with instrumentation necessary for safe operation from that location. Instrumentation typically includes means to monitor the output of the monitored system.

202.3.7.2 Remote instrumentation must have provisions for the installation of instrumentation at the monitored system equipment.

202.3.7.3 Visual status indicators of automatically or remotely controlled vital auxiliaries, power sources, switches, and valves must be provided in the machinery spaces or the cognizant remote-control location.

202.3.7.4 Control system sequential interlocks to show if interlocks are satisfied must have summary indicators in the machinery spaces and at the cognizant control location.

202.3.7.5 Demand instrumentation displays must be clearly readable and immediately available to the operator.

202.3.7.6 Required alarms in high ambient noise areas must be supplemented with rotating beacons or other visual means. Red beacons must be used for general or fire alarm purposes only.

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202.3.7.7 Automatic transfer to required backup or redundant systems or power sources must be alarmed in the machinery spaces

202.3.8 An alarm system is required if instrumentation is not continuously monitored or is inappropriate for detection of failure or unsafe conditions.

202.3.8.1 All alarms must be continuously powered.

202.3.8.2 Alarms must clearly distinguish vital and non-vital machinery alarms from alarms in SPEC 436.

202.3.8.3 Immediate alarm must be provided in the machinery spaces on failure of an automatic control, remote control, or alarm system.

202.3.8.4 Automatic safety trip operation must be alarmed in the machinery spaces and the cognizant remote control locations.

202.3.8.5 Summarized and group alarms shall be sufficiently specific to allow any necessary action to be taken, and have a display at the equipment or an appropriate control location to identify the specific alarm condition or location.

202.3.9 Pilothouse visual alarms and instruments should not interfere with the crew's vision at night. Dimmers must not be capable of totally dimming visual indicators.

SECTION 233 DIESEL ENGINES

233.1 GENERAL

233.1.1 The propulsion diesel engines shall be rated for continuous high-load service associated with full-power icebreaking. The selected engine rating shall permit operation at rated power and speed for 80% or greater of the total operating hours.

233.1.2 Two main diesel engines shall be the CAT C18, 670 BHP at 2,100 RPM, B Rating (Heavy Duty), or equal. Main diesel engines shall be configured from the OEM as follows:

233.1.2.1 Keel Cooled, Separate Circuit

233.1.2.2 SAE 0 Bell Housing / SAE 18 Flywheel

233.1.2.3 Deep Sump Oil Pan (500 Hr)

233.1.2.4 24C DS Starter / Charging Alternator

233.1.2.5 Closed Crankcase Ventilation (CCV)

233.1.2.6 Local Engine Control Panel

233.1.2.7 Duplex Oil Filter

233.1.3 Two diesel generators shall be the CAT 4.4, 65 ekW, or equal. See SPEC 310 for additional generator requirements.

233.1.4 The diesel engines shall be furnished with accessories necessary to meet the requirements of this specification.

233.1.5 Power, torque and RPM of the engine shall not exceed those specified by the OEM for the intended service.

233.1.6 Diesel engines shall meet U.S. EPA Marine Tier 3 Commercial Standards.

233.2 DETAIL REQUIREMENTS

233.2.1 Propulsion diesel engine and generator set diesel engine mounting arrangements shall provide the ability to shim the engine at each support foot.

SECTION 241 PROPULSION REDUCTION GEARS

241.1 GENERAL

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241.1.1 Two propulsion reduction gears shall be the ZF W3350 ratio 3.0:1, or equal. Propulsion reduction gears shall be configured from the OEM with the ability to create right-hand rotation for the starboard propeller and left-hand rotation for the port propeller in ahead propulsion, and opposite rotation in astern propulsion. Marine reduction gears shall be configured from the OEM as follows:

241.1.1.1 SAE 0 Bell Housing

241.1.1.2 Close-coupled connection compatible with the main engine

241.1.1.3 Vertical-offset type

241.1.1.4 Internal Shaft Brake

241.1.2 The gearboxes shall be configured with a trolling clutch, or equivalent feature, to permit low-speed operations, below 5 knots. Repeated cycling of the clutches in and out of gear is not permitted to obtain low speed steady-state operation.

241.1.3 The reduction gear shall prevent freewheeling of the propeller shaft when the reduction gear is in neutral and the vessel is underway or maneuvering.

SECTION 242 MAIN PROPULSION COUPLINGS AND CLUTCHES

242.1 GENERAL

242.1.1 The clutch shall be capable of frequent, consecutive ahead and astern engagements during ATON and icebreaking maneuvers, at idle or low maneuvering speed, without exceeding its allowable operating temperature or degrading clutch performance. The clutch manufacturer shall document the duty cycle and any limitations associated with such operation.

242.2 DESIGN REQUIREMENTS

242.2.1 Flexible couplings shall be used to connect the main engine flywheel to a reduction gear input shaft and designed to accommodate relative motions of the propulsion units. The coupling may be required to be torsionally resilient as determined by vibration analysis. The coupling selected shall be approved by the manufacturers of the engine and the driven machinery.

242.2.2 Between the MDE output shaft and the first reduction gear mesh, the coupling arrangement shall be designed to provide damping of transient torsional loads and to protect the drivetrain from rapid torque reversals associated with icebreaking operations.

242.2.3 A fluid coupling or other slip-capable coupling may be used to permit controlled slip under transient overload conditions without damage to the reduction gear or engine should the propeller become suddenly impeded or arrested by ice.

SECTION 243 MAIN PROPULSION SHAFT

243.1 GENERAL

243.1.1 Propeller shafting shall be solid 5-inch nominal diameter Nitronic 50 / XM-19 type stainless steel, or equal.

243.1.2 Surface finish(es) shall be in accordance with the requirements of ABYC P-6, Propeller Shafting Systems, or the requirements of interfacing component manufacturers (shaft grounding systems, bearings, watertight seals), whichever has the more restrictive requirements.

243.1.3 Propeller shaft Total Indicator Runout (TIR) shall not exceed the following limits:

243.1.4 Tapers, bearing journals, and seal sunning surfaces: 0.005 inch maximum TIR

243.1.5 Shaft body between finished fit areas: 0.015 inch maximum TIR

243.1.6 TIR measurements shall be taken with the shaft supported on two supports only, without intermediate auxiliary supports. Measurements on the shaft body shall be taken every 4 feet.

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243.1.7 Shafts fabricated from stainless steel or corrosion-resistant alloys with a Pitting Resistance Equivalent Number (PREN) less than 28 shall not be left bare in seawater service. Such shafts shall be protected by a continuous reinforced fiberglass wrapping in accordance with the requirements of ABS MVR 4-3-2.

243.1.8 Where a propulsion shaft contains more than one geometric discontinuity within a region less than four shaft diameters, including but not limited to:

243.1.8.1 Shoulders or diameter steps;

243.1.8.2 Keyways, spline roots, or axial slots;

243.1.8.3 Oil holes or radial drilled passageways;

243.1.8.4 Undercuts, shrink-fit seats, or circlip grooves;

243.1.8.5 Stress relief grooves associated with couplings.

243.1.8.6 The combined stress fields shall be evaluated with an FEA under maximum loading conditions to determine local peak stresses and fatigue life.

243.2 INSTALLATION REQUIREMENTS

243.2.1 The shafting system shall be aligned to within the limits set forth by the component manufacturers. Alignment is defined as the positioning of the propulsion engine, intermediate shafting, couplings, joints, and bearing in each system to satisfy requirements of each component in the system.

243.2.1.1 During initial alignment, shafting system bolt stops in each of the components shall be set such that the available clockwise and counterclockwise adjustments are equal.

SECTION 244 MAIN PROPULSION SHAFT BEARINGS AND SEALS

244.1 GENERAL

244.1.1 Stern tube bearings shall be Duramax Johnson Cutless bearings, or equal.

244.1.2 Propeller shaft main seals shall be water lubricated stuffing boxes with integral emergency air seal, Duramax Johnson model 1788, or equal.

SECTION 245 PROPELLERS

245.1 GENERAL

245.1.1 The two propellers shall be a matched right-hand and left-hand pair of NiBrAl fixed-pitch propellers, Michigan Wheel Work Horse 4 designed to ABS IC, or equal. Each propeller shall be 4-bladed, 45 in. diameter × 33 in. pitch, with an expanded area ratio of 0.71, and a 5 in. SAE J755 bore/taper compatible with the final shaft design.

245.2 DESIGN REQUIREMENTS

245.2.1 The propeller shall be a fixed pitch monoblock design.

245.2.2 Propeller shaft shall meet the following:

245.2.2.1 Voids in the hub, hub counterbore, and fairwater shall be filled with corrosion preventive compound Termalene EP Multipurpose Extreme Grease 2 (Bel-Ray Product Code 72440), or equal.

245.2.2.2 The propeller and propeller shaft shall be sealed from water at the forward end of the propeller hub by a rubber packing ring and gland. The propeller hub shall be counter-bored to a depth sufficient to provide a seal between the shaft sleeve and propeller hub.

245.2.2.3 Positive locking devices shall be provided for the propeller connection.

245.2.3 Each propeller shall be plane balanced in accordance with the following equation:

245.2.3.1 $P = \frac{40\,x\,m}{R\,x\,n^2}$, Where:

245.2.3.1.1 P = The maximum permissible residual unbalance, expressed as an equivalent correction

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mass at the propeller blade tip, in kilograms

245.2.3.1.2 m = The mass of the propeller, in kilograms

245.2.3.1.3 R = The radius to the blade tip, in meters

245.2.3.1.4 n = design rotational speed of the propeller, in revolutions per minute

SECTION 256 MACHINERY COOLING SYSTEMS

256.1 GENERAL

256.1.1 The main engines, gensets, and reduction gears shall have cooling system as shown on contract drawings.

256.1.2 The working fluid shall be identical to the fluid utilized in the engine jacket water systems such that stored engine coolant may be used in all thermal fluid systems.

256.2 KEEL COOLERS

256.2.1 Design and Construction,

256.2.1.1 Keel cooler material shall be of 90/10 copper nickel and shall be galvanically isolated from the hull. Keel coolers shall be provided with drain plugs to permit draining the coolers when hauled and changing coolant.

256.2.1.2 Keel coolers shall be installed on the shell bottom recessed into hull pockets for protection.

256.2.1.3 An ultrasonic antifouling system shall be installed to protect keel cooler pockets and keel coolers.

256.2.1.3.1 Antifouling system shall include appropriate number of transducers needed including continuity breaks in equipment to protect from hard and soft marine growth.

256.2.1.3.2 The control panel(s) shall show the system's operational status and alert the operators of transducer malfunction.

256.2.1.4 Guards and fairing plates shall be fitted flush to the hull to fend off ice, debris, and buoy chain from the coolers. Guards shall be removable to allow maintenance and cleaning of the coolers by a diver.

256.2.1.5 Keel cooler pockets shall be fit with vent pipes, allowing collected air to escape. Vent piping connection shall be at the highest point of the pocket and shall continue to the weather deck to terminate in a gooseneck. Keel cooler pocket vents on the same side may be grouped so long as the vent is constantly sloped towards the gooseneck, creating no traps or pockets. A cutout valve shall be installed at the connection to each keel cooler pocket.

256.3 FRESHWATER COOLING REQUIREMENTS

256.3.1 General

256.3.1.1 The system shall be provided with permanently installed flow meters for each supply to individual equipment. Each meter shall have a measurement capacity of 30 to 120 percent of the design flow rate and shall read in gal/min. Meter assemblies shall be provided with flanged or union ends. Flow meters shall be venturi type.

256.3.1.2 High points in each cooling loop shall be fitted with automatic vent valves to purge air from the system. System low point drains shall be installed throughout the vessel as necessary to facilitate draining the system down for layup.

256.3.2 Head Tanks

256.3.2.1 For each closed loop, a head tank shall be provided with level controls and indication.

256.3.2.2 Head tanks for reduction gear loops shall be sized in accordance with ASHRAE Handbook HVAC Systems and Equipment to accommodate the system fluid expansion from minimum to maximum fluid temperatures.

256.3.2.3 Head tanks for engine cooling shall be sized in accordance with the OEM requirements or ASHRAE Handbook HVAC Systems and Equipment as appropriate to accommodate the system fluid

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expansion from minimum to maximum fluid temperatures.

256.3.2.4 The inlet and outlet connections of each reduction gear head tank shall be connected to the system via locked open cutout valves.

256.3.2.5 Head tanks for reduction gears shall have a sight glass, vent, overflow, drain, and a funnel for fill and addition of chemical treatment. The tank location shall be accessible for routine inspection.

256.3.2.6 If filling system is required, the filling system shall be a pump drawing suction from the fill tank. The cut-in and cut-out commands shall be via level controls allowing 2-minute pump run time, and the required volume shall be added to the required acceptance volume.

256.3.2.6.1 The thermal fluid shall be pre-mixed in a tank that contains not less than 200% of the system volume. The tank need not be dedicated to the thermal fluid system and may be combined with the diesel engine jacket water replenishment tank.

256.3.2.6.2 The injection point of the filling system to each system shall be to the expansion tank or suction side of the pump.

256.3.2.6.3 The fill pump shall be sized to have a max fill time of 1 hour

256.3.3 Freshwater Cooling Pumps

256.3.3.1 Freshwater cooling pumps shall be as shown in the drawings.

256.3.3.2 Where standalone (non-gear driven) pumps are used for engine or reduction gear cooling, the pump shall automatically start with the engine.

SECTION 257 JACKET WATER HEATING SYSTEM

257.1 GENERAL

257.1.1 The engines shall have an electric jacket water heating system.

257.1.1.1 The jacket water heating system shall be thermostatically controlled to heat the jacket water to a minimum temperature required by the OEM when the outside air temperature is at -20°F. The temperature shall be measured at the jacket water temperature gauge sending unit.

SECTION 259 EXHAUST SYSTEMS

259.1 GENERAL

259.1.1 Each engine and fuel-oil-fired piece of equipment shall have a dedicated exhaust system. Each system shall route the exhaust gases through the uptake to the weather and discharge away from personnel, equipment, and air intakes.

259.2 EXHAUST SYSTEMS

259.2.1 The exhaust system shall be installed as shown in the drawings.

259.2.2 The system shall be designed to meet the engine OEM requirements for back pressure and limitations on dynamic loading of engine mounted components.

259.2.3 Exhaust systems serving diesel engines shall utilize dry, spark arresting type silencers.

259.2.4 Diesel exhaust systems shall be constructed from sections of piping joined by flexible bellows to accommodate thermal expansion and engine movement as necessary. Piping connecting to engine flanges shall meet the loading requirements of the diesel engine manufacturer. After the first bellows, the piping shall be supported entirely by the pipe hangers.

259.2.5 Piping penetrations, braces and hangers shall thermally isolate exhaust system components from the vessel's structure and allow for differences in expansion to prevent overstress.

259.2.6 Exhaust piping shall be insulated.

259.2.7 Exhaust systems shall be provided with drains at the low points.

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259.2.8 The following minimum parameters shall be used in the selection of expansion joints:

259.2.8.1 Design based on 5000 cycles of full rated movement.

259.2.8.2 Design based on 1000 cycles of movement due to start-up and shut-down.

259.2.8.3 Design based on 100,000 cycles of movement due to system temperature fluctuations.

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SECTION 300 ELECTRIC PLANT, GENERAL

300.1 GENERAL

300.1.1 Electrical systems shall be as shown in the drawings.

300.1.2 The vessel shall be designed and constructed to the following requirements: 46 CFR subchapter J, 46 CFR §62: Vital System Automation, 46 CFR 58.25-65 and 58.25-70 for steering and ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways.

300.2 DESIGN STANDARDS AND CRITERIA

300.2.1 Enclosure penetrations shall be on the bottom of the enclosure, as practical.

300.2.2 Cable terminations shall be provided with strain relief.

300.2.3 Electrical cables that penetrate any watertight envelope or bulkhead on the vessel shall be watertight and employee watertight penetrations.

300.2.4 The 240 VAC electrical power distribution system shall not use the hull, structure, or engine block to complete any circuit.

300.2.5 Electrical equipment bonding and personnel safety grounding shall be in accordance with MIL-STD-1310(series).

300.2.6 The electrical equipment shall be capable of operating simultaneously with electronics equipment without causing interference to any electronic equipment or the magnetic compass.

300.2.7 Electrical installation shall ensure that personnel are not exposed to electrical hazards.

300.2.8 Electrical Panels, motor control centers and associated feeder cables shall be sized to accommodate a 10% growth margin.

300.2.9 Continuity of power to emergency services shall be maintained under all conditions.

300.2.10 Enclosures for electrical equipment shall be watertight (NEMA 4X).

300.2.11 Circuit breakers shall not be used as switches for lighting or other equipment.

300.3 SHORE POWER

300.3.1 Shore Power interface receptacles shall be provided and protected using circuit breakers.

300.3.2 The vessel shall be equipped with one (1) shore power receptacle, located as shown on the drawings.

300.3.3 The shore power receptacle shall be rated for 240VAC, 60Hz, 3-phase, ungrounded power.

300.3.4 The shore power system shall be capable of safely supplying a total maximum current of 200 amps from shore to the vessel.

300.3.5 The shore power connection shall be designed and installed in accordance with IEEE-Std 45, 46 CFR Subchapter J, and ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways.

300.3.6 The shore power receptacle and associated cabling shall be marine-grade, watertight (IP67 or NEMA 4X minimum), and suitable for the marine environment.

300.3.7 The shore power inlet shall be connected to a circuit breaker rated at 200A, located on the interior of the vessel. The circuit breaker shall be located as close as practically possible to the shore power inlet. A voltage verification, phase sequence check relay and a visual indication of both correct and incorrect

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rotation shall be installed in the circuit breaker enclosure. The relay shall prevent the circuit breaker from being closed when phase rotation is reversed.

300.3.8 The shore power system shall be interlocked such that the ship's generators cannot be paralleled with shore power under any circumstances.

300.3.9 All shore power cabling, connectors, and protective devices shall be readily accessible for inspection and maintenance.

300.3.10 The shore power system shall be labeled, and instructions for safe connection and disconnection shall be posted at the connection point.

SECTION 302 ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT

302.1 PERFORMANCE REQUIREMENTS

302.1.1 Electric motors with associated controllers, brakes, master switches, pilot devices and other associated equipment shall be provided as required for the driven equipment.

302.1.2 Motor controllers shall meet the design, testing and construction requirements of both NEMA ICS and UL 60947 "Industrial Control Equipment.

302.1.3 If brake horsepower needed by the driven equipment does not coincide with the NEMA motor standard nominal horsepower size the next larger size motor shall be used.

302.1.4 COTS Motor starters and controllers shall be from the same manufacturer.

SECTION 303 PROTECTIVE DEVICES FOR ELECTRICAL CIRCUITS

303.1 GENERAL REQUIREMENTS

303.1.1 Protective devices shall include but not be limited to: circuit breakers, fuses, thermal tripping devices, current-limiting devices, reverse power protection devices, and power switches.

303.2 PERFORMANCE REQUIREMENTS

303.2.1 Each unit of equipment and circuits shall be protected from short circuit currents and thermal overloads.

303.2.2 The selection, arrangement, and performance of various protective devices shall provide a complete coordinated protective system having the following characteristics:

303.2.2.1 High speed clearing of low impedance faults.

303.2.2.2 Maximum continuity of service under fault conditions to be achieved by the selective operation of the various protective devices. Proper localizing of a fault condition to restrict outages to the equipment affected.

303.2.2.3 Protective devices shall be sized to withstand maximum calculated fault currents.

303.2.3 The minimum rating for circuit breakers shall be 10 amps.

303.2.4 All circuit breakers shall be a minimum of double pole devices.

303.2.5 Circuit breakers shall be from the same manufacturer.

303.2.6 Generator and shore-tie circuit breakers shall include integral under voltage trips (UVT).

303.2.7 Miniature Circuit Breaker (MCB) may be used as supplementary breakers (as defined by NEC 2008) and NOT as a branch circuit breaker.

303.2.8 Circuit breakers within a controller and automation equipment enclosures may have circuit breaker ratings of less than 10 amps for supplementary circuit protection (as defined by NEC).

SECTION 304 ELECTRIC CABLES

304.1 DESIGN STANDARDS AND CRITERIA

304.1.1 Cables shall be sized to continuously carry the full-load current of equipment connected.

304.1.2 Where parallel cables are utilized to increase the current carrying capacity of the circuit or to reduce the voltage drop, parallel conductors shall have the same cross-sectional area and length. For three phase circuits using cables in parallel, each cable shall contain all three phases.

304.1.3 Cable shall be installed in a neat and orderly manner presenting a straight run. Cable shall be tightly fitted to the overhead or bulkhead. Pipes shall not be routed through cable runs.

304.1.4 Cable conductors within equipment or enclosures shall have sufficient length to facilitate tracing, troubleshooting, and opening and closing of hinged doors to prevent conductor damage. Surplus wire length shall be provided to relieve all tension and vibration, to allow for disconnection and servicing, and to permit multiple wires to be fanned at terminal studs.

304.1.5 Cable connections shall be accessible.

304.1.5.1 Whenever cable connections are concealed, access panels shall be provided. Panels shall be labeled to identify the concealed cable connections.

304.1.6 Cables in machinery compartments shall not be installed in or behind insulation or behind protective sheathing.

304.1.7 Cables shall be high-flex stranded tinned annealed copper.

304.1.8 Cable servicing essential systems shall comply with the fire resistant requirements of IEC Publication 60331.

304.1.9 Battery cable connections shall be of the hex nut, lock washer type. Wing nuts shall not be used.

304.1.10 Cabling that penetrates watertight bulkheads or decks shall be watertight.

304.1.11 Cable installation shall be performed in accordance with a standard installation methodology appropriate for the type of cables being installed.

304.1.12 Cables shall be continuous runs. There shall be no splices. The only exception is for quick disconnects associated with removable items.

304.1.13 Power supply cables for power, motor control centers, and lighting panelboard feeders shall be rated to supply the load plus 10% future growth.

304.1.14 Power, control, and signal cables shall be routed to minimize electromagnetic interference (EMI) and ensure electromagnetic compatibility (EMC) throughout the vessel.

304.1.15 Radio frequency (RF), communication, instrumentation, and data cables shall be routed separately from power and lighting cables to the maximum extent practicable.

304.1.16 Shielded cables shall be used for all communication, instrumentation, and RF circuits where required by the equipment manufacturer, system design, or to meet EMC requirements.

304.1.17 All cable shields and metallic barriers shall be properly bonded and grounded in accordance with MIL-STD-1310 and IEEE-Std 45.

304.1.18 The installation shall comply with the requirements of IEEE-Std 45, IEC 60092-352, and ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways.

SECTION 305 ELECTRICAL AND ELECTRONICS DESIGNATING AND MARKING SYSTEMS

305.1 GENERAL

305.1.1 Information plates, label plates, and tags shall be installed for equipment, circuits, conductors and cables for power, lighting, electronics, interior communications, and other electrical systems.

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305.1.2 Nameplates for motors, generators, transformers, control apparatus, switchboards, heaters, brakes, and clutches shall be in accordance with the recommendations provided in applicable nameplate sections of IEEE-STD-45, "Recommended Practice for Electrical Installations on Shipboard. Installations on Shipboard.

SECTION 310 SHIP SERVICE GENERATORS

310.1 GENERAL

310.1.1 Ship service diesel generators shall be two CAT C4.4 marine diesel gensets with electronic control systems' or equal. Generators shall be configured to provide 65KW of 240VAC wired in an ungrounded 3 ϕ delta- configuration at 60Hz. The gensets shall be provided with the following options from the manufacturer.

310.1.1.1 Provide local and remote generator monitoring and control panels.

310.1.1.2 Engine shutdown sensors & shutdown controller

310.1.1.3 Double wall high pressure fuel lines

310.1.1.4 AC voltage monitoring

310.1.1.5 Glow plugs

310.1.1.6 Factory installed generator anti-condensation strip heaters

310.1.1.7 Keel cooled

310.1.1.8 24V DC Starter / Charging Alternator

310.1.1.9 Lube oil filter assembly

310.1.1.10 Fuel Filter assembly

310.1.1.11 Oil & Coolant Sampling Valves

310.2 PERFORMANCE

310.2.1 The maximum basic operating load of one genset shall be the largest of the summer, winter, shore, transit, icebreaking or emergency operating conditions as calculated in the EPLA.

310.2.2 Manual and automatic paralleling of the generators shall be provided.

310.3 MONITORING ALARM AND CONTROLS

310.3.1 Emergency stops for each ship service generator shall be provided in the engine room and pilothouse to open the generator output circuit breakers.

310.3.2 Local generator control panels shall be installed to allow full front access and be hinged and capable of being locked in the open position.

310.3.3 Ship Service Generator Control shall be capable of operating as a standalone system in event of Machinery Control and Monitoring Systems failure.

310.3.4 Excitation

310.3.4.1 The ship service diesel generators shall be equipped with a Permanent Magnet Generator (PMG) excitation system.

310.3.4.2 Excitation system shall limit voltage buildup to 115% of rated voltage under abnormal or failure conditions.

310.3.5 Voltage Regulation

310.3.5.1 Voltage regulator shall provide manual and automatic control of voltage. Automatic control shall not override manual control.

310.3.5.2 A spare automatic voltage regulator shall be provided.

SECTION 313 STORAGE BATTERIES

313.1 GENERAL

313.1.1 Batteries shall be Absorbed Glass Mat (AGM).

313.2 PERFORMANCE

313.2.1 Each installed battery charger, alternator, and voltage regulator shall be compatible with the batteries and battery bank configuration selected, shall have battery temperature compensation, and shall be capable of completely recharging the attached battery bank in a maximum of eight (8) hours without exceeding a safe charging rate. Battery chargers/alternator voltage regulators for AGM batteries shall use three-stage charging.

313.2.2 Each battery charger that is attached to a diesel engine starting battery bank shall have a disconnect device which automatically isolates the charger from the battery bank during engine starting. A cross connect shall be provided to allow engine starting from each battery bank of similar engine type without affecting the operation of any running engines.

313.2.3 Each battery charger shall have an audible alarm function that provides charger output failure indication.

313.2.4 Each battery comprising a battery bank shall have equal characteristics and be from the same manufacturer.

313.3 ENGINE STARTING BATTERY SYSTEMS

313.3.1 This section defines the requirements for the dedicated 24VDC starting battery systems for all Main Propulsion Diesel Engines (MPDEs) and Diesel Generator Sets, hereafter referred to as "engines."

313.3.1.1 Each engine shall be equipped with its own dedicated starting battery system. Each starting battery system shall have crossover starting capability with engines of similar types for redundancy. Engine starting systems shall be independent from all other DC systems on the vessel, including the ship's service battery banks.

313.3.1.2 Each engine starting battery system shall be as shown on the drawings.

313.3.1.3 Each starting battery bank shall be sized with sufficient capacity to provide, at a minimum, six consecutive starts for its respective engine without being recharged.

313.3.1.4 The battery bank and charger for each starting system shall be installed in close proximity to the respective engine to minimize the length of the starting cables and reduce voltage drop during engine cranking.

313.3.1.5 Volt meters shall be provided for starting batteries. The meters shall have a minimum range of 0VDC to 36VDC. The voltmeters shall be located within eyesight of the battery bank selector switches.

SECTION 314 POWER CONVERSION EQUIPMENT

314.1 GENERAL

314.1.1 Transformers and AC/DC converters shall have KVA ratings sufficient to support 115% of the maximum demand load plus the spare circuits. Transformers shall be dry type.

314.1.2 Power conversion equipment with similar power characteristics shall be from the same manufacturer.

314.2 BATTERY CHARGER

314.2.1 The battery charger for each starting system shall be powered from the 240VAC distribution system. It shall be a fully automatic, multi-stage charger designed to maintain its associated battery bank in a fully charged and equalized state without requiring manual intervention.

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SECTION 324 SWITCHBOARDS & POWER PANELS

324.1 GENERAL

324.1.1 Programmable controllers shall be compliant with IEC 61131-3

324.2 SHIP SERVICE SWITCHBOARD

324.2.1 A dead-front switchboard shall be provided, built, designed and tested to UL 891. Except that destructive tests do not need to be performed.

324.2.2 Circuit breakers shall meet the requirements of UL 489 SA.

324.2.3 Switchboard buses shall be copper. Bus connections shall have silver surfaced contacts. Bare bus bars shall meet the minimum spacing requirements of one (1) inch.

324.2.4 Terminals in switchboards and panelboards shall be located so that it will not be necessary to reach across uninsulated line bus to make connections or replace fuses.

324.2.5 Switchboard instruments shall be flush mounted. The instruments shall display the monitored parameter in an analog format for instantaneous recognition of trend information. The instrument's scale shall be marked to indicate the rated value of the parameter being measured. Instruments shall have sensitivities which are twice the sensitivity of the associated controls; for example, 5% sensitivity instruments shall be used with 10% sensitivity controls.

324.2.5.1 An ammeter shall be provided on the switchboard capable of measuring the ships ampere draw while on shore power.

324.2.6 Switches for instrument transfer or control functions shall be of the rotary type, equipped with clearly marked escutcheon plates to indicate function and position. Switches shall be mounted on and operated from the front of the switchboard. Switches shall have detents to securely hold the switch in the selected position.

324.2.7 Indicator lights shall be flush mounted and shall incorporate long life LED. Bulb size and base shall be standard throughout the switchboard.

324.2.7.1 Indicator lights shall be provided to indicate when the ship service generator motorized breakers are in the tripped position.

324.2.8 A wiring diagram frame behind acid resistant clear coating shall be mounted in each switchboard section inside of the rear hinged access cover for the section. In addition to showing point-to-point wiring, the diagrams shall also depict the system's setup, control and power sources.

324.2.9 Circuit breakers for the ship service generator shall be interlocked with the manual and automatic synchronization systems to prohibit being closed onto an energized bus without first being synchronized. The manual and automatic synchronization systems shall be independent so that failure of either system will not render the other synchronization system inoperable.

324.2.10 Where the Class Rules are silent, interrupting devices, control, instrumentation, and metering and protective and regulating equipment assemblies shall be in accordance with IEEE-STD-C37.20.1.

324.3 POWER DISTRIBUTION PANELS

324.3.1 These panels shall be provided with a minimum of one spare circuit breaker for each five active circuit breakers or fraction thereof. The spares shall be of the size and type most frequently used within the panel.

324.3.2 All motors regardless of horsepower shall have overload protection independent of the feeder breaker.

SECTION 330 LIGHTING SYSTEMS

330.1 GENERAL

330.1.1 Interior lights shall be light-emitting diode (LED).

330.1.2 Illumination levels in all compartments shall meet the requirements of ABS Crew Habitability on Workboats Section 6/Table 1.

330.1.3 Definitions

330.1.3.1 "General Illumination" - The illumination provided from all lighting fixtures on the overhead and bulkheads, except detailed lighting fixtures.

330.1.3.2 "Detail Illumination" - The illumination provided for specific seeing tasks, such as provided by lights on desks, berths, and work bench.

330.1.3.3 "Special Illumination" - The illumination provided by miscellaneous fixtures for purposes other than covered by general and detail lighting.

330.1.3.4 "Normal Ship Service Lighting System" - The normal ship service lighting system consists of solid state lighting fixtures installed throughout the vessel for general and/or detail illumination. The only source of power for normal ship service lighting is the ship service power distribution system.

330.1.3.5 "Emergency Lighting System" - The emergency lighting system consists of a specific group of lighting fixtures dedicated to provide reduced illumination during times of loss of ship service power. The emergency lighting system primary source of power is the ship service power system. The emergency lighting system's alternate source of power shall be dedicated emergency power supply (e.g, UPS with battery banks, or self-contained battery packs) with sufficient capacity to provide required illumination in accordance with 46 CFR subchapter J and ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways.

330.2 PERFORMANCE

330.2.1 Lighting distribution in any compartment which has multiple power sources shall be arranged such that the failure of one circuit does not leave any area without light. Emergency lighting shall provide coverage for all egress routes, machinery spaces and critical operational areas.

330.2.2 Floodlights shall be provided on the weather deck structure to provide sufficient illumination for the exterior decks, waterline, and for vessel maneuvering.

330.2.3 All emergency lighting fixtures shall be clearly labeled and distinguishable from normal lighting fixtures.

330.3 GENERAL ILLUMINATION

330.3.1 The flag, hull illuminating, and exterior lights shall be individual switch controllable from the pilothouse.

330.3.2 Switches for exterior lighting shall be located in the pilothouse and be protected from inadvertent operation.

330.3.3 Exterior lighting shall be provided with an electrical means to de-ice and prevent icing.

330.3.4 Lighting fixtures in exterior or wet locations shall be rated IP67 or NEMA 4X minimum.

330.4 RECEPTACLE

330.4.1 Receptacles shall be installed throughout spaces in locations designated in the EPLA for electric equipment use.

330.4.2 Receptacles shall be installed evenly distributed within each space.

330.4.3 Each machinery space shall be fed by separate feeders from the switchboard within or adjacent to the space.

330.4.4 Berthing Rack lights – Each rack shall have a rack light with USB-C receptacle configuration.

SECTION 402 CYBERSECURITY REQUIREMENTS

402.1 GENERAL

402.1.1 This section contains requirements for an integrated approach to Cybersecurity and Information Systems Security, Assessment and Authorization (A&A), including standards and policies.

402.1.2 All vessel systems containing logic-bearing components shall be designed and implemented in accordance with the following International Association of Classification Societies (IACS) Unified Requirements (UR):

402.1.2.1 IACS UR E22 – On Board use and Application of Computer-based Systems

402.1.2.2 IACS UR E26 – Cyber Resilience of Ships

402.1.2.3 IACS UR E27 – Cyber Resilience of On-Board Systems and Equipment

402.1.3 All vessel systems shall remain physically and logically separated unless otherwise authorized by the Government.

402.1.4 All ports, protocols, and services not necessary to the operation of the system shall be disabled.

402.1.5 Physical data interfaces shall be secured within enclosures that are lockable or that require tools to open, except as otherwise directed by the USCG.

402.1.6 Automatic data communications outside of a system's local network shall be disabled.

402.1.7 System components shall be configured to prevent remote access from outside the local network.

402.1.8 Wireless data communication features for system hardware shall be physically disabled.

402.1.9 Components prescribed by the Government that have wireless data communication features shall have those features logically disabled unless otherwise directed by the Government.

402.1.10 Any temporary or test accounts shall be deleted, except as otherwise directed by the USCG.

402.1.11 The Contractor shall install components in accordance with OEM specifications.

402.1.12 Prior to acceptance testing, software and firmware in Contractor-furnished components shall be verified to match the version recommended by the OEM.

SECTION 404 RADIO FREQUENCY, TRANSMISSION LINES, AND CABLES

404.1 GENERAL

404.1.1 This section sets forth the general requirements for radio frequency transmission lines and cabling, and provides requirements for installation. For all other cable types or where this section is silent, electrical/electronic cabling shall meet the requirements of SPEC 304, and shall be labeled in accordance with SPEC 305.

404.2 INSTALLATION REQUIREMENTS

404.2.1 Cables shall be installed in accordance with IEEE 45-2002.

404.2.2 Cable connectors not inside a watertight enclosure shall be made with IP67 connectors.

404.2.3 Cables associated with electronic equipment shall be installed in continuous runs without splices.

404.2.3.1 Quick disconnects may be installed to accommodate removable items.

404.2.4 Cables shall be installed with a service loop of excess cable that allows for the removal of equipment from consoles in order to access all interconnections without disconnecting any conductors.

404.2.5 Stuffing tubes or multi-cable transits shall be used for deck and bulkhead penetrations to maintain their watertight, airtight, fume-tight, or light-tight integrity of the structure.

404.2.5.1 Stuffing tubes shall be ASTM F1836M-15 type.

404.2.5.2 Multi-cable transits shall be ABS- or UL-certified.

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404.2.6 Cables near fluid routing shall have drip-proof shields or other barriers installed to protect from leak damage.

SECTION 405 ANTENNAS

405.1 GENERAL

405.1.1 Antennas shall be arranged for satisfactory system performance across all frequencies and shall meet the EMI/RFI reduction requirements.

405.1.2 Antennas shall be physically separated to reduce electrical interaction and to avoid physical contact due to antenna deflection caused by ice loading, wind, sea conditions, or other adverse conditions.

405.1.3 Antenna mounts shall be constructed to support the antenna without failure while subjected to the HSC-L operating environment.

SECTION 407 GROUNDING, BONDING, AND ELECTROMAGNETIC ENVIRONMENT

407.1 GENERAL

407.1.1 All vessel systems, including but not limited to lighting, signaling, communication, power, and propulsion equipment, shall be designed, selected, and installed in strict compliance with the following standards to ensure safety and electromagnetic compatibility and guard against electromagnetic interference:

407.1.1.1 IEEE 45-2002, Recommended Practice for Electrical Installations on Shipboard.

407.1.1.2 MIL-STD-1310, Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility, Electromagnetic Pulse (EMP) Mitigation, and Safety.

407.1.2 RF transmission lines and cables shall be electrically bonded and be routed within the structure to protect against EMI. Type I or II bond straps shall be used where required.

407.1.3 EMI and RFI shall be minimized in accordance with OEM recommendations and allow the operation of all equipment simultaneously without disrupting other equipment.

407.1.4 Safety rails, lifelines, and lanyards shall not generate EMI.

407.1.5 The Contractor shall consider the impacts to crewmembers when designing the placement of equipment that emits electromagnetic radiation and shall identify hazardous areas. Access points to hazardous areas shall be marked using one Type 2 identification marker, NSN: 7690-01-377-5896. 6.

SECTION 410 COMMAND AND CONTROL SYSTEMS

410.1 GENERAL

410.1.1 Controls and gauges shall be installed in order to meet the requirements of the Control Criticality Table (Specification Table 410-1) and in accordance with the requirements of SPEC 088.

410.2 ANTHROPOMETRY REQUIREMENTS FOR CRITICAL CONTROLS

410.2.1 Controls, displays, and equipment identified on the Control Criticality Table (Table 410-1) shall meet the following requirements:

410.2.1.1 “Primary Viewable” (PV) shall be within 35 degrees left and right of center and 25 degrees above and 35 degrees below the horizontal line of sight for the seated positions.

410.2.1.2 “Secondary Viewable” (SV) shall be within 60 degrees left and right of center and 50 degrees above and below the horizontal line of sight for the seated positions.

410.2.1.3 “Reachable” (R) shall be within the Functional Reach (extended), Vertical Arm Reach (sitting) for the 5th percentile female to 95th percentile male in accordance with ASTM F1166, Figures 50 and 51, for seated operations. For standing operations, reach shall be within the Forward Functional Reach (back of shoulder to fingertips) and Maximum Overhead Gripping Reach for the North American 5th percentile female to 95th percentile male in accordance with ASTM F1166, Tables 16 and 17.

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410.2.2 The viewing angle of the console shall be in accordance with ASTM F1166.

Table 410-1: Control Criticality Table – Pilothouse

Component	Helmsman Fwd			Control Station Aft		
	PV	SV	R	PV	SV	R
Tactical Radio (APX 8500) O7 Control Head		X	X			
Commercial VHF DSC Radio with Mic		X	X			
Loud Hailer (or 2nd DSC VHF)		X	X		X	X
Primary SINS 2 Multi-Functional Display (12")	X		X			
Secondary SINS 2 Multi-Functional Display (12")		X	X			
Tertiary SINS 2 Multi-Functional Display (12")					X	X
SINS 2 Remote Information Display (i70)	X		X			
SINS 2 Remote Information Display (i70)		X				
AIS 2 Display and Control		X				
Magnetic Compass	X					
Lighting Controls						
Searchlight		X	X			
-Navigation			X			
-Flood			X			X
-Law Enforcement			X			
Dimmer Controls			X			
Primary Propulsion Controls			X			
Primary Helm Controls			X			
Propulsion and Steering Systems Displays/Instruments and Alarms (Primary Display)		X	X			
Primary Propulsion Shutdown (Fwd)			X			
Propulsion and Steering Systems Displays/Instruments and Alarms (Secondary Display)					X	X
Secondary Propulsion Shutdown (Aft)						X
Emergency Engine/Propulsion Cutoff			X			X
Remote Fuel Shut-off (Fwd)			X			X
Remote Fuel Shut-off (Aft)						X
Mounted Searchlight Control			X			
Horn			X			
Window Wiper and Defog/Defrost Controls			X			
Generator Controls/Monitoring		X	X			
Generator E-Stops (Pilothouse)			X			
Electrical System Monitoring Displays		X	X			
Autopilot Display and Control		X	X			

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Monitoring Camera System Display and Control		X				
Secondary Helm Tiller Controls						X
Secondary Propulsion Controls						X
ATON Crane Controls						X
HPU Alarm Panel					X	
Ventilation Controls / Fire Damper E-stops		X			X	
Cross Deck Winch Controls						X
Windlass Controls			X			
Fire Alarm Panel		X	X		X	
AIMS laptop					X	X

410.2.3 Neither polarized nor tinted display surfaces shall be used.

410.2.4 Displays shall be configured to minimize glare and reflection.

410.2.5 Displays shall be flush mounted to the console surface unless approved by the USCG.

410.2.6 Touch screens.

410.2.6.1 Touch screens shall be avoided if other options are reasonably available.

410.2.6.2 If used, touch screens shall be fully functional when wet.

410.2.6.3 If used, displays with touch screen technology shall have finger rails, or similar support, at a minimum, along the top horizontal and each vertical side of the display to allow for stabilization of the operator's hand while using the thumb to operate specific buttons during operations.

410.2.6.4 If used, a touch screen shall not be the sole input means.

410.2.6.5 Full functionality shall be provided without the use of a touch screen.

SECTION 421 NON-ELECTRONIC NAVIGATION SYSTEM

421.1 MAGNETIC COMPASS

421.1.1 A permanent magnetic compass shall be installed.

421.1.1.1 The compass shall meet the requirements of ISO 25862.

421.1.1.2 The compass shall have a dampened display at least 4-1/2 inch in diameter.

421.1.1.3 The compass shall be capable of compensating for deviation.

421.1.1.4 The compass shall be provided with lighting dimmable to 0 lumens for night operations.

421.1.2 The compass shall be installed in the Pilothouse Console, forward of the primary helm station, and within easy view of the helmsman while underway.

421.2 CLINOMETERS

421.2.1 Heeling and trimming Clinometers meeting standard CID A-A-59308 shall be installed on the fore and aft axis and athwartships in the pilothouse.

421.3 DAY SHAPES

421.3.1 Day shapes shall be provided in accordance with COMDTINST M16672 2(series) "Navigation Rules, International – Inland" for each of the operation scenarios described in SECTION 422.1.1.

421.3.2 Storage for day shapes shall be provided within the vicinity of the pilothouse.

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SECTION 422 ELECTRICAL NAVIGATION AIDS

422.1 NAVIGATION LIGHTS

422.1.1 The HSC-L shall have solid state navigation lights in accordance with the USCG Navigation Rules and Regulation handbook; International Rules for Prevention of Collisions at Sea (72 COLREGS) Annex I and Inland Navigation Rules Annex I requirements corresponding with underway operations, anchoring, towing astern, less than 200 meters, more than 200 meters and towing alongside

422.1.2 The Navigation lights shall be powered by a single circuit breaker and switched using a single toggle or rotary type selector switch for the different navigational configurations.

422.2 SEARCHLIGHT

422.2.1 The HSC-L shall have mounted searchlight(s) able to rotate 360 degrees on the horizontal axis.

422.2.2 The searchlight shall be Imtra DHR 230RCL-Series LED searchlight, part number DHR 230, or equal, and be equipped with Imtra DHR non-focusing control panel, part number PAN2019-NF, or equal.

422.2.3 The searchlight shall be integrated into the HSC-L electrical system and not use batteries for control power.

422.3 LAW ENFORCEMENT LIGHT

422.3.1 A blue strobe Law Enforcement Light shall be installed in accordance with 33 CFR 88.05, located to provide maximum visibility to other vessels.

SECTION 423 ELECTRONIC NAVIGATION SYSTEMS

423.1 GENERAL

423.1.1 The Contractor shall provide an electronic navigation system using the USCG 1SG38-SINS2(V) system, hereafter referred to as “SINS”.

423.1.2 SINS shall comprise the following equipment:

423.1.2.1 RayMarine Axiom 2 Pro 12 Multifunctional Display (MFD), part number E70656.

423.1.2.1.1 One (1) Axiom Pro 12 MFD shall be installed at the helm and configured as a Master.

423.1.2.1.1.1 The MFD shall be capable of displaying AIS data.

423.1.2.1.1.2 The Master MFD shall be provided with two micro-SD cards.

423.1.2.1.2 Qty (2) Axiom Pro 12 MFDs shall be installed and configured as a Slave MFD.

423.1.2.1.2.1 Each slave MFD shall be provided with one micro-SD card.

423.1.2.1.2.2 One slave MFD shall be installed at the helm.

423.1.2.1.2.3 One slave MFD shall be installed at the pilothouse aft operator position within close proximity to the USAIMS processor.

423.1.2.2 Micro-SD cards shall meet the following minimum requirements:

423.1.2.2.1 Provide 32GB of storage space.

423.1.2.2.2 Support FAT32 or NTFS file format.

423.1.2.2.3 Support Speed Class 10 or UHS Speed Class 1 data transfer.

423.1.2.3 One (1) Raymarine CP370 SONAR module, part number E70297.

423.1.2.3.1 The CP370 shall be interfaced with one of the below transducer options to suit hull geometry:

423.1.2.3.1.1 RayMarine SS60 transducer element, 0 degree, part number A80568.

423.1.2.3.1.2 RayMarine SS60 transducer element, 12 degree, part number A80569.

423.1.2.3.1.3 RayMarine SS60 transducer element, 20 degree, part number A80570.

423.1.2.4 Two (2) RayMarine i70S Marine Instrument displays, part number E70327-S2.

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423.1.2.4.1 One (1) each display shall be installed at the helm and aft operator position.

423.1.2.5 One (1) RayMarine 4KW 24" HD Radome marine RADAR, part number E92143.

423.1.2.5.1 The RADAR shall be interfaced with the helm Master MFD.

423.1.2.6 One (1) RayMarine 200WX Weather Station, part number A80755.

423.1.2.7 One (1) RayMarine RNS-5 5-port gigabit RayNet network switch, part number A80731.

423.1.2.8 Two (2) Actisense NGX-1-ISO National Marine Electronics Association (NMEA) 2000 gateways, part number A80852.

423.1.2.9 RayMarine ECI-100 Universal Engine and Control Interface, part number E70227.

423.1.2.10 RayMarine Evolution P70RS Autopilot Control Head, part number E70329.

423.1.3 Components necessary to deliver a fully integrated and operable SINS shall be provided. The contractor shall use additional OEM-standard interconnection components such as the following as necessary to ensure compatibility with the Coast Guard SINS configuration.

423.1.3.1 RayMarine SeaTalk NG 5-way connector, part number A06064.

423.1.3.2 RayMarine SeaTalk NG T-Piece spur connector, part number A06028.

423.1.3.3 RayMarine SeaTalk NG Spur Cable, part numbers by length: A06038 (400mm), A06039 (1m), A06040 (3m), A06041 (5m).

423.1.3.4 RayMarine SeaTalk NG in-line terminator, part number A06074.

423.1.3.5 RayMarine SeaTalk NG blanking plug, part number A06032.

423.1.3.6 Raymarine NMEA 2000 (Devicenet) to SeaTalk NG Adaptor cable, part numbers by length: A06079 (120mm), A06045 (400mm), A06075 (1m), A06080 (1m).

423.1.4 A Trimble MPS566 dual-antenna GNSS heading Receiver shall be installed.

423.1.5 SINS shall interface with the Trimble MPS566 dual-antenna GNSS heading Receiver.

423.1.5.1 The Trimble MPS566 will be provided by the Government to the Contractor.

423.1.5.2 The Trimble MPS566 shall send the following navigation data to the SINS system.

423.1.5.2.1 GGA.

423.1.5.2.2 GRS.

423.1.5.2.3 GSA.

423.1.5.2.4 GST.

423.1.5.2.5 GSV.

423.1.5.2.6 HDT.

423.1.5.2.7 VHW.

423.1.5.2.8 VTG.

423.1.5.2.9 ZDA.

423.1.6 SINS shall interface with the Coast Guard 1SG38-AIS2(V) Automatic Identification System, hereafter referred to as "AIS" via a RayMarine DeviceNet NMEA 2000 to SeaTalk NG Adaptor.

423.1.6.1 SINS shall exchange supported NMEA 2000 Parameter Group Number (PGN) data with the AIS transceiver via the SINS RayMarine SeaTalk NG backbone.

423.1.7 SINS shall interface with the Coast Guard USAIMS processor. The processor shall be a carry-on Dell Latitude Toughbook, or equivalent, provided by the vessel crew.

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423.1.7.1 SWAP shall be provided for the USAIMS processor at the aft operator position within the Pilothouse as follows:

423.1.7.1.1 Width x Depth x Height: 18 inches x 13 inches x 12 inches.

423.1.7.1.2 Weight: 7.5 lbs.

423.1.7.1.3 Power Consumption: 110VAC at 1A, 50-60 Hz auto switching.

423.1.7.1.4 A power receptacle shall be installed within 3 feet of the SWAP location.

423.1.7.1.5 SINS shall send NMEA-0183 navigation data to the USAIMS processor via one (1) Actisense NGX-1-ISO NMEA 2000 gateway.

423.1.7.1.5.1 This connection shall be presented to the USAIMS processor via a permanently mounted female DE-9 connector located within 3 feet of the processor SWAP location.

423.1.7.1.5.2 The navigation data shall include the following NMEA-0183 data sentences.

423.1.7.1.5.2.1 DPT.

423.1.7.1.5.2.2 DTM.

423.1.7.1.5.2.3 GGA.

423.1.7.1.5.2.4 GRS.

423.1.7.1.5.2.5 GSA.

423.1.7.1.5.2.6 GST.

423.1.7.1.5.2.7 GSV.

423.1.7.1.5.2.8 HDT.

423.1.7.1.5.2.9 VHW.

423.1.7.1.5.2.10 VTG.

423.1.7.1.5.2.11 ZDA.

423.1.8 SINS shall interface with the EO/IR camera system.

SECTION 425 AUTOPILOT

426.1 GENERAL

425.1.1 The HSC-L shall have an autopilot system with the following features:

425.1.1.1 Automatic heading control.

425.1.1.2 Adjustable steering response.

425.1.1.3 Automatic heading adjustment based on pitch, roll, and yaw.

425.1.1.4 The autopilot shall interface with the SINS system.

425.1.1.5 When set to the appropriate mode on the interface, the autopilot shall automatically follow routes programmed on the SINS MFDs without requiring programming of additional waypoint data within the autopilot itself.

425.1.1.6 The autopilot shall accommodate real-time course adjustments from the SINS MFDs.

425.1.1.7 The autopilot shall monitor the course, turn points, and autopilot status in real time.

SECTION 436 ALARMS

436.1 GENERAL

436.1.1 An alarm system shall be installed and shall meet the requirements of 46 CFR Subchapter J & Subchapter F and ABS River Rules (Steel Vessels for Service on Rivers and intracoastal Waterways).

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436.1.2 The alarm system shall integrate all bilge, fire, smoke, hydrogen sulfide, and carbon monoxide alarms and fire suppression activation.

436.1.2.1 There shall be a minimum of one hydrogen sulfide detector in the enclosed void housing the sewage system.

436.1.3 Alarms shall actuate both locally and, in the Pilothouse, and shall be able to be silenced through acknowledgment of the alarm.

436.1.4 Alarm loudness and frequency shall be designed in accordance with ASTM F1166.

436.1.5 The alarm system displays and controls shall be installed in the pilothouse consoles where they shall be visible immediately within the full range of head and body movements and accessible for system resets and testing from either a seated or standing position.

436.1.6 Warning lights and an audible alarm shall activate simultaneously to draw the crew's attention to the display panel and identify what type of alarm has occurred and in what location(s).

436.1.6.1 Each audible alarm shall have the capability to be silenced while the condition is being investigated. However, the alarm indication light shall remain illuminated until the condition is returned to its normal operating condition.

436.1.6.1.1 Lights for Alarm system controls and indicators shall be dimmable to zero lumens.

436.1.6.2 A means shall be provided to test the warning lights and audible alarm to verify that they are operational.

436.1.6.3 Alarm system controls and indicators shall be consolidated in one alarm panel or grouped in a centralized location in the pilothouse.

436.1.6.4 General Emergency Alarm.

436.1.6.4.1 A general emergency alarm shall be installed in accordance with 46 CFR 113.25.

436.1.6.5 Bilge Alarm.

436.1.6.5.1 A bilge alarm system shall be provided that will automatically detect the presence of liquid no more than six inches above the bilge pump suction in each compartment. Each sensor shall be equipped with a delayed trigger such that it is not triggered by sloshing of small quantities of bilge water.

436.1.6.6 Fire and Smoke Alarm.

436.1.6.6.1 A fire and smoke alarm system shall be installed in all normally occupied interior compartments and in each space containing machinery equipment, an electrical distribution panel, or battery banks.

436.1.6.6.2 Each normally occupied interior compartment shall have an illuminating light and audible alarm when there is an active fire alarm.

436.1.6.7 Carbon Monoxide Alarm System.

436.1.6.7.1 Each normally occupied compartment shall be fitted with a carbon monoxide alarm system that complies with the requirements of ABYC A-24.

436.1.6.8 Dockside Alarm.

436.1.6.8.1 The vessel shall have an external audible and visual alarm to alert the shoreside/station personnel of fire, smoke, flooding, and general emergency while the vessel is moored.

436.1.6.8.1.1 The dockside alarm shall be automatically and manually activated and silenced via the same means as any other alarm in this section.

SECTION 408 CCTV MONITORING CAMERA SYSTEM

439.1 GENERAL

439.1.1 A marine grade Closed Circuit Television (CCTV) system shall be installed.

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439.1.2 The system shall be capable of low-light operation and allow the crew to monitor interior compartments and exterior deck spaces in all operating conditions.

439.1.3 The following interior compartments and exterior spaces shall have the following camera(s) with unobstructed view of the compartment/space:

439.1.3.1 Machinery Space(s) – one port and one starboard.

439.1.3.2 Forward Deck Space – one centerline.

439.1.3.3 Aft Deck Space – one port and one starboard.

439.1.3.4 Navigable Waters – As required to provide a 360 degree view of the horizon used to assist with identification and monitoring of surface contacts during navigational watches.

439.1.4 The output video of each camera shall be viewable by the helm operator using dedicated display(s).

439.1.4.1 Displays and control indicators shall be dimmable to 0 lumens.

439.1.5 System displays and control interfaces shall be installed in accordance with ASTM F1166.

SECTION 441 EXTERIOR COMMUNICATIONS SYSTEM

441.1 GENERAL

441.1.1 The following communication systems shall be installed:

441.1.1.1 At least One Motorola APX-8500 Tactical Radio System.

441.1.1.2 At least One Standard Horizon GX-6000 Class D Digital Selective Calling (DSC) radio system.

441.1.2 Communication systems installation shall be modular, using connector terminated cables, to the maximum extent practicable to facilitate maintenance and future radio upgrades.

441.1.3 Radio system components shall be installed in the pilothouse with all controls and indicators readily available to the helm operator and installed in accordance with ASTM F1166.

441.1.4 Radios shall be mounted so that all connections servicing regular maintenance and programming shall be readily accessible without dismounting any components.

441.1.5 Each radio system shall perform independently and have a dedicated antenna(s) through which it can transmit and receive.

441.1.6 For each radio, the Contractor shall furnish all programming hardware, cables, adapters, and special tools needed for testing, programming, and maintenance.

441.1.7 Tactical Radio System

441.1.7.1 The Tactical Radio System shall comprise the following components:

441.1.7.1.1 Motorola APX-8500 multiband mobile radio, part number M37TSS9PW1AN.

441.1.7.1.2 Motorola APX Mobile 07 Control Head, part number H1905A.

441.1.7.1.3 Motorola remote-mount 7.5W speaker, part number HSN4038A.

441.1.7.1.4 Motorola palm microphone, part number HMN1089C.

441.1.7.1.5 Motorola control head cable, part number HKN6187B.

441.1.7.1.6 Motorola radio programming cable, part number HKN6184D.

441.1.7.1.7 Motorola CGAI key loading adaptor cable, part number HKN6182B.

441.1.7.1.8 Hascall-Denke multiband antenna, with pigtail, part number MADP150/450/816.

441.1.7.1.9 Hascall-Denke 1 inch-14 male to female extension, part number, UM032.

441.1.8 Commercial Marine VHF-FM DSC Radio System

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441.1.8.1 The DSC Radio System shall comprise the following components:

441.1.8.1.1 Standard Horizon GX-6000 DSC Marine Radio kit, part number GX-6000, which includes the following components:

441.1.8.1.1.1 Marine-grade microphone.

441.1.8.1.1.2 Radio Programming Cables.

441.1.8.1.1.3 Mounting bracket kit.

441.1.8.1.1.4 Customer programming software.

441.1.8.1.1.5 Firmware.

441.1.8.1.1.6 Hascall-Denke marine band VHF antenna, part number MADP156-162.

441.1.8.1.1.7 Transceiver remote radio speaker, part number MLS-410SP-B.

441.1.8.1.1.8 Transceiver radio flush mount kit, part number MMB-84.

441.1.8.2 The DSC Radio System shall interface with SINS via a RayMarine DeviceNet NMEA 2000 to SeaTalk NG Adaptor and exchange available NMEA 2000 PGN data with the SINS MFD units.

SECTION 443 LOUD HAILER/ INTERCCOM

443.1 GENERAL

443.1.1 The vessel shall have a system capable of emitting automatic audible signals and external voice commands in all operating environments.

443.1.2 The system shall provide sound signals to meet the requirements of the USCG Navigation Rules and Regulations Handbook; International Rules for Prevention of Collisions at Sea (72 COLREGS) Annex III; and Inland Navigation Rules Annex III for sound signaling.

443.1.2.1 An additional dedicated Standard Horizon GX-6000 DSC Radio System may be provided by the builder to provide this functionality.

443.1.3 The system shall have four (4) remote intercom stations (galley/mess area and berthing spaces, workshop and machinery space (s)) and two (2) exterior loudhailer/listener stations. Interior stations shall be push to talk.

443.1.4 The system shall have a volume control.

443.1.5 The system shall be independent of other communication systems.

443.1.6 The speaker(s) shall be IP67 rated.

443.1.7 The system shall have listen-back capability.

443.1.8 The system shall have a siren/yelp feature that is activated by means other than the handheld microphone.

443.1.9 The system shall be configured with a remote water-resistant microphone (IP65 or greater).

443.1.10 The system shall be controllable from the aft console in the pilothouse and shall be in a location convenient to the helmsman.

443.1.11 A horn signal shall be operated by a dedicated momentary switch accessible from each helm location.

SECTION 455 AUTOMATIC IDENTIFICATION SYSTEMS

455.1 GENERAL

455.1.1 The vessel shall have a Coast Guard 1SG38-AIS2(V)2 system, hereafter referred to as AIS, comprising the following components:

455.1.1.1 RayMarine AIS5000 Transponder Bundle, part number T70529.

455.1.1.2 The Coast Guard variant bundle includes the following components:

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455.1.1.2.1 RayMarine AIS-5000 Transceiver, Class A, part number A80601.

455.1.1.2.1.1 The transceiver unit shall be installed at the helm.

455.1.1.2.2 RayMarine Antenna, VHF, part number A80590.

455.1.1.2.3 RayMarine Antenna, GPS, with Mounting Kit, part number A80589.

455.1.1.2.4 RayMarine Junction Box, part number A80588.

455.1.1.2.5 RayMarine Pilot Plug Cable Assembly, part number A80650.

455.1.1.2.6 14-pin data cable.

455.1.1.2.7 18-pin data cable.

455.1.1.2.8 AIS Transceiver mounting bracket.

455.1.1.2.9 GNSS Antenna cable assembly.

455.1.1.2.10 Power cable.

455.1.2 The Pilot Plug Cable Assembly shall be installed in accordance with 33 CFR 164.46 (g).

455.1.3 The Pilot Plug Cable Assembly shall be interconnected with the AIS5000 transceiver via the AIS junction box.

455.1.4 AIS shall interface with SINS via a RayMarine DeviceNet NMEA 2000 to SeaTalk NG Adaptor and exchange available NMEA 2000 PGN data with the SINS MFD units

SECTION 457 ELECTRO-OPTICAL AND INFRARED SURVEILLANCE SYSTEM

457.1 ELECTRO-OPTICAL (EO) AND INFRARED (IR) CAMERA SYSTEM

457.1.1 A marine grade Electro-Optical (EO)/Infrared (IR) camera system shall be installed. It shall:

457.1.1.1 Be integrated with SINS and available to display camera feed data on all SINS MFD units.

457.1.1.2 Have thermal, infrared and visible light sensors.

457.1.1.3 Have a minimum 4X zoom function.

457.1.1.4 Be capable of detecting a 30-foot vessel at a range greater than 2 NM in total darkness.

457.1.1.5 Be provided with remote-controlled pan (360º), tilt (+/- 90º), and home control.

457.1.1.6 Have image stabilization.

457.1.2 The EO/IR camera system shall be capable of monitoring visibility both fore and aft to aid in navigation, identify targets of interest, and monitor vessels being towed astern.

457.1.3 Displays and control indicators shall be dimmable to 0 lumens.

457.1.4 System displays and control interfaces shall be installed at the helm position in accordance with ASTM F1166.

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SECTION 505 GENERAL REQUIREMENTS FOR PIPING SYSTEMS

505.1 GENERAL

505.1.1 This section specifies requirements for the design, construction, material, fabrication, arrangement, installation, testing, and cleaning of piping systems and piping components.

505.1.2 Component design pressures shall not be less than system maximum allowable working pressures. Normal, abnormal, and emergency operation and casualty conditions shall be considered in determining the maximum allowable working pressure.

505.1.3 Normal, abnormal, emergency, and casualty conditions shall be considered in determining the maximum system temperature. The design temperature shall equal or exceed the maximum system temperature.

505.2 DESIGN AND SELECTION OF COMPONENTS

505.2.1 Material selections shall be as shown in contract drawings.

505.2.2 Joints between dissimilar metallic piping materials shall be protected against galvanic corrosion. Such joints shall be made with dielectric fittings or components.

505.2.3 Joint Bolting. Selection of bolting lengths shall be in accordance with ASTM F704.

505.2.4 Raised face flanges shall not be used against bronze or other relatively low strength composition valves, fittings or flanges.

505.2.5 Use of threaded pipe, valve, and fittings in sea water systems is prohibited.

505.3 PRESSURE RELIEF

505.3.1 Relief valves on non-fired pressure vessels shall take into account maximum filling rate and the possibility of fire in the compartment and be sized in accordance with ASME BPVC Section VIII.

505.3.2 Where relief valve discharge piping is provided, it shall be arranged and sized so that the backpressure does not cause unsatisfactory relief valve operation, either from a stability or capacity standpoint. Back pressure build-up shall be based on the maximum capacity of the installed relief valve rather than the minimum required relief valve flow rate based on source flow.

505.3.3 The open ends of relief valve discharge piping shall be located so that discharge does not damage machinery or equipment or endanger personnel.

505.4 PRESSURE, TEMPERATURE, LEVEL AND FLOW CONTROLS

505.4.1 Orifices

505.4.1.1 Orifices shall be installed in a flanged joint and constructed in accordance with USCG Drawing YD-505-001.

505.4.1.2 Where orifices are installed in constant flowing copper nickel piping systems, piping material downstream of each orifice shall be 70-30 copper-nickel for at least ten(10) pipe diameters.

505.4.1.3 Where required, Orifices shall have a cavitation index K of 1.0 or greater calculated as follows:

$$K = \left[\frac{(H_u - H_v)(1 - (D_o/D_i)^2)}{H_u - H_d}\right] - 1$$

Where:

K = cavitation index

Hu = static head upstream of the orifice, ft.

Hd = static head downstream of the orifice at 10 pipe diameters, ft.

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Hv = absolute fluid vapor pressure, ft.

Do = orifice diameter, in.

Di = pipe inside diameter, in.

Where the cavitation index is found to be less than or equal to 1, the condition shall be corrected by installing a multistage orifice.

505.4.2 Control valves shall be evaluated for cavitation. The valve shall be designed and configured such that the downstream restriction does not affect valve performance other than for the intended purpose of correcting cavitation using the following formula for cavitation index:

$$K = \frac{(P2 - Pv)}{(P1 - P2)}$$

Where:

K = cavitation index

P2 = absolute pressure downstream of the valve

P1 = absolute pressure upstream of the valve

Pv = absolute fluid vapor pressure.

The cavitation index shall be in accordance with the manufacturer's data for avoidance of incipient cavitation. Installation of cavitation trim, downstream orifice plate(s) are permitted means to bring the cavitation index into compliance, provided that they do not affect the operation of the valve.

505.5 VALVES

505.5.1 Valves shall be installed and be in accordance ASTM F1166 Section 12, Valve Placement, Orientation, and Location.

505.5.2 Globe and angle valves shall be arranged with the system pressure or vacuum under the disc so that in the shut position, the pressure or vacuum is not exerted on the bonnet joint or stem packing.

505.6 PIPE SUPPORTING ELEMENTS

505.6.1 Supports shall be installed on or adjacent to concentrated weights in the piping system to preclude contact with adjacent pipe, equipment, and structure under loading or under working of the ship.

505.6.2 Design and installation of rigid pipe hangers shall be in accordance with ASTM F708.

505.7 PIPING STRUCTURAL REQUIREMENTS

505.7.1 Piping systems shall have the flexibility to prevent overstressing of piping materials or supports, leakage of joints and unacceptable distortion of connected equipment.

505.8 ARRANGEMENT

505.8.1 Piping shall not obstruct or interfere with the operation of doors, hatches, manholes, scuttles, or openings covered by portable plates, nor obstruct or interfere with access panels, access doors, inspection manholes, hand holes, sight glasses, drain plugs or test cocks used for inspection and maintenance of machinery and equipment.

505.8.2 Connections to pumps, tanks, and equipment shall have take down joints to facilitate maintenance.

505.8.3 Local high and low points shall be avoided in the arrangement of piping. Where necessary for the proper functioning of the system and its connected machinery and equipment, vents, and drains shall be installed at the high and low points.

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505.8.4 Waster pieces shall be installed in the overboard discharges and other locations where joints between ferrous and non-ferrous materials are required. Waster pieces and their installation shall be in accordance with Coast Guard Drawing YD-505-003.

505.8.5 Overboard discharges shall be fit with a swing check and cutout valve. Unless otherwise specified, the cutout valve shall be at the shell of the ship with the swing check valve located as close as practicable to the cutout valve and installed in a fore and aft direction.

505.9 INTERFACE TO SHIP STRUCTURE

505.9.1 The penetration of decks and bulkheads shall be minimized. Bulkheads and decks shall generally be penetrated close to boundaries of compartments.

505.9.2 Single pipe penetrations through watertight bulkheads and decks may be installed using ABS-approved Roxtec model SPM, or equal, sleeves/seals for piping not located in bilge areas, or below deckplate. Roxtec or equal products are prohibited in hydrocarbon fluid systems (e.g., hydraulic oil, fuel oil, etc).

505.1.1 Piping penetrations in the bilge shall be installed in accordance with NAVSHIPS drawing 803-1385866, Figure 1C.

505.10 FIRE HAZARD REDUCTION

505.10.1 Flammable fluid piping shall not be located within 18 inches of hot surfaces.

505.10.2 Piping with hot surfaces shall not be located within 18 inches of tanks containing flammable fluid.

505.10.3 In machinery spaces and in other operating spaces that contain both machinery and electric equipment, combustible or flammable fluid piping shall be kept as far from electrical equipment as practicable.

505.10.4 Takedown joints in piping containing combustible fluids shall be located as remotely as practicable from hot surfaces.

505.11 TAILPIPES

505.11.1 Tailpipe location with respect to adjacent plating or other components shall ensure a free suction area around the open-end periphery not less than 1- 1/2 times the inside area of the pipe.

505.11.2 Each tailpipe shall have a minimum of one valve between the tailpipe and the piping system.

505.11.3 Tailpipes shall terminate ½ the tailpipe nominal pipe size from the tank bottom except for the following:

505.11.3.1 Fuel tank stripping and overflow: 3/4".

505.11.3.2 Fuel service to engine: 3”

505.11.3.3 Fuel return from engine to top of tank.

505.12 PIPE INSULATION

505.12.1 Piping systems shall be insulated and lagged in accordance with ASTM F683 except as modified herein.

505.12.2 The requirements of ASTM F683 section 5.4 shall not apply.

505.12.3 Where insulation is required, elastomeric cellular insulation and lagging in accordance with ASTM F683 Table 1 shall be used for the following system operating temperatures:

505.12.4 For piping operating between 32 °F and 125 °F: Insulation shall be 3/4" thick in non-conditioned spaces and 1/2" thick in conditioned spaces.

505.12.4.1 For chilled/hot water and freshwater cooling loops shall be 1-1/2" thick in non-conditioned spaces and 1" thick in conditioned spaces.

505.12.5 Calcium silicate and expanded perlite insulation shall not be used.

505.13 PIPING AND VALVES

505.13.1 Erosion in continuously operating piping systems shall be mitigated by the following:

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505.13.1.1 Pumps shall be selected to meet system curves based on the flow characteristics and operating requirements

505.13.1.2 Avoiding the use of tees, short radius elbows, or other fittings which cause a sudden change in direction.

505.14 HOSE AND HOSE ASSEMBLIES

505.14.1 Flexible piping connections such as hoses or expansion joints shall be installed between two points to provide flexibility, isolation or control vibration.

505.14.2 Connections shall absorb the maximum anticipated excursions of equipment, without overstressing the connection, attached piping, or the equipment to which the connection is attached.

505.14.3 Hose and Hose Assemblies.

505.14.3.1 Hoses and hose assemblies shall comply with SAE J1942, be listed in SAE J1942-1 for the intended service and installed in accordance with J1273.

505.14.3.2 Hose lengths shall be limited to that necessary to provide flexibility and for proper operation of the machinery. Excluding bilge pump hoses, hose lengths shall not exceed 30 inches, except where required for equipment movement.

505.14.3.3 Braided, stainless steel jacketed, flexible hoses meeting National Sanitation Foundation (NSF) 61 may be used in the potable water system between the system cut out valve and end user.

505.14.3.4 Fuel, lube oil, and hydraulic systems hose fittings shall be stainless steel and have either crimp-on or re-useable end fittings.

505.14.3.5 Hoses in the raw water and bilge systems shall use hose barb fittings with two stainless steel hose clamps (if practicable). For raw water hoses in sizes exceeding that covered by SAE J1942 shall be Bellowsflex 7910, or equal.

505.14.3.6 Hose assemblies shall be hydrostatically tested to 150% of the system service pressure.

505.14.4 Expansion Joints

505.14.4.1 Non-Metallic Flexible Expansion joints used for fluid systems (excluding diesel air intake and exhaust, and heating, ventilation, and air conditioning [HVAC]) shall meet the requirements of ASTM F1123.

505.14.4.2 Expansion joints shall not be used in hydraulic systems.

505.14.4.3 The outside covers of expansion joints shall be neoprene.

505.14.4.4 For lube oil service and seawater systems, the inner sleeve of expansion joints shall be nitrile-butadiene (BUNA-N).

505.14.5 Hose Tags

505.14.5.1 Metal hose tags shall be installed on all hose assemblies and expansion joints and contain the component serial number, test pressure, and service life date listed in the Hose Assembly Report.

505.14.5.2 Tags shall be attached using materials that will not damage hoses or flexible joints. If metal strapping causes chaffing, nylon cable ties may be used. Nylon cable ties shall not be used on hoses that have operating temperature over 180°F.

505.15 MACHINERY AND PIPING SYSTEM DRAINAGE

505.15.1 Discharges above the water line shall be fitted with drip edges to prevent drainage from staining or corroding the hull.

SECTION 506 OVERFLOW, VENTS, AND SOUNDING

506.1 GENERAL

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506.1.1 Overflows, vents and sounding tubes shall be as shown in the contract drawings.

506.2 OVERFLOWS AND AIR VENTS

506.2.1 Tank vents and overflows shall meet ABS MVR 4-6-4/9 except as amended herein.

506.2.2 Where vents and overflows are combined, provisions shall be provided to permit testing the tanks individually.

506.2.3 Vents from fuel tanks and sewage tanks shall terminate clear of ventilation intakes, openings into the vessel, and sources of ignition such as combustion exhaust gas outlets.

506.2.4 Sewage holding tank air escapes shall be sized such that the seal of any plumbing trap will not be subjected to a pressure differential of more than 0.25 kPa (1 inch of water) when all sewage pumps are discharging at their maximum anticipated flow rates, but in no case shall be less than 1-1/2-inch NPS.

506.3 SOUNDING TUBES

506.3.1 Sounding tubes shall be provided and installed for fuel tanks.

506.3.2 The upper ends of sounding tubes for fuel tanks shall terminate above the Main deck in the weather with a cap and chain. The sounding tube caps shall be designed so that any accumulated air pressure in the tube will be gradually released and equalized before the cap or plug is completely unscrewed.

506.3.3 Sounding tubes shall measure fluid in a tank or compartment at its lowest level. A sounding tube of not less than 1-1/2 inch NPS shall be installed. Such tubes may be run on an angle or they may be bent to a radius of not less than 10 feet. Sounding tube wall thickness shall be in accordance with ABS MVR 4-6-4/11.3.3.

506.3.4 A striking plate shall be provided at the bottom of each sounding tube or welded to the tank bottom in way of the sounding tube to protect the tank plating from damage by the sounding device. Where sounding tubes are nonferrous, the striking plate shall be mounted in double shear.

506.4 ELECTRONIC TANK LEVEL INDICATION (TLI)

506.4.1 Black and Grey Water tanks shall have either a radar type or pressure sensor tank level indication device for local and remote reading of the tank level.

506.4.2 Radar type tank level indication devices shall be installed on fuel oil tanks.

506.4.2.1 Fuel tank TLI readings shall be displayed both in the Pilothouse and in the Engine Room.

506.4.3 The failure of the TLI device shall not result in the release of the content of the tank through the device.

506.4.4 TLI standpipes shall be separate from manual sounding tubes and constructed of non-ferrous material.

506.4.5 TLI's shall comply with the following at a minimum:

506.4.5.1 Be approved by a maritime classing society

506.4.5.2 Utilize 316L stainless steel housing and wetted parts (pressure type only).

SECTION 507 MACHINERY AND PIPING DESIGNATION AND MARKING

507.1 GENERAL INFORMATION

507.1.1 Information and identification labels shall be permanently installed on all machinery, equipment, and piping systems. Labels shall be designed and placed to prioritize legibility, clear identification of function, and ease of maintenance in accordance with Section 15 of ASTM F1166.

507.1.2 Equipment and piping shall be identified using plain English functional names consistent with the vessel's Piping Diagrams and technical manuals. Equipment identification labels shall include the following information:

507.1.2.1 Equipment Nomenclature

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507.1.2.2 Serial number

507.1.2.3 Manufacturer name

507.1.2.4 Equipment component location/identification number

507.1.2.5 Critical ratings, as applicable to the equipment.

507.2 LABEL MATERIAL AND INSTALLATION REQUIREMENTS

507.2.1 Material Selection. Label materials shall be selected based on their installed environment to ensure they withstand wear throughout the life of the equipment. (See Table 507-1)

507.2.2 Installation. Adhesive labels shall be applied to clean, dry, and properly prepared surfaces. Metallic plates shall be affixed using mechanical fasteners or marine-grade structural adhesives appropriate for the substrate.

Table 507-1. Label Material Selection.

Installation Environment	Acceptable Label Material
Interior / Climate Controlled	High-performance, marine-grade self-adhesive vinyl (e.g., 3M Scotchcal or equivalent), durable plastic tags, or metallic plates.
Interior / High Wear or Bilge	Engraved durable plastic or metallic plates (Stainless Steel 316L or Anodized Aluminum).
Exterior / Weather Exposed	Type A (etched), B (engraved), or C (stamped) stainless steel per ASTM A240, type 316L.
High Heat (Surfaces > 125°F)	
Attached via Wire/Lanyard	Metallic or rigid marine-grade UV-resistant plastic.

507.3 PIPING SYSTEM IDENTIFICATION AND MARKING

507.3.1 Piping Color Coding. Piping systems shall be color-coded to identify their contents in accordance with Table 6-8 of COMDTINST M10360.3 Coatings and Color Manual. Color bands shall be placed adjacent to the functional text labels.

507.3.2 Piping Marking Contents. All piping systems shall be marked for identification. The marking shall include:

507.3.2.1 The system's functional name in plain English (e.g., "FIREMAIN", "POTABLE WATER", "DIESEL FUEL").

507.3.2.2 A directional flow arrow pointing away from the text. For reversible flow, arrows shall point in both directions.

507.3.2.3 Operating pressure, only if the fluid exceeds 50 psi or has major pressure differences for similar functions.

507.3.3 Spacing and Placement. Piping system labels are not required to follow rigid distance spacing. Instead, labels shall be placed at functional locations to allow operators to easily trace systems. Markings shall be applied at the following minimum locations:

507.3.3.1 Adjacent to all valves, pumps, and major system components.

507.3.3.2 On both sides of bulkhead and deck penetrations.

507.3.3.3 At changes in piping direction.

507.3.3.4 At least once in each discrete compartment or space the piping traverses.

507.3.4 Valve Identification. Valves shall be labeled with their specific function and system (e.g., "FIREMAIN OVERBOARD DISCHARGE"). Where a valve is installed below a deck plate or is similarly hidden, a

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duplicate identification label shall be installed on the portable access plate or surrounding visible structure.

507.4 HVAC SYSTEM LABEL PLATE DESIGNATIONS.

507.4.1 Major Components. Major HVAC components (fans, duct coils, heaters, fan coil units, thermostats, filters) shall be labeled with their functional name and the specific compartments or spaces they serve.

507.4.2 HVAC Closures. Watertight and weather-tight closures on ventilation ducts shall be labeled with their functional designation and the compartments secured by the closure.

507.4.3 Duct Runs, Terminals, and Openings.

507.4.3.1 HVAC ductwork, terminals, and weather openings shall be identified using plain English labels and an airflow direction arrow. Labels shall clearly indicate the system type (e.g., SUPPLY, EXHAUST, RECIRC) and the primary space or equipment served (e.g., "GALLEY EXHAUST" or "ER SUPPLY"). Labels shall be placed at the following minimum locations:

507.4.3.1.1 Penetrations: On both sides of all bulkhead and deck penetrations.

507.4.3.1.2 Weather Openings: At all exterior intakes and exhausts. If the opening is equipped with an emergency closure (flap or damper), the "OPEN" and "CLOSED" positions shall be clearly marked.

507.4.3.1.3 Critical Terminals: At interior supply diffusers or exhaust grilles where the function is critical or not immediately obvious (e.g., dedicated battery box exhaust or electronics cooling).

SECTION 512 HEATING, VENTILATION AND AIR CONDITIONING

512.1 GENERAL

512.1.1 The objective of the HVAC system is to provide efficient and effective heating, cooling, and ventilation to all of the compartments on the vessel, as well as to establish the required air supply and exhaust to ensure crew safety and support equipment requirements. It will consist of fan coil units in the living spaces, workshop, and pilot house as well as ventilation systems for the machinery spaces to maintain the design temperatures identified in the contract drawing through the whole range of operating conditions identified in Section 070. Replenishment air for the fan coil units will be supplied by a dedicated ventilation supply system, and exhaust will be handled naturally (pilot house and engine room) or through mechanical ventilation. Heating and cooling will be provided by a 2-pipe thermal fluid system with 45°F chilled water in cooling season and 180°F hot water in heating season. Heating of conditioned spaces will be via the fan coil units, while duct heaters, convection heaters, and unit heaters will provide the balance of the heating capacity. Supply air for recirculating system replenishment and for the auxiliary machinery space will be preheated.

512.1.2 The HVAC system shall be as shown in the contract drawings.

512.2 SYSTEM REQUIREMENTS

512.2.1 Weather Openings. Weather openings shall be designed and located to prevent accumulation of ice and/or snow in all operating conditions down to the design temperature, shipping seawater, driving rain, or spray. Resistance to entrance of water may be either inherent by reason of location or design or obtained by use of water excluding ventilators. Ventilator throat heights shall meet the requirements derived from heel angles, down flooding angles and trim lines required to meet damage control requirements without the use of closing apparatuses where possible.

512.2.2 Supply system intakes shall be located to prevent recirculation of air from combustion air discharge openings, exhaust air, and noxious or toxic fumes and smoke. Supply system intakes shall not be in the vicinity of sewage, gray water, or flammable liquid tank vents and shall be located so that it is not possible to ingest fumes from such vents during any foreseeable condition of operation.

512.2.3 Hazardous Spaces. Compartments containing A2L refrigerants shall be compliant with ASHRAE Standard 15, including but not limited to the use of refrigerant monitoring devices and airflow alarms.

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512.2.4 Routing of Duct. Installation of duct sections, terminals, cooling coils, and fan coil units over electrical and electronic equipment is not permitted.

512.2.5 System Test and Balance Requirements

512.2.6 System testing and balancing shall be in accordance with ASHRAE Standard 151 and SOW Section 512. At the conclusion of balancing, balancing dampers shall be drilled and permanently riveted in place.

512.3 SYSTEM VELOCITIES

512.3.1 The maximum design air velocity for recirculating ventilation ducting shall not exceed 1,500 feet per minute (fpm).

512.3.2 Air velocities for all other ventilation system components (including terminals, filters, and weather openings) shall be sized to prevent moisture carryover, excessive noise, and excessive system pressure drop.

512.4 EQUIPMENT REQUIREMENTS

512.4.1 Filters. Disposable Air filters having a MERV rating of 8 shall be provided for all preheaters as well as cooling and dehumidifying equipment. Ventilation supply systems containing preheaters shall have a filter installed upstream of the preheater. Face area of filters installed upstream of preheaters shall be at least equal to that of the preheater.

512.4.1.1 Filters shall be accessible and easily removable\Frames shall be airtight.

512.4.2 Screens. Weather terminals and ventilation exhaust inlets shall be provided with galvanized steel, aluminum, or CRES screens, ½” mesh with 0.063” wire diameter.

512.4.3 Terminals

512.4.3.1 Exhaust Terminals. Bellmouth exhaust terminals shall be used in all locations, except where side duct openings would more efficiently serve to exhaust heat from equipment with internal exhaust blowers.

512.4.3.2 Location of Terminals. Terminals shall be arranged to prevent water from dripping, splashing, or being blown on electric or electronic equipment; to prevent short circuiting of air between supply and exhaust terminals, or between terminals and compartment accesses; to prevent dead spaces; and to exhaust heated air or fumes directly from the sources. Compartment air distribution shall be arranged for, as near as practicable, a full sweep of the room.

512.4.3.3 Supply and exhaust terminals shall be installed in the overhead, except as follows:

512.4.3.4 Replenishment air terminals shall be directed into and terminated not more than 300 mm (12 inches) from the fan coil unit intakes or directly connected to the return for ducted systems.

512.4.3.5 Except for main machinery spaces, the exhaust terminals in spaces containing hydraulic oil reservoirs shall be located close to the reservoir breather pipe.

512.5 CONSTRUCTION REQUIREMENTS

512.5.1 Unless otherwise specified, duct construction shall be in accordance with SMACNA HVAC Duct Construction Standard and ASHRAE Handbooks. All joints in watertight duct shall be welded. Gasketed watertight flanges shall be used for takedown and attachment to equipment.

512.5.2 Entrance Requirements. Installation of fans, cooling coils, heaters, and supply system take-offs shall ensure full and unstratified airflow.

512.5.3 Duct Shapes. Where rectangular ducts are used, the ratio of the large to small dimension shall not exceed 3.5.

512.5.4 Spirally Wound Ducts. Spirally wound galvanized steel or aluminum duct and fittings may be used for round or flat oval non-watertight ductwork.

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512.5.5 Corrosion Protection. All HVAC system components subject to seawater spray, driving rain, or condensation including supply and exhaust system fan rooms and intake/discharge plenums shall be given corrosion protection as follows:

512.5.6 Duct sections expected to collect water from one of the above sources shall be constructed from CRES 316L.

512.5.7 Aluminum and galvanized steel surfaces shall be protected inside and out in accordance with Section 631.

512.5.8 Corner Radii. Where corner radii are required on rectangular duct, the connecting duct shall be faired in if the reduction in cross sectional area is 5 percent or greater.

512.5.9 Gaskets. Gaskets shall be used for flanged joints.

512.5.10 Flanges. Flanges or flange corners protruding below the headroom level shall be padded or provided with a headroom flange to prevent injury to personnel. Watertight flanges shall be bolted together with a flat, continuous face, and fully welded to the duct.

512.5.11 Watertight Ducts. Welded construction shall be used for watertight ductwork. Take down joints and equipment connections shall be flanged.

512.5.12 Blind Rivets. Aluminum blind rivets may be used in non-watertight aluminum ductwork.

512.5.13 Screws. The use of sheet metal screws is prohibited. Tapping Screws, ASME B18.6.3-2010, may be used where metal thickness allows a thread engagement equal to a standard nut of the same screw size and where the thread cutting screw does not have to be removed.

512.5.14 Ducting and Equipment Access Openings. Cleaning and inspection openings shall be provided to access all sections of the system.

512.5.14.1 On each side of duct heaters

512.5.14.2 On the air inlet side of centrifugal fans, vane turns and splitters.

512.5.14.3 At the impeller end of axial fans.

512.5.15 In exhaust ducts serving the machinery rooms so that all interior areas of the ducts from the exhaust inlet to the weather can be reached and cleaned.

512.5.16 Duct Hangers. Hangers for ductwork and heaters shall properly and adequately support the equipment for all static and dynamic conditions outlined in Section 070. This includes ramming of ice.

512.5.17 Flexible Duct Connections. Flexible joints shall be used on all fan duct connections and shall be flanged rubber spools. The spool material shall be at least 3/16 inch thick and at least 2 inches long in the direction of airflow. The joint shall be able to deflect sufficiently to allow free travel of equipment.

512.5.18 Balancing Provisions. System balance shall be achieved by orifice plates and/or dampers. Where dampers are used for balancing, they must be permanently affixed by riveting following balancing. Dampers must be present at every supply and exhaust terminal

512.5.19 Deck Penetrations. Ventilation ducts that pierce decks shall be watertight for a distance of 3 inches above the deck. This shall be achieved by a section of watertight pipe, or a spool welded to the deck.

512.6 CONTROL REQUIREMENTS

512.6.1 Fan motor controllers for the engine room shall be located outside the compartment in the ATON Workshop.

512.6.2 Chilled Water Cooling Coils.

512.6.2.1 Recirculating Systems. Chilled water flow through fan coil units shall be controlled by three-way solenoid-actuated control valves.

512.6.3 Heater Controls

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512.6.3.1 Thermostat for preheaters shall be a proportional integral derivative (PID) controller producing a 0(2)-10vdc control output. The proportional (throttling range), integral, and derivative gains shall be adjustable. The sensing element shall be a duct mounted Positive Temperature Coefficient (PTC) thermistor or iron constantan type "J" thermocouple downstream of the pre-heater. Thermostat shall be set for a constant preheat air delivery temperature.

512.6.3.2 Unit heaters and convection heaters shall utilize a wall mounted proportional thermostat providing a 0(2)-10vdc modulating output.

512.6.3.3 Recirculating, Reheat, and Space Heat Thermostats. The thermostats shall be located in the return air stream from the space served, wherever practical. Room thermostats shall be mounted approximately 1.5 m (5 ft) above the deck in a location which is representative of the average temperature of the space. Thermostats shall be located away from sources of heat or stagnant air pockets.

512.6.3.4 Fan and Damper Control Interfaces and Interlocks. Controls of auxiliary equipment, such as cooling coils, electric duct heaters, or battery charging units, shall be interlocked with the fan controller of the fan serving or associated with that equipment or device such that when fan is secured the auxiliary equipment or device is secure.

512.6.3.5 Automatic closures shall be installed in the supply ducting serving compartments protected by fixed firefighting systems. Fans and closures shall be interlocked to secure airflow before fixed firefighting systems are discharged.

512.7 DAMAGE CONTROL REQUIREMENTS

512.7.1 Where watertight closures are required, the duct shall be continued watertight from the penetration to the watertight closure.

512.7.2 Fire Tight Integrity. Requirements of NVIC 9-97 and MSC PRG.GEN-04 shall apply.

512.7.3 Fire Dampers. Fire dampers shall be Coast Guard Approved Type 164.139. Where watertight closures are required at the same boundary as a fire damper, the watertight closure may fulfill the requirement of the fire damper if the control requirements are met.

SECTION 514 HVAC CHILLED AND HOT WATER SYSTEMS

514.1 HVAC CHILLED AND HEATING WATER SYSTEM REQUIREMENTS

514.1.1 The HVAC Chilled and Heating Water System shall supply heating and cooling thermal fluid (in this section, "water" is to be interpreted as thermal fluid) in a 2-pipe configuration to HVAC services including but not limited to: duct coils, fan coil units, unit heaters, and convection heaters. Heating water shall be supplied at 180°F by an Aldrich L-17W fired heater through a dedicated hot water pump, Cooling water shall be supplied at 45°F and 3.9 gpm/ton by two Dometic 48,000 btu/h chillers through a dedicated chilled water pump. A common expansion tank shall set the system pressure upstream of the fired heater and chillers as well as handle the thermal expansion and contraction of the fluid due to the variation in operating conditions. Each service shall be piped in parallel branches off the main, and shall contain a wye strainer, three-way modulating or two-position zone valve depending on the service, flowmeter, service valves and balancing valve(s). Fan coil units shall have a dedicated balancing valve for heating and cooling mode, while preheaters, unit heaters, and convection heaters shall be fitted with a single balancing valve and be secured in cooling season. When in port, heating shall be provided by an immersion heater using ship's electric power via the shore tie.

514.1.2 The chilled and hot water system shall be as shown on the contract drawings.

514.2 THERMAL FLUIDS

514.2.1 The working fluid for hydronic heating systems shall be in accordance with section 256. If the working fluid is to be used in air intake preheaters or any other services exposed to the cutter design service temperature, the ratio of water and glycol serving that system shall have a freezing point no higher than -55 degrees F.

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514.2.2 The thermal fluid shall be pre-mixed in a tank that contains not less than 20 gallons. The tank need not be dedicated to the thermal fluid system and may be combined with the diesel engine jacket water replenishment tank. An automatic replenishment system shall draw directly from the tank via a permanent connection.

514.2.3 The automatic replenishment system shall have an automatic shut off to ensure the system is not overfilled. Automatic shut off for the system shall be triggered via level indication or pressure indication in expansion tank.

514.2.4 Where the expansion tank is air over water, the filling system shall be a pump drawing suction from the fill tank. The cut-in and cut-out commands shall be via level controls allowing 2-minute pump run time, and the required volume shall be added to the required acceptance volume.

514.2.5 Where the expansion tank is bladder-type, the filling system shall be a pump drawing suction from the fill tank. The cut-in and cut-out commands shall be via pressure controls, with the cut-in pressure being the pressure required to fill the system and the cut-out pressure being the system cold fill pressure allowing for the full thermal expansion of the system without opening the relief. The pre-fill of the expansion tank between these two pressures shall be added to the acceptance volume when sizing the tank. This volume shall be based on a minimum pump run time of 2 minutes. Alternately, a hydropneumatics charging tank sized for a 2-minute run time may be installed, with a pressure regulating valve set at the set at the cold fill pressure feeding the expansion tank.

514.2.6 The replenishment pump shall be sized to flow 1 gpm at a head equal to the relief setting of the highest-pressure system.

SECTION 516 REFRIGERATION SYSTEMS

516.1 GENERAL

516.1.1 HVAC chilled water will be a mixture of water and glycol provided by two chillers. The chillers will be staged in a lead-lag configuration to provide capacity control. Refrigeration of food stores will be provided by a standalone reefer/chiller unit.

516.2 OPERATION.

516.2.1 Pressure Relieving Systems. Where required by ASHRAE Standard 15, each refrigerant circuit shall be provided with a pressure relieving system. Each pressure relieving system shall consist of a high-pressure rupture disc assembly, a refrigerant relief valve, a low-pressure rupture disc, and associated piping. Refrigerant overboard discharge shall be piped to a main weather deck. The discharge shall terminate in a safe location where refrigerant cannot be picked up by HVAC systems or where water can be trapped and collect against a rupture disc. Piping arrangement shall prevent seawater corrosion of the rupture discs. Refrigerant relief piping from multiple units in the same compartment may be combined. The required capacity for refrigerant relief piping shall be the sum of all connected relief valve capacities.

516.2.2 Relief valves. Relief valves and refrigerant relief piping shall be provided and sized in accordance with ASHRAE Standard 15. Relief valves shall be brass or bronze body with corrosion resistant internal parts.

516.3 WATER CHILLER PLANTS

516.3.1 The chilled water plant shall consist of two chillers. The chillers shall be Dometic MCGX or equal, minimum capacity rating 48,000 btu/h at 3.9 gpm per ton, 45°F leaving water temperature, and condenser entering conditions as described herein.

516.3.2 The chiller plant shall have the following characteristics:

516.3.2.1 Titanium condensers suitable for seawater application

516.3.2.2 Rated for an ambient temperature of at least 130°F

516.3.2.3 A controller capable of coordinate plant staging and distribute compressor run-time evenly

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516.3.3 Plant controls.

516.3.3.1 Controls shall provide for sequential lead-lag control of chiller units.

516.4 SELF-CONTAINED EQUIPMENT

516.4.1 Self-contained equipment shall be defined to include reach-in chill and freeze boxes (internal gross volume of less than 100 cubic feet each), ice machines, beverage dispensers, compressed air driers, and similar small refrigerated units.

516.4.2 Self-contained equipment shall use refrigerants that are hydrofluorocarbon (HFC) or HFC/HFO (hydrofluoroolefin) blends, are non-ozone depleting, have a Global Warming Potential < 2500, and are classified as Safety Group A1 or A2L in ASHRAE 34.

SECTION 517 FIRED HEATERS AND OTHER HEAT SOURCES

517.1 GENERAL

517.1.1 This section contains the requirements for the cutter heating plant, which will consist of a fired heater to provide hot water while underway and an electric circulation heater while in port and connected to the shore tie. The heating plant provides heat to vessel HVAC heating equipment.

517.1.2 The fired and immersion heaters shall be configured as shown in the contract drawings.

517.2 FIRED HEATERS

517.2.1 Design Standards – Fired heaters shall be certified to ASME Boiler and Pressure Vessel Code Section IV.

517.2.2 The fired heater shall be an Aldrich Model L-17W, or equal, oil-fired vertical firetube unit operating at 180F (cut-in) to 185F (cut-out).

517.2.2.1 Fired heater shall be independently ducted to fresh air as shown on the contract drawings.

517.2.3 The system shall be compliant with ASME CSD-1 and UL 726.

517.2.4 Controls.

517.2.4.1 Fired Heaters shall be equipped with a "first-out" safety alarm and indicating system which will shutdown the unit in the event any condition exists which could cause damage to the equipment, sound an audible alarm, and give a visual indication for the initial cause for shutdown. The alarms shall sound locally and in the Pilot House.

517.3 ALTERNATE HEAT SOURCE.

517.3.1 An immersion heater shall be provided in parallel with the fired heater(s) to supply heat when in port and connected to shore power. The immersion heater shall be a Chromalox NWH-06-040P-E4 240V-3P 40kW circulation heater, or equal.

517.3.2 The immersion heater shall be controlled by an enforced zero voltage firing thyristor (SCR) power controller. The thermostat for the thyristor controls shall be a proportional controller. The sensing element shall be mounted in the pipe 5 diameters downstream of the heater. Thermostat shall be set for a constant water delivery temperature.

517.3.3 The immersion heater shall be equipped with safety controls in accordance with ASME CSD-1 including but not limited to a secondary manual reset temperature switch.

SECTION 521 SEAWATER SERVICES

521.1 SEA CHESTS AND OVERBOARDS

521.1.1 Overboard discharges shall be located at least one foot below the light ship design waterline.

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521.1.2 Sea chests shall be fitted at the forward ends of keel cooler recessions, where applicable, to mitigate ice ingestion.

521.1.3 Each sea chest shall be served by a secondary seawater source to clear blockages. The piping shall be arranged to dislodge and clear ice.

521.2 STRAINERS

521.2.1 Strainers shall be installed in supply piping to equipment, instruments, and flow control components to protect the smallest flow passage from clogging. Unless otherwise specified in the contract drawings, strainer perforations shall be sized between 50% and 90% of the diameter, or smallest dimension, of the smallest flow path served.

521.2.2 The total clear area of basket perforations shall be not less than three times the area of the strainer discharge connection.

521.2.3 Y-type strainers, where specified, shall be provided with valved drain lines.

521.2.4 All strainers shall be located such that personnel can access and clean the baskets while standing on deck plates without the use of ladders or stools.

521.3 SEA/HULL VALVES

521.3.1 Sea/hull valves shall be full port ball valves.

521.3.2 A sea/hull valve shall be installed in each pipe connecting to a sea chest or overboard discharge connection and shall be located as close as practical to the structural penetration.

521.3.3 Sea/hull valves using stud bolts to attach the valve to the hull fitting shall not require removal of the stud bolts to remove the valve. Where more than one pump is connected to a sea suction or overboard discharge, an additional valve shall be installed in each branch.

521.3.4 Where a sea/hull valve is attached to a steel connection, a steel waster piece shall be installed. Shell and sea chest penetrations and waster pieces shall be fabricated and installed in accordance with USCG Drawing YD-505-003.

521.4 PIPING

521.4.1 Arrangements - The piping shall be pitched to a low point drain. The drain will gravity drain the entire system without the removal of components. The system is intended to remain dry when not in operation.

521.5 FLOW BALANCING & DISTRIBUTION

521.5.1 Automatic balancing valves shall not be used in seawater systems.

521.5.2 System balancing in a distributive seawater system shall be accomplished by using fixed orifice plates for each branch or flow path in the system. See Section 505 for orifice plate sizing criteria, calculation of cavitation indices, and requirements for multi-stage orifice plate arrangements. Orifice plates shall be fitted with a bypass globe valve, and a differential pressure gauge. Orifice plates shall be installed in a straight run of pipe at least 10 pipe diameters downstream, and 5 pipe diameters upstream, of any fitting or component.

521.5.3 Where equipment requires temperature regulation, the temperature regulation shall be accomplished on the process side. Where this is not possible due to the media being cooled, the system shall use modulating three-way valve control at each heat exchanger service in the mixing or diverting configuration. The bypass at each control valve shall contain a fixed orifice plate equivalent to the pressure drop of the respective heat exchanger. Modulating valves shall actuate using a 4-20 mA control signal, and shall be capable of fully bypassing flow around the equipment when offline.

521.5.4 Except for sea chest temperature regulating valves, where direct acting 3-way temperature regulating valves are installed for seawater systems, modulation control via refrigerant filled capillary tube is prohibited when installed in a compartment with a maximum design temperature above 95°F.

521.5.5 Regulating valves shall have manual overrides or a bypass. The temperature setpoint shall be adjustable.

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521.5.6 Seawater systems shall be configured to recirculate water discharged from the plate heat exchanger to the sea chest to limit icing. This shall be accomplished by a 3-way diverting valve capable of sending 0-100% of the water to overboard or back to the sea chest. Temperature regulation shall be controlled by a thermocouple or sensing bulb in the sea chest suction piping upstream of the duplex strainer. The recirculation waster piece in the sea chest shall be configured to fully heat the sea chest and efficiently return all of the recirculated water back to the sea chest suction piping with minimal loss through the sea chest grating.

521.6 DECK WASHDOWN SYSTEM

521.6.1 Washdown seawater system shall be as shown on contract drawings.

521.6.2 The system shall be a dry type capable of being charged from the Pilothouse or the local pump control with no other actions required. The washdown seawater service system shall consist of one power driven pump and shall service two hose stations.

521.7 SEAWATER AUXILIARY COOLING SYSTEM

521.7.1 The seawater auxiliary cooling system shall be as shown on the contract drawings.

SECTION 528 PLUMBING AND DECK DRAINS

528.1 GENERAL

528.1.1 All plumbing drains and interior deck drains will direct water to sewage/graywater tanks with a 500-gallon capacity. Condensate from AC cooling units will be routed through water seal traps to a 7.5-gallon condensate sump tank and discharged overboard at least 12 inches above DWL.

528.1.2 Sewage collection tanks, vacuum toilets, transfer pumps, and gravity drains as well as the components and pipe sizing shall be as shown on the contract drawings.

528.1.3 The sewage/gray water holding tank shall receive waste from the vacuum sewage collection system and gray water system.

528.1.4 Gravity drains from the galley sink, wash basins and shower shall be lead through water seal traps to a Sewage/Gray water holding tank.

528.1.5 Gravity drain piping shall be installed in accordance with the International Plumbing Code as modified herein, with a minimum slope of 1/4 inch per foot.

528.2 PLUMBING AND DECK DRAINS

528.2.1 Gravity drains shall be a minimum of 1 1/4 inches NPS.

528.3 CONDENSATE DRAINS

528.3.1 Air conditioning cooling unit(s) condensate below main deck shall be lead through water seal traps to condensate sump tank(s). Each condensate sump tank shall have a minimum capacity of 5 gallons and be made of aluminum or polyethylene. Each sump tank shall be cleanable and vented to the atmosphere.

528.3.1.1 Pump(s) and piping components, shall be provided to allow for automatic discharge of air conditioning unit(s) condensate overboard.

528.4 TRAPS AND CLEAN-OUTS

528.4.1 Each fixture trap shall have a readily accessible means for cleaning. No fixture shall be double trapped. Traps shall be installed in a fore-and-aft direction. Each trap shall have a water seal of not less than two (2) inches nor more than four (4) inches.

528.4.2 Clean-outs. Clean-out fittings shall be installed in accessible locations to permit cleaning drain pipes. Clean-outs shall be installed at each change of direction greater than 90 degrees. Clean-outs shall be the same nominal size as the pipe served. Clean-outs for drains shall be installed with a minimum clearance of 12 inches for rodding.

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528.5 PLUMBING VENTS

528.5.1 Protection of trap seals from siphonage or back pressure shall be accomplished by air admittance valve.

528.6 SEWAGE SYSTEM

528.6.1 The sewage system shall consist of two vacuum operated water closets, holding tanks, vacuum pumps, shore discharge pump, and necessary wiring, piping and controls.

528.6.2 The 24-volt DC Dometic VG 4 vacuum pumps shall draw waste from the bowl and discharge to the sewage water holding tank. Flushing shall be with potable water.

528.6.3 Holding tanks shall be constructed of linear or cross linked polyethylene or stainless steel with gel coat inside. Two holding tanks shall be provided with a minimum capacity of 250 gallons each.

528.6.3.1 Wall thickness of polyethylene tanks shall be no less than 0.25 inches.

528.6.3.2 Tanks shall be tested to 3 psi or 1-1/2 times the total head of water from the lowest point in the tank to the highest point in the tank's vent, whichever is greater.

528.6.3.3 CRES tanks, including welding material, shall be fabricated of alloys not susceptible to corrosion from sewage, cleaning agents, or other additives.

528.6.3.4 Sewage tank level indication shall be provided in the pilothouse and display 1/3, 2/3, and 3/4 full capacities at a minimum.

528.6.3.5 Holding tank mounting and piping connections shall be made so that the piping can be disconnected and the tank removed for cleaning without destruction of the foundation or any piping.

528.6.4 Each water closet shall have a means of isolation to allow for maintenance.

SECTION 529 BILGE AND BALLASTING SYSTEMS

529.1 GENERAL

529.1.1 The Bilge system shall provide the capability of emergency dewatering in the case of flooding. The system shall also be capable of pumping out bilge contents to a shoreside facility. The emergency dewatering shall be accomplished via Rule 4000, or equal, bilge pumps. A portable pump will be utilized for pumping bilge water to shore facilities.

529.1.2 The bilge system shall be as shown on the contract drawings.

529.1.3 Pumps shall be capable of local control as well as remote control from the Pilothouse.

529.1.4 Each bilge pump shall be located so that it takes suction from the lowest practical point of the bilge space.

529.1.5 Switches shall be in one location within the Pilothouse arranged for easy operation while minimizing the risk of accidental operation. The switches shall provide for a manual on/off operation.

529.1.6 The Pilothouse shall drain water either to a bilge pump location or directly overboard through a check valve.

529.2 BALLAST SYSTEM

529.2.1 The forepeak tank shall be filled and emptied pier side using shoreside resources.

SECTION 530 AUXILIARY FRESHWATER COOLING

530.1 GENERAL

530.1.1 The freshwater cooling system shall utilize Alfa Laval T-6 PFG, or equal, to freshwater heat exchangers and circulate freshwater to cool auxiliary equipment. The freshwater piping consists of schedule 10 stainless steel piping gr304l or 316l, stainless steel buttwelds, socket weld or press connect fittings, and

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stainless steel valves. Seawater shall be drawn from keel cooler pockets serving as sea chests, pumped through 90/10 copper nickel piping with bronze silbraze or copper nickel welded fittings to the heat exchanger then discharged over the side.

530.1.2 The freshwater cooling system shall be as shown on contract drawings.

530.1.3 The working fluid for freshwater cooling systems shall be in accordance with section 256.

530.1.4 Additives shall be specifically accounted for in system design, as reduced fluid heat transfer coefficients relative to water will reduce system cooling capacity.

530.2 FRESHWATER TO SEAWATER HEAT EXCHANGERS

530.2.1 Piping shall be arranged to allow the heat exchanger to be isolated and serviced without disturbance to the connected piping systems. Where this is not possible, take down joints shall be provided between the heat exchanger and cutout valves.

530.2.2 Heat exchangers fitted with an internal strainer shall be mounted such that the strainer can be removed without interference or introducing the strained materials back into the cooler during removal. The strainers shall be located such that personnel can access and clean the baskets while standing on deck plates without the use of ladders or stools.

530.2.3 Plate type heat exchangers for seawater service shall be constructed using titanium plates in accordance with ASTM B265. This standard applies for seawater plate type heat exchangers, both propulsion and auxiliary systems.

530.2.4 Seawater cooled plate heat exchangers nozzles that are in contact with seawater shall be titanium. The seawater inlet and outlet piping serving the heat exchanger shall be galvanically isolated from the titanium plates with non-metallic hoses or non-conductive rubber flex couplings at each fluid connection.

530.3 FRESHWATER COOLING SUPPLY REQUIREMENTS

530.3.1 Where a fixed orifice plate is required, it shall be installed downstream of the heat exchanger and shall not be directly connected to the heat exchanger flange.

530.3.2 High points in each cooling loop shall be fitted with automatic vent valves or a deaerator system to purge air from the system.

530.4 HEAD TANK

530.4.1 A head tank shall be provided for each cooling loop.

530.4.2 Each head tank shall be sized to accommodate the thermal expansion of the total volume of fluid of the system over the entire temperature gradient possible, to include ambient space temperatures.

530.4.3 Head tanks shall be sized in accordance with ASHRAE Handbook HVAC Systems and Equipment to accommodate the system fluid expansion from minimum to maximum fluid temperatures.

530.4.4 Tanks shall be accessible for routine inspection.

530.4.5 Systems utilizing compression type head tanks shall be provided with alarms to indicate low system pressure.

530.4.6 Systems utilizing vented, gravity-style head tanks shall be provided with a low fluid level alarm.

530.4.7 Other additives are subject to USCG approval. Additives shall not be added with a dedicated hard piped connection to the system.

SECTION 533 POTABLE WATER SYSTEMS

533.1 GENERAL

533.1.1 The Potable Water Systems stores and distributes hot and cold potable water to plumbing fixtures and a window washing system. Two potable water tanks each with a capacity of 250 gallons are configured to

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receive potable water from a shore tie filling line. The Potable Water System includes a 20-gallon pressurized tank and pump that is capable of the delivery of water at a minimum pressure of 20 psi at shower heads and as recommended by equipment vendors, with the system operating at design capacity. One instantaneous water heater is sized to provide 120°F water to sinks and shower.

533.1.2 Potable water system shall be as shown on contract drawings.

533.1.3 Potable water components and installation shall be certified lead free and compliant with ANSI/NSF 61 or ANSI/NSF 372.

533.2 POTABLE WATER STORAGE

533.2.1 There shall be two equal potable water tanks each with a capacity of at least 250 gallons. Tanks shall be non-integral tanks made of stiffened composite, stainless steel, or aluminum material.

533.2.1.1 Stainless steel potable water tanks, including welding materials, shall be fabricated of alloys not susceptible to corrosion from potable water, chlorine, or other disinfecting agents and water treatment additives.

533.2.2 Only sealing compounds that conform to SAE AMS8660 and NSF/ANSI Standard 61 shall be used.

533.2.3 Potable water outlets, connections, and vents shall be provided with protection against siphonage and backflow of contaminants.

533.2.4 Each potable water storage tank shall have a sight glass.

533.3 SERVICE PUMP

533.3.1 Pump shall be Par-Max model Q402J-115S-3A or equal.

533.3.2 Pump shall have a disconnect switch nearby and shall be equipped with a pressure switch that starts the pump at 20 psi and stops the pump at 40 psi.

533.4 PRESSURE TANK

533.4.1 Pressure tank shall have an FDA approved vinyl bladder or polypropylene liner within a welded steel shell. Tank shall be sized to a minimum 1.5 minute pump cycle time to prevent short cycling. Pressure tank shall be pressurized 2-4 psi below minimum cut-in pressure Amtrol Model WX-202, or equal, meets these requirements.

533.5 WATER HEATER

533.5.1 Water heater shall be 16kw instantaneous hot water unit, Hubbell model MTX016-3T or equal.

533.6 WINDOW WASHING SYSTEM

533.6.1 A window washing system shall be installed for spraying each window equipped with a window wiper.

533.2.5 The system storage tank shall have a capacity of at least 10 gallons.

533.6.2 The tank shall have provision for filling from the potable water system, for adding anti-icing fluid, wetting agents and corrosion inhibitors.

533.6.3 The spray shall be controlled by a push button or other actuating device adjacent to the wiper control. A push button and control valve shall be furnished for each wiper control.

SECTION 541 FUEL SYSTEMS

541.1 GENERAL

541.1.1 The fuel oil system shall be constructed of Schedule 10 316L stainless steel pipe with 316L stainless steel fittings and valves. Booster pumps for each piece of fired equipment shall be mounted on the forward bulkhead of the Machinery Room and shall take suction on a header connected to each fuel oil tank and discharge to their respective piece of equipment. A return line shall allow fired equipment and booster pumps to send fuel back to the fuel oil tanks.

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541.1.2 The fuel systems shall be as shown on the contract drawings.

541.2 FUEL FILLING SYSTEM

541.2.1 The deck filling connections shall be 2-1/2 inches, located as shown on the drawings, and shall terminate in a blind flange. A containment coaming shall be provided around each deck connection and be drained to the fuel overflow tank via a threaded plug.

541.2.2 The fuel tank combined vents and overflow shall be collocated with a deck filling connection in the common containment coaming area.

541.2.3 The containment area shall have a drain plug as low as possible in the side for draining seawater/rain water.

541.2.4 The drain plug shall be installed in the drain hole to the overflow tank when not in use and shall be fitted with a keeper chain.

541.3 FUEL SERVICE SYSTEMS

541.3.1 Quick closing cutout valves shall be installed at each tank boundary suction connection with the common header pipe. The quick closing valves shall be capable of being operated locally and remotely.

541.4 TANKS

541.4.1 A high-level audible and visual alarm shall be provided for each fuel storage tank, set to actuate at 95% of tank capacity. A low-level audible and visual alarm shall be provided for each tank, set to actuate at 25% of tank capacity. Alarms shall actuate both locally and in the Pilothouse and shall be able to be silenced through acknowledgment of the alarm.

541.4.2 An overflow tank with a minimum capacity of 50 gallons shall be installed as shown on contract drawings.

541.4.2.1 A high-level audible and visual alarm shall be provided for the overflow tank, set to actuate at 10% of tank capacity. Alarms shall actuate both locally and in the Pilothouse and shall be silenced through acknowledgment of the alarm.

541.4.3 Tank Stripping

541.4.3.1 Each fuel storage tank shall have a stripping suction line, hard piped in the tank, connected to a common stripping header to support use of a portable pump operating at a minimum of 10 gpm.

SECTION 555 FIRE EXTINGUISHING SYSTEM

555.1 PORTABLE FIRE EXTINGUISHERS

555.1.1 Portable fire extinguishers shall be installed in accordance with and meet the requirements of ABYC A-4, Fire Fighting Equipment. The number and location of portable fire extinguishers shall be in accordance with ABYC A-4 Table 2, except as modified herein. At least one portable extinguisher shall be USCG Type 20-B.

555.1.2 Fire extinguishers shall be mounted so that they are secure but readily accessible with a quick and positive release for immediate use. Fire extinguishers shall be located so that they do not hinder crew movement and operation.

555.1.3 Fire extinguisher mounting brackets shall be marine type, heavy-duty, made of corrosion-resistant metal and appropriately sized to the extinguisher.

555.1.4 All portable fire extinguishers shall have an inspection tag installed on the device.

555.2 FIXED FIRE SUPPRESSION SYSTEM

555.2.1 The fixed fire suppression system shall be as shown on contract drawings.

555.2.2 The fixed firefighting system serving the machinery space shall be a Marioff MAU150 pre-engineered water mist system, or equal.

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555.2.2.1 The system shall be powered by pressurized nitrogen cylinder(s) to provide at least ten minutes of coverage.

555.2.2.2 The system shall be USCG type approved.

555.2.3 The system shall be installed in accordance with the type-approved Design, Installation, Operation, and Maintenance manual (DIOM).

555.2.4 The fixed fire suppression system shall have at least two manual actuation stations: one in the main egress route outside the engine room spaces, and another in a conspicuous location in the pilothouse.

555.2.4.1 The fire suppression system(s) shall not be capable of automatic discharge.

555.2.5 Upon activation, automatic switches shall:

555.2.5.1 Shut down engines, gensets or other equipment that processes or consumes diesel in the protected space.

555.2.5.2 Energize electrical warning indicators, and audible/visual alarms; and

555.2.5.3 Secure ventilation fans serving the protected space and closing any ventilation dampers

SECTION 556 HYDRAULIC OIL SYSTEMS

556.1 GENERAL

556.1.1 Cranes and exposed deck machinery shall use an environmentally acceptable lubricant (EAL) in accordance with EPA 800-R-11-002.

556.1.2 The contamination level for hydraulic systems shall be at least ISO 4406 code 20/18/15 or in accordance with manufacturer specifications, whichever is more stringent.

556.1.2.1 Cleanliness shall be achieved and maintained in accordance with ISO 4406. Cleaning by mechanical means, followed by dry air blast, shall be used where cleaning of pumps, motors, rams, valves and other components and accessories become necessary.

556.2 CRANE HYDRAULIC SYSTEM ARRANGEMENTS

556.2.1 A hydraulic system shall be used for powering the crane.

556.2.1.1 Hydraulic circuits shall be situated below the working deck.

556.2.1.2 Hydraulic piping deck penetrations shall be within the pedestal.

556.2.1.3 Piping installed in the weather shall be protected from accidental impact damage.

556.2.1.4 Hydraulic system components shall be provided with a drip pan or deck coaming to contain hydraulic oil incidental to use, leakage and maintenance of the units.

556.2.1.5 Isolation valves shall be installed as close as practical to each piece of equipment and each hydraulic pump.

556.3 SYSTEM PERFORMANCE

556.3.1 The temperature of hydraulic fluid shall be maintained within the operating limits of the equipment OEMs.

556.3.2 Systems shall support continuous service at full flow and at least three hours of service at no flow conditions without overheating.

556.4 HYDRAULIC PUMP

556.4.1 Hydraulic pumps shall be driven by electric motors. Pumps shall be capable of continuously variable output from zero to full power and shall be configured to start unloaded.

556.5 PIPING SYSTEMS

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556.5.1 Hydraulic piping systems shall include connections to allow flushing in accordance with ISO 12669.

556.5.2 Fittings installed to connect rigid piping shall be welded.

556.5.3 Piping may utilize tubing and swaged marine fittings in lieu of welded fittings. Where tubing fittings are used, threaded tubing connections shall be SAE J1453 straight thread with "O" ring seal.

556.5.4 Where equipment is furnished with other than SAE J1453 interfaces, SAE J514 37 degree flare fittings may be used.

556.5.5 Tapered pipe threads and 45 degree flare fittings shall not be used.

556.5.6 Take-down joints and connections to equipment or components shall be flat-face O-ring seal union type, or SAE type 4-bolt flanges with O-ring seal shall be used.

556.6 VALVES

556.6.1 Adjustable valves shall be lockable at service adjustment.

556.6.2 Manifolded valves shall be individually replaceable. Valves within junction blocks shall be removable cartridge type only; junction blocks with non-replaceable valve body elements are not permitted.

556.6.3 Pressure control valves (including unloading, backpressure, and sequence valves) and check valves shall be damped.

556.6.4 Relief valves shall begin opening at 110% of operating pressure and be set by a flow test of at least 80% of expected flow. The relieving capacity shall not be less than full pump flow with a maximum pressure rise in the system of not more than 10% of the relief valve setting.

556.6.5 When relief valves are set, tags shall be attached to the valves which include the following information:

556.6.5.1 Date set

556.6.5.2 Name of activity and person conducting or witnessing test

556.6.5.3 Setting and test conditions

556.6.5.4 Test stand: Flow rate used for setting pressure, i.e., (3450 lb/in2 at 20 gal/min)

556.6.5.5 Hand pump: Cracking pressure and describe test conditions

556.6.6 Control valve spools for deck equipment shall be high strength stainless steel, and the spools shall be in a totally encapsulated/flooded assembly.

556.7 FILTERS AND STRAINERS

556.7.1 Filtration shall be provided as indicated below:

556.7.1.1 Strainers in pump suction lines from reservoirs.

556.7.1.2 Filters in the discharge lines of pumps except:

556.7.1.2.1 Filters in the discharge of hand pumps are not required.

556.7.1.2.2 Filters in the discharge lines of pumps in reversible flow service are not required, provided that alternative systematic filtration of the circulating fluid acceptable to the pump and equipment manufacturers and suitable for the service intended.

556.7.1.3 Filters in return lines.

556.7.2 Strainer Selection. Suction line strainers shall be cleanable wire mesh strainers and shall be removable from the reservoir without disassembly. The elements shall be 50 mesh or finer if fluid returning to the reservoir is filtered by a return line filter, or 100 mesh or finer if fluid returning to the reservoir is not subject to return line filtration. Suction line strainers with a mesh finer than 200 shall not be used.

556.7.3 Filter Selection

556.7.3.1 Filter housings shall not be equipped with a filter bypass.

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556.7.3.2 Filters shall be equipped with an indicator or differential pressure gauge to indicate when servicing is required.

556.7.3.3 Filters shall be readily accessible and filter elements shall be removable for servicing without disconnecting the attached pipe or dismounting the filter housing from its foundation. Filter assemblies shall be arranged for viewing of the element indicator or differential pressure gauge by watchstanding personnel.

556.7.3.4 Filters, bowls, and housings shall be equipped with drains or other devices which will permit changing of elements with minimum spillage of fluid. If this is accomplished by drain ports, the installation shall be such that a container can be used to catch fluid from the drain port.

556.7.4 Filtration elements internal to valve or manifold bodies shall not be used. Where such filters are normally supplied by the equipment manufacturer for protection of contaminate sensitive elements, external filtration shall be provided.

556.8 RESERVOIRS

556.8.1 Reservoirs shall have quick disconnect fittings and cutout valves for fluid transfer and filtration.

556.8.1.1 Reservoirs shall be equipped with drain valve configured for gravity drainage via hose to portable containers.

556.8.1.2 Quick-disconnect fittings shall be provided with attached plastic plug or cap to minimize contamination of the fitting.

556.8.2 Hydraulic system reservoir shall have an additional 15 percent additional capacity over the calculated minimum reservoir volume.

556.8.3 Reservoirs shall have an exterior, magnetic float type tank level indicating system with continuous reading colored magnetic flag indicators similar to ASTM F2044.

556.8.4 Information plates shall be installed adjacent to each fluid filling opening identifying the system, fluid and filtration level.

556.9 TEST FITTINGS.

556.9.1 Test fittings shall be provided in the supply and return lines of each circuit.

556.10 CONTROLS AND MONITORING

556.10.1 Control systems shall not be wirelessly accessible.

556.10.2 A panel shall be provided in the same compartment as the hydraulic pump and include the following:

556.10.2.1 Pressure and temperature gauges necessary for the operation of the unit.

556.10.2.2 On/Off control and status indication of reservoir heaters.

556.11 ALARMS

556.11.1 The following alarm conditions shall be monitored for each hydraulic circuit. A summary alarm shall indicate in the Pilothouse and individual alarms on the HPU Control Panel.

556.11.1.1 Hydraulic oil high temperature

556.11.1.2 Reservoir low level

556.11.1.3 Circuit high pressure

556.11.1.4 Hydraulic oil cooler high differential pressure

556.12 HYDRAULIC FLUID MAINTENANCE AND FILTRATION SYSTEMS

556.12.1 Each HPU shall be equipped with a permanently mounted, dedicated off-line (kidney loop) filtration system compatible with the system fluid.

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556.12.1.1 Systems shall be capable of continuous or timer-based operation independent of the main hydraulic pumps.

556.12.1.2 Filters shall feature a particulate removal rating of at least Beta(10) > 200 to maintain an ISO cleanliness code of 15/13/12 or better.

556.12.1.3 The off-line filtration system shall incorporate water-absorbing filter elements capable of removing free and emulsified water.

556.12.2 All HPU reservoirs shall be fitted with desiccant breather assemblies sized appropriately for the maximum fluid draw-down rate. Breathers shall incorporate a particulate filter of three (3) microns or less and utilize a color-indicating desiccant to prevent atmospheric moisture ingress.

SECTION 561 STEERING SYSTEMS

561.1 GENERAL

561.1.1 The steering system provides a means for the crew to steer the vessel from the steering stations. The wheel and/or lever at the station(s) provides signal to the main steering gear hydraulic power circuit units (HPU) to actuate the steering cylinders to turn the rudders, with auxiliary backup.

561.1.2 The steering system shall be in accordance with 46 CFR 182.610 and 620 except as amended herein:

561.1.2.1 The auxiliary means of steering exemption in 46 CFR 182.620 (c) shall not be used.

561.1.2.2 The steering system shall perform the required rudder sweep in no less than 15 seconds.

561.1.2.3 The steering gear HPU disconnect switch shall be collocated in the compartment with the HPU.

561.1.3 Rudders shall have linkage that connects the tillers with adjustable spherical rod ends that can be locked to prevent movement after alignment. The linkage shall be arranged to permit adjustment of rudder toe in and out.

561.1.4 The Permanent witness and a pointer for rudder position shall be provided. Marks shall indicate the neutral rudder angle and each 5-degree increment of rotation up to 35 degrees from the neutral rudder angle on each rudder stock. The neutral rudder angle (zero) and each ten-degree increment shall be labeled with 1/4-inch numbers. The neutral angle shall include toeing.

561.2 POWER STEERING HYDRAULIC SYSTEM

561.2.1 The power circuit shall consist of HPU(s) with at least one DC powered hydraulic pump, control and isolation valves, power cylinder(s), and inline filter(s) configured on the oil return to the HPU.

561.2.2 Transfer of steering control from the power circuit to the auxiliary means shall occur automatically upon loss of the HPU.

561.3 CONTROL AND INDICATION

561.3.1 The forward steering station shall consist of a wheel and electric follow-up lever type steering.

561.3.2 The aft steering station shall consist of electric follow-up lever type steering.

561.3.3 Control and indication of the HPU and rudder angle shall be provided at the steering stations.

SECTION 568 BOW THRUSTER

568.1 GENERAL

568.1.1 [Reserved]

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SECTION 573 CROSS DECK WINCHES AND TIE DOWN FITTINGS

573.1 CROSS DECK WINCHES

573.1.1 The vessel shall have two cross deck winches located on the working deck as shown on the drawings. The winches shall be Warn DC3000 24V PN 85252 with two layers of line (50 feet), or equal.

573.1.1.1 The winch shall have a line pull of not less than 2000 pounds at all line wrap levels.

573.1.1.2 The winch shall have a line speed of not less than 30 feet per minute at all line wrap levels.

573.1.1.3 The winch shall use Class II high-strength synthetic cordage recommended for the application be the manufacturer with a safety factor of 5:1 based on the rated minimum breaking strength.

573.1.1.4 The winch shall be equipped with a roller fairlead to maintain required fleet angle to the drum.

573.1.2 Winches shall have a joystick for variable speed control.

573.1.1.5 The winches shall be protected from inadvertent strikes during buoy tending operations.

573.2 TIE DOWN FITTINGS

573.1.3 Burchell Type 14 Inconel, or equal, tie down fittings shall be provided on the working deck to secure buoys.

573.2.1.1 The minimum safe working load for the deck tie down fitting shall be 3,000 lbs.

573.2.1.2 Placement of fitting shall be as shown on the drawings.

573.1.4 Griping tie downs which interface with the Burchell fittings shall be provided.

573.3 CHAIN STOPPERS

573.3.1.1 Two mechanical chain stoppers in accordance with CG Drawing FL-2605-33 shall be provided and arranged in accordance with the drawings.

SECTION 581 ANCHOR

581.1 GENERAL

581.1.1 The anchoring system shall provide a means of stowing, deploying and retrieving one anchor.

581.1.1.1 The anchor will be manually transferred from the stowage position and deployed/retrieved using the windlass.

581.1.1.2 Anchor arrangements shall ensure the anchor or anchor chain does not foul or damage the hull, hull appendages or equipment when weighing, dropping, or riding at anchor

581.1.2 The anchor and anchor rode shall be stowed on the foredeck.

581.1.3 The anchor rode shall be installed on a reel protected from the weather.

581.2 ANCHOR

581.2.1 A 300 ft anchor rode consisting of a combination of line and chain attached to the anchor shall be provided and configured as follows:

581.2.1.1 One (1) Fortress FX-55 or equal anchor.

581.2.1.2 A minimum of 25 ft. of not less than 1/2 inch BBB galvanized chain with a minimum Working Load Limit (WLL) of 4500 pounds shackled to the anchor.

581.2.1.3 Double braided nylon line with a minimum circumference of 2-¾ inches with and a Minimum Breaking Strength (MBS) of 19,000 lbs inches spliced with a thimble to the chain.

581.2.2 Line end terminations shall be greater than 95% efficient as recommended by the cordage manufacturer.

581.2.3 Fittings used in the anchor rode shall be galvanized and have a WLL exceeding the WLL of the chain.

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581.2.4 A spare Fortress FX-55 or equal anchor shall be provided onboard.

581.3 WINDLASS

581.3.1 Anchor deployment and recovery shall utilize a Vertical Windlass with a wildcat capable of hauling both rope and chain. The windlass shall have an inhaul rate of not less than 30 ft/min under rated load.

581.3.2 The anchor windlass shall be constructed of stainless steel.

581.3.3 The anchor windlass foundation and fasteners shall be designed for not less than three times the rated capacity of the windlass.

581.3.4 Means shall be provided to manually operate the anchor windlass.

581.3.5 The anchor windlass shall be electrically powered and have a load rating not less than 600 lbs.

581.3.6 The anchor rode shall be arranged to be routed through a centerline chock and secured to a bitt when deployed.

SECTION 582 MOORING AND TOWING

582.1 MOORING AND TOWING LINES

582.1.1.1 The vessel shall have four (4) 3-inch circumference Samson RP-12 Ultra Blue or Cortland Supertuf Plus or equal lines. These mooring lines shall be 90 feet in length with an eye splice in each end.

582.1.1.2 Towing system shall have:

582.1.1.2.1 one 9/16 in diameter Samson Amsteel blue, or equal, towing hawser with minimum rated breaking strength of 36,500 lbs. This towing line shall be 300 feet in length.

582.1.1.2.2 One 3.88 diameter thimble with 17 ton WLL, Samson Code 963 SSB-17, or equal.

582.1.1.2.3 One 1-1/2 in Shackle, anchor, Alloy, bolt-type with 30 ton WLL, Crosby G-2140 Stock # 1021110, or equal.

582.1.1.2.4 One 7/8 - 1 inch rope diameter Thimble, Samson Code 933, or equal.

582.1.1.2.5 One 3 1/2 in cir. 35,300 lbs min rated breaking strength Bridle, Samson RP-12 Polyester, or equal. Line shall be 75 ft.

582.1.1.3 Mooring Lines and Towing system components shall be stowed in bins.

582.2 HULL FITTINGS

582.2.1.1 Hull fittings such as chocks and bitts shall be provided to enable mooring and towing operations.

582.2.1.2 Fittings shall be cast steel or welded steel and have a Safe Working Load exceeding the MBS of the higher of the mooring, towing or anchoring line which may use the fitting.

582.2.1.3 Chocks shall have a minimum of opening of nominally 3 inches tall at the centerline and 6 inches wide at the centerline.

582.2.1.4 Bitts shall be 6 inches in size and be of double type welded construction designed for welding to the deck.

582.2.1.5 Bitts and Chocks shall be arranged as shown on the drawings.

582.2.1.6 Supporting structure shall meet manufacturer specifications and the requirements of ABS MVR 3-5-1.

SECTION 583 LIFE SAVING APPLIANCES

583.1 LIFE RINGS

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583.1.1 Four 24-inch diameter life rings shall be installed. The rings shall meet 46 CFR 160.05 and SOLAS Life Saving Appliance requirements and shall be stowed in approved, float free cradle devices.

583.1.1.1 Two life rings shall be located on the pilothouse sides (one Port/one Starboard), and two life rings shall be located on the forward deck.

583.1.1.2 The rings shall be installed vertically in open racks and shall be capable of being rapidly lifted free and easily cast loose. In case of submergence, the rings shall float free.

583.1.2 The rings shall be marked with two (2) inch wide reflective tape into four (4) quadrants. The tape shall wrap around the floatation section of the ring and shall be visible from any direction. The ring quadrants shall be marked with two (2) inch black decal lettering or stencils with the words “U.S.”, “COAST”, and “GUARD” (left to right, counterclockwise) on the lower three quadrants and the vessel number on the top quadrant.

583.1.3 Accessories

583.1.3.1 A rescue line throw bag shall be stowed adjacent to each life ring, so that it floats free with the ring. The CRES snap hook from the throw bag shall be attached to the life ring but shall be easily detachable.

583.1.3.2 A floating electric marker light unit shall be stowed adjacent to each life ring, so that it floats free with the ring. A short lanyard of 3/8 inch double braid construction and CRES snap hooks shall be provided and attached to the marker light. The CRES snap hook shall be attached to the life ring but shall be easily detachable.

583.1.3.3 A cleat shall be provided in the vicinity of the life ring for securing the line from the throw bag, after it is thrown.

583.2 LIFE RAFTS

583.2.1 One life raft with a capacity of at least 10 persons shall be provided. It shall be a USCG approved inflatable life raft and shall be stowed in white hard-side containers and secured in a deck mount stowage cradle with hydrostatic release unit (HRU) on the top of Pilothouse and accessible for manual release.

583.2.2 Life rafts shall not become entrapped within the vessel structure when deployed against at least a 15-degree adverse list.

583.2.3 A painter cleat shall be provided for each raft on the deck edge or railing adjacent to raft stowage, for control of the painter to a deployed raft.

SECTION 589 CRANES

589.1 GENERAL

589.1.1 The buoy crane shall comply with all requirements in Project Peculiar Document (PPD) PPD-589-001, 'Detail Specification for Buoy Crane'. The hydraulic, deck mounted crane shall have a safe working load of 4,500 lbs. The crane shall be Appleton Marine Knuckle Boom Crane KB20-21 or equal.

589.1.2 The crane shall be located as shown in the drawings.

589.1.3 In the stowed position, the crane shall not interfere with the movement of personnel or material.

589.1.4 The alternate chest pack control connection specified in PPD-589-001 shall be arranged and permanently installed aft in the pilothouse to provide line-of-sight control of the buoy crane.

589.1.5 Besides buoy handling the crane shall be capable of handling debris and general goods. It will not be used to lift personnel.

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SECTION 600 OUTFITTING

600.1.1 GENERAL

600.1.1 The Contractor shall provide the items and quantities identified in Specification J-1L with each vessel.

600.1.2 Stowed items shall be located and arranged to support effective use by the crew.

SECTION 602 HULL, MECHANICAL DESIGNATION, AND MARKING

602.1 VESSEL IDENTIFICATION PLATE

602.1.1 The vessel shall be provided with a manufacturer's identification plate, mounted in accordance with the Boat Management Manual, COMDTINST 16114.4 (series). The plate shall identify vessel and manufacturer information in accordance with 33 CFR 181. The USCG vessel number will be provided at the time an individual vessel is ordered.

602.1.2 The identification plate shall be a minimum of 4 by 6 inches and be made of metal with either engraved or raised molded permanent letters. The plate shall be a minimum of 1/8 inches thick. The label plate shall be mounted in a readily viewable location inside the Pilothouse.

602.2 HULL MARKINGS

602.2.1 The vessel shall include USCG visual identification including draft markings in accordance with Coast Guard Drawing No. FL-2804-021 per instructions for vessel length 50' to 64'. Markings shall include the Coast Guard stripe and emblem on the port and starboard bow, the words "U.S. COAST GUARD" on the port and starboard aft of the stripe, the vessel number port and starboard forward of the stripe, and the hull number above the station name on the stern.

602.2.2 Travel lift sling positions shall be permanently marked on the exterior of the vessel in locations that can be easily seen from the weather deck.

602.3 LABEL PLATES

602.3.1 Each control, switch, gauge, and valve shall be provided with a durable and permanently attached label plate to indicate its function.

602.3.2 Each radio, microphone, and speaker shall be labeled with the radio information (e.g., VHF/UHF/700/800).

602.3.3 Each tank deck connection shall be labelled in accordance with ABYC standards including fuel fill, potable water, and sewage.

602.3.4 Label plates for differential pressure gauges shall state a maximum allowable differential pressure before cleaning of strainers is required.

602.3.5 All labels shall be a minimum of 12-point font.

602.3.6 All permanent notices and signs shall be mounted and sized in accordance with ABYC T-5, Safety Signs and Labels. The Contractor may propose certain notices and signs to be provided in the BIB rather than being mounted as approved by the USCG.

SECTION 604 LOCKS, KEYS, AND TAGS

604.1 GENERAL

604.1.1 Locks and latch sets shall be marine grade hardware.

604.1.2 Locks shall have a unique serial number stamped or engraved on the outer surface. Keys shall be stamped or engraved with the serial number of the lock served.

604.1.3 All external-facing doors with access to the interior of the vessel shall be provided with a hasp-type mechanism that may be secured using a padlock.

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604.1.4 All potable water fills and sounding tubes shall be provided with a hasp-type mechanism that may be secured using a padlock.

604.1.5 Hasps and staples shall be fitted so that when the door is opened or closed, padlocks cannot be caught between the door and the door frame.

604.1.6 Each lock shall be provided with two (2) keys. Two (2) master keys shall be provided for opening all locks except crew lockers and berth lockers.

SECTION 612 RAILS, STANCHIONS AND LIFELINES

612.1 DEFINITIONS

612.1.1 Lifelines – Refers to protective devices in the weather fabricated of flexible line or cables supported by stanchions allowing for flexibility or easy removal to gain access.

612.1.2 Liferails - Refers to protective devices fabricated of rigid pipe or tubing wherever there is danger of crew members falling overboard or to a lower level of 24 inches or more including along deck edges, waterborne mission walkways, and around antenna platforms.

612.1.3 Stanchions – Vertical supports for lifelines or liferails.

612.2 GENERAL

612.2.1 Arrangement of liferails and lifelines shall be as shown in contract drawings.

612.2.2 Stanchions and liferails shall be galvanically compatible with the deck or structure materials to which they are fastened.

612.2.3 Lifelines shall be black.

612.2.4 Unguarded openings between adjacent sections of liferails and lifelines or between the ends of the rails, lines, and adjacent structure shall be no more than five (5) inches.

612.2.5 Removable lifelines shall be used at designated areas depicted in the contract drawing.

612.2.6 Liferail and lifeline stanchions shall be constructed per ABS MVR 3-2-17. Braced stanchions shall be provided as necessary to withstand the pull of the lifeline. End stanchions shall have support braces.

SECTION 613 CANVAS AND COVERS

613.1 GENERAL

613.1.1 The vessel shall be provided with covers for the anchor line reel, and P-6 pump container that have the following characteristics:

613.1.1.1 Be fabricated of coated cloth, CID A-A-55308, Type 1;

613.1.1.2 Be mildew resistant, oil resistant, abrasion resistant, and fire resistant; and

613.1.1.3 Be gray.

613.1.2 The edges shall be reinforced with:

613.1.2.1 MIL-C-20079, Type II Class 3 tape; or

613.1.2.2 One inch marine grade acrylic bias binding; or

613.1.2.3 One inch marine grade polyester bias binding.

613.1.3 The covers shall:

613.1.3.1 Not trap or pool water when installed;

613.1.3.2 Be able to sustain 50-knot winds from any direction when installed; and

613.1.3.3 Be marked for proper installation.

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613.1.3.4 All fasteners and hardware used as part of the covers to secure or attach the cover shall be stainless steel.

613.1.4 Covers shall be stowed onboard the vessel.

SECTION 621 NONSTRUCTURAL BULKHEAD

621.1 DEFINITIONS

621.1.1 Joiner bulkheads bound and subdivide living, berthing, messing, control, and office spaces, and passages which are not bound by structural bulkheads.

621.2 GENERAL

621.2.1 Protective coverings shall not be removed from panels until work in the space is complete.

621.3 DETAIL REQUIREMENTS

621.3.1 BULKHEADS

621.3.1.1 In addition to the regular stiffening, nonstructural bulkheads shall be stiffened locally in way of furniture, lavatories, water closets, door hooks, door stops, clothes hooks, and other articles supported from or attached to bulkheads.

621.3.1.2 Screws and bolts used for the purpose of mounting equipment to bulkheads shall be furnished with "acorn" or "cap" nuts in areas where exposed threads may subject personnel to injury.

621.3.1.3 Bulkheads enclosing any shop within or adjacent to living and messing spaces shall be solid for the full deck height.

621.3.2 COAMINGS

621.3.2.1 Coaming for bulkhead sheathing - the material specifications shall be the same as denoted under coamings for nonstructural bulkheads except the coaming shall not be watertight.

621.3.2.2 Draining holes, 1/2-inch diameter spaced every 12 inches through the coaming shall be provided at the level of the deck covering.

621.3.2.3 Low spots between the coaming and the structure shall be filled with underlay.

621.3.3 JOINER BULKHEADS

621.3.3.1 Joiner bulkheads shall be of aluminum alloy or fiber reinforced plastic (FRP), or galvanized steel.

621.3.3.2 Joiner bulkheads shall receive paint or factory bonded decorative faced coverings. Decorative faced sheets shall be either High Pressure Plastic Laminate (HPPL) or CRES 304 with a No. 4 finish.

621.3.3.3 HPPL material shall be in accordance with MIL-P-17171 Type IV and thickness of 0.027-0.037 inches factory bonded directly to the fiberglass faced sheet. HPPL materials shall be bonded to the fiberglass faced sheet with adhesive conforming to FSC 8040. In addition to the above thickness requirement, HPPL material shall exhibit fire resistance characteristics equal to MIL-STD-1623. Exposed structures associated with the installation of nonstructural bulkheads, shall be finished with baked enamel.

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621.3.3.4 Bottom edge joints in dry spaces shall be caulked with compound conforming to Fed-Spec A-A-272 and bottom and vertical edge joints in wet spaces shall be sealed with silicone sealant MIL-A-46106, or AMS 3362.

621.3.3.5 Hinged access panels latched with recessed quick-acting captive fasteners operable without tools shall be provided in joiner bulkheads for normal and emergency access to valves, dampers, electrical junction boxes, stuffing tubes, electrical transits and other such items.

621.3.3.6 Joiner bulkheads shall be designed and constructed so that any panel may be removed and replaced without removing adjacent panels. Hardware associated with this requirement shall be reusable.

621.3.3.7 Joiner bulkheads shall have fire stops.

621.3.3.8 Piping, wiring and ductwork in habitability and sanitary spaces shall be concealed either behind the bulkhead, within bulkhead posts, or in casings finished to match surroundings.

SECTION 622 FLOOR PLATES

622.1 GENERAL

622.1.1 Removable decking system shall be provided to provide a flat walking surface and to allow access to the machinery, tanks, and bilges below the decking for inspection and maintenance in accordance with ASTM F1166.

622.1.2 Floor plates and platforms shall be capable of supporting a load of 144 pounds per square foot.

622.1.3 All decking system and latching mechanisms shall:

622.1.3.1 Be constructed from corrosion-resistant materials; and

622.1.3.2 Be designed to securely hold in the open and closed positions in all operating environments.

622.2 MACHINERY SPACE DECKING

622.2.1 Machinery space decking systems shall allow the crew members access to and around machinery and bilge below without having to step on hull plating and structure.

622.2.2 Deck panels shall be aluminum Diamond plate and include quick-acting latching mechanisms that interlock mechanically with the framework in a manner that holds the panel in place securely.

622.2.3 Deck panels requiring lifting for regular maintenance or inspection, shall be hinged on the appropriate side to facilitate the maintenance or inspection activity.

622.2.4 Deck panels shall be able to be removed or replaced by one crew member without the use of tools.

622.2.5 The working surface of the deck panel shall have a slip-resistant surface and shall be free of protrusions and other features that could present a tripping hazard in the installed configuration.

622.3 NON-MACHINERY SPACE DECKING

622.3.1 USCG approved floating deck is acceptable for noise and/or climate control.

622.3.2 Deck panels requiring lifting for regular maintenance or inspection, shall be hinged on the appropriate side to facilitate the maintenance or inspection activity.

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622.3.3 Deck panels shall be able to be removed or replaced by one crew member.

622.3.4 The working surface of the deck panel shall have a slip-resistant surface and shall be free of protrusions and other features that could present a tripping hazard in the installed configuration.

SECTION 623 LADDERS & HANDRAILS,

623.1 DEFINITIONS

623.1.1 Grabrods - Refers to bars installed near ladders where they will aid personnel in ascending, descending, or stepping from the same.

623.1.2 Handrail - Refers to protective devices fabricated of rigid pipe or tubing on a bulkhead adjacent to ladders, ladderways, and walkways or ramps to steady movement along the same.

623.2 GENERAL

623.2.1 Vertical ladders, stringers, and supports shall support a 500 lb. static load for every 78 inches of the height of the ladder.

623.2.2 Ladders, handrails, staging, and service platforms shall not interfere with the opening and closing of hatches, scuttles, doors, manholes, hinged gratings, or equipment.

623.2.3 Ladders shall be removable, bolted in place and fitted with handrail or grabrods.

623.2.4 Sufficient number of grabrods, grabrails or hand holds shall be provided for personnel safety.

623.2.5 The number and location shall allow a 5th percentile adult female to be able to grab standing anywhere in the pilothouse, workshop, head, berthing area, and galley area and along the primary transiting paths in all other spaces.

623.2.6 Grabrails shall be sized and placed in accordance with ASTM F1166.

SECTION 625 FIXED PORTLIGHTS AND WINDOWS

625.1 GENERAL

625.1.1 Windows and windows and portlights installed in doors shall be as shown in contract drawings.

625.1.2 Windows in the pilothouse shall be electrically heated for defrosting and defogging with a minimum heating capacity of 750 watts/m2. The maximum window temperature in operating environments shall not cause delamination.

SECTION 631 PAINTING

631.1 GENERAL

631.1.1 Coatings, color schemes, surface preparation and corrosion control for all exterior and interior areas of the vessel shall comply with the applicable material and location to include Steel hull, Ice Breaking Capable Vessels <235' in salt water, and Black Hull requirements given in the COMDTINST M10360.3D, and SFLC Standard Specification 6310.

631.1.2 Underwater hull coating systems shall be either:

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631.1.2.1 International Intershield 163 Inerta 160,

631.1.2.2 Int'l Intershield 8163 ,

631.1.2.3 PPG Sigmashield 1200 , or

631.1.2.4 Sherwin-Williams Seaguard Flake Filled

SECTION 633 CATHODIC PROTECTION

633.1 GENERAL

633.1.1 The vessel's hull shall be protected from corrosion with a sacrificial anode cathodic protection (cp) system designed and installed in accordance with abs guidance notes on cathodic protection of ships.

633.2 SACRIFICIAL ANODE CATHODIC PROTECTION SYSTEM

633.2.1 Anodes shall be in accordance with ABS guidance.

633.2.2 Sacrificial cathodic protection systems installed on the vessel shall provide a minimum service life of four years.

633.2.3 Sacrificial anodes shall be installed in a manner to facilitate ease of replacement and not require special tools or training.

633.2.4 The vessel shall be equipped with a hull electrical potential monitoring system which measures potential difference between the underwater hull and anodes vs. a permanently installed external electrode fixed to the hull.

SECTION 634 DECK COVERING

634.1 GENERAL

634.1.1 Deck coverings shall be installed.

634.1.2 Deck covering systems and installation shall be in accordance with SFLC Standard Specification 6341.

634.1.3 Deck covering shall be applied to the entire area of a compartment except under builtin furniture. Before a deck covering is applied, the decks shall be painted and faired with a minimum amount of underlay material in accordance with MIL-PRF-3135 in way of laps, depressions and similar conditions, as well as provide sloping decks in those spaces requiring drainage.

634.1.4 Insulating underlayment shall be installed on decks above fuel tanks, or areas subject to condensation.

634.1.5 Floors in the pilothouse galley/mess area, workshop and berthing spaces shall be covered with electrical grade pvc matting in accordance with MIL-DLT-15562G.

634.1.5.1 The pilothouse, berthing areas and galley shall have TYPE I marbleized pattern sheeting, and the workshop shall have TYPE III (diamond tread pattern) sheeting.

634.1.6 Color of flooring material shall be uniform throughout.

634.1.7 Black rubber standing mats shall be installed in the pilothouse at the forward and aft console.

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634.1.8 The head decks shall be sealed with an epoxy flake coating system.

634.1.9 Safety treads shall be coated with silicon carbide particles and have a pressure sensitive backing, in conformance with MIL-PRF-24667. Three treads, each 6 inches by 24 inches, with no space between shall be installed at the top and bottom of inclined and vertical ladders and at each side of doors or arches having a coaming and used for continuous traffic.

634.1.9.1 The safety treads shall not be painted.

634.1.10 Coarse slip resistant Peel and Stick Non-Skid material in accordance with MIL-PRF-24667, type XI, composition PS, shall be applied in any exterior or interior location where slip resistance, greater durability and performance are required.

SECTION 635 THERMAL, ACOUSTIC AND FIRE PROTECTION INSULATION

635.1 GENERAL

635.1.1 Insulation materials shall be u.s. coast guard approved (https://cgmix.uscg.mil/equipment/equipmentsearch.aspx) or meet the applicable standards listed herein.

635.1.2 Blown-in insulation shall not be used.

635.1.3 Fire insulation shall be rated for unrestricted use.

635.2 APPLICATION AND INSTALLATION

635.2.1 Insulation on bulkheads shall extend from 6 inches above the deck to the overhead. Where insulation is subject to damage, a continuously welded Z-bar coaming shall be installed at the bottom edge of the insulation. Doors and hatches shall meet the fire and thermal insulation requirements of the bulkheads and decks in which they are installed.

635.2.2 Fasteners shall not crush or otherwise reduce the insulation value of the insulation.

635.2.3 Insulation shall be installed so that movement of the enclosed structure, such as by vibration, will not damage the insulation.

635.2.4 Insulation shall be segmented and overlapped to provide a tight fit without voids around webs and flanges of beams and stiffeners and other fittings.

635.2.5 Thermal and acoustic insulation shall not be installed in bilge regions.

635.2.6 Sheathing shall be installed wherever necessary to protect the insulation from mechanical or fluid damage. A surface treatment or covering shall be installed on sheathing where necessary for the protection of personnel from cuts or abrasion or from hot surfaces

635.3 STRUCTURAL FIRE PROTECTION

635.3.1 Boundaries of the engine room with other spaces shall be treated with a minimum of A-30 Structural Fire Protection (SFP) insulation.

635.4 THERMAL INSULATION

635.4.1 Thermal insulation shall be provided on compartment boundaries, including webs and flanges of beams and stiffeners. The following additions and exemptions apply to the thermal insulation requirements:

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635.4.2 Weather doors and doors between conditioned and non-conditioned spaces shall be insulated to the same level as the boundary in which they are installed to the maximum extent possible. Insulation shall extend 12 inches beyond the area requiring insulation, including abutting uninsulated boundaries and stiffener webs and flanges.

635.4.3 Vapor barrier and Lagging - Vapor barrier treatment shall be applied to all thermal insulation to prevent penetration of moisture and shall remain intact and continuous over the protected area by means of sealed joints and edges. Lagging shall be installed as part of the vapor barrier treatment over thermal insulation.

635.5 ANTI-SWEAT TREATMENT

635.5.1 Anti-sweat treatment shall be applied to the warm side of uninsulated boundaries and surfaces and closures susceptible to condensation, including webs and flanges of beams and stiffeners. Anti-sweat treatment shall only be used on surfaces unsuitable for thermal insulation.

635.5.2 Anti-sweat treatment shall not be applied to any part of a door, hatch or scuttle operating mechanism, or contact surfaces.

635.5.3 Anti-sweat treatments are considered ceramic insulation coatings and shall be in accordance with Sect. 631.

635.6 ACOUSTIC INSULATION

635.6.1 Acoustic insulation shall be installed on compartment surfaces to meet the ship space airborne noise criteria.

635.6.2 Perforated acoustic insulation shall not be installed in machinery spaces where such perforations could act as collectors of combustible material.

635.6.3 Spray on acoustic treatments and damping compounds are considered coatings and shall be in accordance with the vessel specification and be U.S. Coast Guard approved (https://cgmix.uscg.mil/equipment/equipmentsearch.aspx).

635.6.4 If acoustic insulation is required for any area for which thermal insulation is required, the acoustic treatment shall be applied to the plane surfaces and thermal insulation shall be applied to beams and stiffeners.

635.6.5 Where both fire protection and thermal or acoustic insulation are required, and the fire insulation does not meet the thermal or acoustic specifications, additional fire insulation may be installed to satisfy the requirements if permitted by the certificate.

SECTION 640 LIVING SPACES

640.1 GENERAL

640.1.1 Arrangement of Living spaces shall be as shown in contract drawings.

640.1.2 Clearance shall be provided around furniture to ensure the full use of drawers, lockers and writing shelves. Articles of equipment such as coat hooks and light switches shall be located to ensure their utility.

640.2 FURNITURE AND FURNISHINGS

640.2.1 Deck and bulkhead mounted furnishings shall be properly secured to prevent movement. Movable components such as drawers, sliding shelves, and hinged mechanisms shall be captive in any normal

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operating position to prevent movement and shall be sufficiently snug to prevent rattle of parts during vessel vibration.

640.2.2 Unless otherwise approved, materials used for furnishing specified herein shall be in accordance with 46 CFR Part 164.

640.2.3 Means to secure portable furniture, such as chairs and wastebaskets, in a seaway shall be provided. Such means shall not involve the use of tools.

640.2.4 Furniture shall be installed so that horizontal surfaces are parallel to the baseline of the vessel. Furniture, such as berths, desks, and lockers shall be removable and shall be secured by pinned or threaded connection to hard welded studs or fasteners.

640.2.5 Textiles shall be chosen from standard catalogue colors and patterns. The textiles shall be colorfast, fade resistant, resistant to salt spray, free from cracking, and have a shrinkage tolerance no greater than 1.5%.

640.2.6 Mirrors shall be centered 64 inches above the deck covering, unless otherwise specified.

640.3 CLOCKS AND BAROMETER

640.3.1 One 24 hour, 6 inch, mechanical clock shall be installed in the Pilothouse.

640.3.2 One 12 hour, 6 inch, electric clock shall be installed in each of the following locations:

640.3.2.1 Workshop

640.3.2.2 Galley

640.3.3 A barometer shall be provided and installed inside the pilothouse. The barometer shall be of the same diameter, style, and quality as the pilothouse clock.

640.4 BERTHING

640.4.1 Berths shall:

640.4.1.1 Be oriented generally fore and aft.

640.4.1.2 Have a minimum clear area of 77-1/2 inches long by 27-1/2 inches wide.

640.4.1.3 Have padding with waterproof covers and a means to secure them to the berth;

640.4.1.4 Have a white LED reading light per rack with 120V USB-C receptacle.

640.4.1.5 Steps or a ladder shall be provided to access berths as required.

640.4.1.6 Have privacy curtains

640.5 GALLEY/MESS AREA

640.5.1 The galley shall be provided with the following:

640.5.1.1 A sink with faucet for preparing and cleaning up meals with hot and cold potable water;

640.5.1.2 Freezer and refrigerator storage:

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640.5.1.2.1 At least five cubic feet of freezer food storage;

640.5.1.2.2 At least five cubic feet of refrigerated food storage;

640.5.1.2.3 At least 25 cubic feet of general storage for food and supplies;

640.5.1.2.4 At least four square feet of counter top area with stowage below;

640.5.1.2.5 A trash container with captive lid;

640.5.1.2.6 A microwave oven without a rotating table;

640.5.1.2.7 A paper towel holder and handwipe dispenser; and

640.5.1.2.8 A soap dispenser.

640.5.2 Mess Area shall be provided with the following to accomidate 6 people:

640.5.2.1 Mess table.

640.5.2.2 Bench seating with storage underneath.

640.5.3 The mess table and bench seating area shall be arranged to allow the area to be converted to a spare berth taking advantage of all available space that the benches and table occupy. Mess table shall be designed so that it can be lowered and secured in position to fit in between the benches. Backrest cushions from the benches shall then be placed over the table to achieve a uniform level surface, and the combined seating and table shall act as a berth. Benches shall have stainless steel pans for stowage.

SECTION 644 SANITARY SPACES AND FIXTURES

644.1 GENERAL

644.1.1 A complete plumbing system including fittings, fixtures, and trim shall be installed.

644.1.2 Sanitary space shall be arranged as shown in the contract drawings.

644.1.3 A mirror with suitable light and 120 V AC outlet shall be provided and installed over the sink.

644.1.4 Piping shall be concealed behind sheathing, as practical, except for terminations and connections to hoses serving the fixture. The plumbing and fixtures within sanitary spaces shall be arranged so that surfaces are accessible for cleaning and maintenance.

644.2 WR/WC

644.2.1 A grab rod shall be provided adjacent to each toilet.

644.2.2 Fixtures shall include at least:

644.2.2.1 A toilet paper role adjacent to each toilet

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644.2.2.2 Soap dish

644.2.2.3 Towel bar

644.2.2.4 Clothes hook

644.2.2.5 Paper towel dispenser and waste receptacle

644.2.2.6 Shower curtain

644.2.3 A label plate shall be provided near each toilet that states:

644.2.4 DO NOT DISCARD PRODUCTS OTHER THAN TOILET PAPER, TO INCLUDE FEMININE HYGIENE PRODUCTS, IN WATER CLOSET

644.3 BATH

644.3.1 A shower shall be of the individual stall type with privacy curtain and curtain rod. Minimum size shall be 30 inches wide by 30 inches deep.

644.3.2 The shower fittings shall consist of a mixed flow, hand held, low flow shower head permanently attached to a flexible hose. One shower head with valve and hose shall be installed in the shower stall. A holster shall be provided in the shower stall for stowage of the shower head. A shut off valve of the globe type shall be installed in the supply line to the shower valve.

644.3.3 Towel bar shall be provided on or within reach from the shower stall. A soap dish shall be provided within the shower stall.

644.3.4 Vessel structure next to the shower enclosure shall be prepared and painted as a closed-in space.

644.4 MISCELLANEOUS

644.4.1 Portable Emergency eyewash unit shall be provided in the vicinity of the workshop.

644.4.2 Paper towel dispensers and waste receptacles shall be surface-mounted CRES material.

SECTION 660 SEATS

660.1 GENERAL

660.1.1 Dimensions of seating shall follow the recommendations of ASTM F1166.

660.1.2 Seats shall be fabricated of corrosion resistant materials.

660.1.3 Seat covering materials shall:

660.1.3.1 Be waterproof;

660.1.3.2 Be designed for a marine environment;

660.1.3.3 Be resilient to sun and saltwater exposure; and

660.1.3.4 Resist puncture, ripping, and tearing in a high-use environment.

660.1.3.5 Seats shall be padded.

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660.1.3.6 Seats shall be removable using the onboard tool kit.

660.2 PILOT HOUSE SEATS

660.2.1 The Pilothouse shall be fitted with a pedestal mounted helm seat aft of the forward Helmsman/Conning Workstation and an additional seat positioned as shown in the drawing.

660.2.2 Chairs shall:

660.2.2.1 Be a high-back pedestal mounted chair with folding foot rests and arm rests.

660.2.2.2 Be capable of 360° swivel with the ability to lock at least every 45°.

660.2.2.3 Have height and fore/ aft adjustment to accommodate the applicable user population.

660.2.2.4 Allow for standing operation at the helm without causing interference.

660.2.2.5 Not require electrical power for egress.

660.2.3 The helm chair adjustment range of motion, with a seated operator, shall be provided with adequate clearance of adjacent installed equipment/ consoles.

SECTION 665 WORKSHOP

665.1 GENERAL

665.1.1 Dimensions of the workbench as specified herein or shown in the Contract Drawings are approximate and are subject to the development of the space.

665.1.2 Items such as cabinets, workbenches and supporting structures for counter tops shall be aluminum unless otherwise specified

665.1.3 Drawers and cabinet doors shall be provided with a latch to prevent accidental opening

665.2 EQUIPMENT

665.2.1 Workshop shall include:

665.2.1.1 One workbench, approximately 5 feet long by 2 feet wide by 3 feet high

665.2.1.2 At least one equipment locker 20 inches wide by 20 inches deep by 4 feet high

665.2.1.3 At least 6 half height lockers

665.2.1.4 Workbench:

665.2.1.4.1 Top shall be covered with a hard-board of dielectric non-sparking material, 1/8 inch minimum thickness.

665.2.1.4.2 Workbench shall be able to hold 300 pounds anywhere on the bench.

665.2.1.4.3 Workbench shall be fitted with four aluminum drawers on left hand side under the top with suitable guides and drawer pulls.

665.2.1.4.4 Drawers shall be at least 18 inches wide by 6 inches high by 24 inches deep

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SECTION 670 STOWAGE

670.1 GENERAL

670.1.1 Stowage for the outfit items as identified herein and any other items the Contractor deems necessary for the safe operation of the vessel shall be provided.

670.1.2 Stowage locations shall suit the items being stored, preventing damage and wear to the item. Additional guidance on stowage locations is provided in the tables of outfit as well as elsewhere in this Specification.

670.1.3 All exterior stowage lockers shall have drains leading directly to the deck and be provided with captive removable plug(s).

670.2 CREW PERSONAL GEAR STOWAGE

670.2.1 Dedicated stowage shall be provided in the habitability spaces for six duffle bags sized 20 inches wide, 20 inches tall, and 24 inches deep.

670.3 DECK LOCKERS

670.3.1 At least two deck lockers shall be installed on the main deck as shown on the Contract Drawings.

670.3.2 Lockers shall be made out of 3/16 inch aluminum plate and stiffeners with stainless steel hardware and be bolted on steel frame at least 2 inches above the deck.

670.3.3 Lid of locker shall be attached with a hinge to open.

670.3.4 Locker and lid shall be designed so that water will not readily enter the locker from rain and shall have a means to secure the lid in the full open condition.

670.3.5 Lid shall have a hasp and a padeye for locking.

670.4 TOOL KIT AND ONBOARD REPAIR PARTS, AND STOWAGE

670.4.1 The vessel shall be provided with a tool kit. The tool kit shall be contained in a watertight, airtight, dustproof, chemical resistant, corrosion proof case, approx. 14 inches x 12 inches x 6 inches, with inserts, and shall at a minimum have the following tools:

670.4.1.1 Metric Combination Wrench Set: 10mm, 11mm, 12mm, 13mm, 14mm, 15mm, 16mm, and 17mm in a durable case;

670.4.1.2 SAE Combination Wrench Set: 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, and 11/16 in. in a durable case;

670.4.1.3 3/8 in. drive SAE 6 or 12-point Socket Set: 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, and 3/4 in.ch in a durable hard plastic case;

670.4.1.4 3/8 in. drive Metric 6 or 12-point Socket Set 10mm, 12mm, 13mm, 14mm, 15mm, 16mm, 17mm, 18mm, and 19mm in a durable hard plastic case;

670.4.1.5 3/8 in. drive ratchet with 3 inches and 6 inches extension bars in a durable hard plastic case;

670.4.1.6 10 in. Adjustable Wrench;

670.4.1.7 Strap Wrench Set (two Piece);

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670.4.1.8 10 in. Curved Jaw Locking Pliers;

670.4.1.9 10 in. Straight Jaw Pushlock Pliers;

670.4.1.10 10 in. Straight Jaw Pliers;

670.4.1.11 10-in-1 Ratcheting Multi-bit Screwdriver Set;

670.4.1.12 LED Rechargeable Waterproof Spot-Beam Flashlight with at least 290 lumen;

670.4.1.13 1/8 inch x 1/8 inch x 7.5 inch black poly cable ties, 50 pack; and

670.4.1.14 One roll (20 yards) of 2-inches wide duct tape.

670.4.2 The HSC-L shall be provided with onboard repair parts to enable the crew to correct minor underway casualties (e.g., belts, filters, light bulbs, fuses, etc.).

670.4.3 The stowage for these parts shall be with the tool kit.

670.4.4 The onboard repair parts shall be in a waterproof, chemical resistant, corrosion proof case similar to the case provided for the tool kit.

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