*ATTACHMENT J-1*

# Statement of Requirements

**for**

# Design and Construction

**of a**

# NOAA SWATH
# Coastal Mapping Vessel (CMV)

**January 25, 2004**

Revision B

**United States Department of Commerce**

**National Oceanic and Atmospheric Administration**

**REVISION HISTORY**

**Revision A – Released with Solicitation Amendment 0001. Incorporated responses to Bidder's Questions.**

**Revision B – Released with Contract Modification 0001. Incorporated responses to Contractor Questions.**

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# 000 GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION

## *042 GENERAL ADMINISTRATIVE REQUIREMENTS*

### 042a. General

This Statement of Requirements (SOR) describes the performance requirements for design and construction of a Small Waterplane Area Twin Hull (SWATH) Coastal Mapping Vessel (CMV) for the National Oceanic and Atmospheric Administration (NOAA).

This SOR does not include a complete statement of all Regulatory Body requirements necessary to satisfy the classification and certification requirements of Section 070 and United States Regulatory Bodies. The Contractor shall ensure that all such Regulatory Body requirements are met.

### 042b. Definitions

**ABCU** – ABS notation for automation, remote monitoring and control enabling the propulsion spaces to be periodically unattended. Propulsion control is to be effected primarily from the navigating bridge.

**ABS** - American Bureau of Shipping.

**ACS** - Aft Control Station.

**ADCP** – Acoustic Doppler Current Profiler.

**AISC** - American Institute of Steel Construction.

**AMCA** – Air Movement and Control Association.

**AMS** – ABS notation indicating compliance with ABS machinery requirements.

**ANSI** - American National Standards Institute.

**'area'** - The term '**area**' or '**net area**', unless otherwise defined, means the usable area after losses from structure, insulation, linings and distributive systems.

**ARI** - Air-Conditioning and Refrigeration Institute.

**'as approved'** - The terms '**as approved**,' '**to approve**', '**approved**', '**as required**', '**required**', and '**as selected**' mean the approval by, the requirements of, or the selection of the Government. Additionally, the terms '**approved**' and '**required**' may also mean approved or required by a Regulatory Agency or Regulatory Body. Wherever these terms are used without further qualification, it is the approval, decision, or direction of the Government or Regulatory Bodies, as appropriate, that is required. Where an item is required to be submitted for approval, work shall not proceed, except at the sole risk of the Contractor, until notification of approval is received. In the event the subject item is not approved, rationale will be provided, and subject effort shall not proceed until such time as a satisfactory and mutually agreeable resolution has been resubmitted and approved. Where the Contractor desires to deviate from the requirements of the contract, compliance with the Configuration Management clause of the contract is required.

**ASHRAE** - American Society of Heating, Refrigeration, and Air Conditioning Engineers.

**ASME** - American Society of Mechanical Engineers.

**ASTM** - American Society for Testing and Materials.

**AT** - Acceptance Trials.

**BERP** – Bolted Equipment Removal Plate.

**CDRL –** Contract Data Requirements List (Attachment J-2)

**CFE** - Contractor-Furnished Equipment.

**CFM** - Contractor-Furnished Material.

**CFR** - Code of Federal Regulations.

**COLREGS** or **72 COLREGS** - The International Rules formalized by the Convention on the International Regulations for Preventing Collisions at Sea, 1972, and subsequent amendments, as applicable.

**Construction** - The construction of the ship to meet the requirements identified in this SOR.

**Contractor** - The design-ship construction entity that holds the prime Contract with the Government.

**CRES** - Corrosion Resistant Steel, as specified in Section 078.

**CPIR** – Contract Problem Identification Report.

**CPA** - Closest Point of Approach.

**CTD** - Conductivity, Temperature and Depth.

**DGPS** – Differential Global Positioning System.

**DIM** - Distributed Isolation Material.

**DPS** - Dynamic Positioning System.

**ECDIS** – Electronic Chart Display Information System.

**EMC** - Electromagnetic Compatibility.

**EMI** - Electromagnetic Interference.

**EOS** - Engineer's Operating Station.

**ESWBS** – Extended Ship Work Breakdown Structure.

**EVMS –** Earned Value Management System

**ET** - Electronics Technician.

**FAT** - Factory Acceptance Testing.

**FCC** - Federal Communications Commission.

**FDA** - Food and Drug Administration.

**First Tier and Subtier References** - A referenced document which is directly cited for use or application by an identifying number and/or name in this SOR is a first tier reference for each particular use or application for which it is so cited. A document which is cited in a first tier reference, or in a document referenced therein, is a subtier reference. A document which is a subtier reference in one application may also be a first tier reference in another application when it is cited directly.

**GEIPS** - Galvanized Extra-Improved Plow Steel.

**GFE** - Government-Furnished Equipment.

**GFI** - Government-Furnished Information.

**GFM** - Government-Furnished Material.

**GMDSS** - Global Maritime Distress and Safety System.

**Good Marine Quality** - Constructed of materials unaffected by moisture, sea spray, extremes of temperature, and other hazards of the marine environment, and has been designed and constructed to perform its intended function in the marine environment conditions, plus the dynamic motions and cyclic loads imparted in a marine environment. The item shall further be designed and constructed for ease and safety of operation under dynamic conditions, and shall require minimum maintenance.

**Good Shipbuilding Practice** - Construction to soundly conceived, and engineered drawings, prepared by the Contractor, incorporating the specified components and utilizing recognized shipbuilding construction and testing methods to ensure that the completed ship conforms to specification requirements. Inspection by the Government is for the purpose of verifying the proper functioning of the Contractor's quality assurance measures and is not a substitute for in-process control of quality by the Contractor. Inspection by the Government does not replace or supersede Regulatory Body surveys or approvals.

**Government** - The United States Government.

**GPS** - Global Positioning System.

**HVAC** - Heating, Ventilation and Air Conditioning.

**HSHR** – High speed high resolution side scan sonar system

**IBS** - Integrated Bridge System.

**IEEE** - Institute of Electrical and Electronics Engineers.

**IES** - Illuminating Engineering Society.

"**immediate access**" - The term "**immediate access**" means that the space, location or compartment shall share a common boundary and access, and be on the same deck as the referenced location.

**IMO** - International Maritime Organization.

**IMU** – Inertial Measurement Unit.

**ISO** - International Standards Organization.

**IWRC** - Independent Wire Rope Core.

**Laboratories** - Include all mission spaces identified by name as laboratories as well as the Service Area and ET Shop.

**LAN** – Local Area Network for Computer and Data Acquisition System

**LSP** - Logistic Support Plan.

**MCC** - Main Control Console.

**MCS** - Machinery Control System.

**MVR**- Multiview Report

**MSD** - Marine Sanitation Device.

**NAVSEA** - Naval Sea Systems Command, United States Navy,.

**NAVSHIPS** – The predecessor organization to NAVSEA.

**NEMA** - National Electrical Manufacturers Association.

**NFPA** - National Fire Protection Association.

**NIBS** – ABS notation, Navigational Integrated Bridge System.

**NMEA** - National Marine Electronics Association.

**NOAA** - National Oceanic and Atmospheric Administration.

**NPT** – National Pipe Thread.

**NSN** – National Stock Number.

**NVIC** - USCG Navigation and Vessel Inspection Circular.

**Objective** – Desired performance level.

**Option** – An item, feature or service identified, that can become incorporated in the vessel design and construction which is priced separately in the contract. The government will determine whether to exercise the option in accordance with the schedule and procedures in Section C of the contract.

**OSHA** - Occupational Safety and Health Administration.

**Owner** - The United States Government or its authorized representative.

**PO** – Purchase Order.

**"provide"** - The term "**provide**" means to provide and install all services, labor, materials, systems or equipment to accomplish a function which is not now available.

**PTO** – Percent Time Operable.

**"ready access"** - The term "**ready access**" means that the space, location or compartment shall be within the same subdivision, no more than one deck away and with no more than two intervening doors from the referenced location.

**Regulatory Body** – includes, but are not limited to, ABS, USCG, FDA, USPHS, OSHA, FCC, IMO, SOLAS, MARPOL, and any other industry or Government agency which oversees the design and construction of the ship, or component or assembly, as required by federal law or international agreement.

**Regulatory Body Requirements** or **Regulatory Requirements** - Those regulations and interpretations issued by cognizant Federal or international agencies, and the rules and requirements of the American Bureau of Shipping.

**RMS** - Root Mean Square.

**SAMMS** - Shipboard Automated Maintenance Management System.

**SCC** - Ship Control Console.

**SCR** - Silicon Control Rectifier.

**SEAS** - Shipboard Environmental Acquisition System.

**SNAME** - Society of Naval Architects and Marine Engineers.

**SOLAS** - International Convention for Safety of Life at Sea.

**SOR** - Statement of Requirements.

"**Space and weight**" or "**reserve space and weight**" means that space, weight and support service reservations shall be provided. Space and weight items shall be incorporated in design analyses and used in

the design and selection of service system components and installation. Support services for space and weight items shall be terminated within the compartment affected, ductwork shall be sized for load, and water and air piping shall be terminated on the interior side of compartment bulkheads unless otherwise specified. Electrical service for space and weight items shall be carried to the intended power distribution panel or load center.

**SSFC** - Solid State Frequency Converter.

**SSPC** - Steel Structures Painting Council.

**SSV** - Single System Vendor.

**SWATH** – Small Waterplane Area Twin Hull.

**THD** - Total Harmonic Distortion.

**Threshold** – Minimum Required Performance.

**TM** – Technical Manual.

**TMOP** - Technical Manual Organization Plan.

**Ton** - Metric ton (1,000 kilograms).

**UL** - Underwriters Laboratory.

**UNOLS** - University National Oceanographic Laboratory System.

**UPS** – Uninterruptible Power System.

**USCG** - United States Coast Guard.

**USPHS** - United States Public Health Service, US Department of Health and Human Services.

**USSG** - United States Steel Gauge.

**VCG** - Vertical Center of Gravity.

**VMS** - Voyage Management System.

**Wherever Practicable** - Means that the requirement shall be effected where feasible.

**WBS** - Work Breakdown Structure.

**WERP** – Welded Equipment Removable Plate.

To ensure commonality of understanding, definitions of words used throughout the SOR are those contained in Webster's Unabridged Dictionary.

**042c. Effective Issue**

Where regulatory body requirements, industry standards or Government Specifications are referenced, the issue or revision in effect at date of award (Feasibility/Preliminary Design award and Contract Design award) shall apply.

Where manufacturer's type, model, or other commercial designation is referenced herein, the latest characteristics in effect on the date of submission of the Contractor's final proposal shall apply. Where model numbers or other commercial design actions have been superseded since submission of the Contractor's final proposal, new model numbers or designations may be utilized, provided the equipment characteristics associated with the new designation are equivalent to or superior to those associated with the superseded designation.

**042d. Order of Precedence**

In case of inconsistency between the requirements of the Contract, this SOR and the documents referenced herein, the following order of precedence applies:

a. The Contract and all attachments (including CDRLs).

b. The SOR.

c. First tier references.

d. Subtier references.

In case of conflict between Regulatory Body requirements, and other specific requirements of this SOR, statutes and Regulatory Body requirements take precedence over the SOR requirements. Where such conflict is identified, the Contractor shall notify the Government of the conflict and the proposed method of compliance with Regulatory Body requirements. Where SOR requirements exceed Regulatory Body requirements, no conflict exists and the specific SOR requirements take precedence.

Silence of one document with respect to details or requirements in another document is not considered an inconsistency.

Where first tier references cited herein use terms similar to "should" or "recommended", those requirements are mandatory.

**042e. Correspondence**

Correspondence shall be prepared and submitted.

**042f. Schedules**

The Contractor shall prepare and maintain schedules necessary for the purpose of establishing an orderly and systematic design and construction program, relaying that design and construction plan to the Government, and providing the basis of evaluation of the Contractor's performance. Schedules shall identify critical path milestones and events. The schedules shall include the following:

a. A Design and Construction Schedule to show the order in which the design and construction of the ship will take place.

b. A Drawing Schedule.

c. A Material Ordering Schedule.

d. A Schedule of Major Events and Milestones.

e. A Multiview Report (MVR) showing earned value management system data.

**042g. Purchase Orders**

A purchase order (PO) index shall be prepared, maintained current and available for review by the Government at all times. Copies of purchase orders and changes thereto shall be provided.

**042h. Government-Furnished Material (GFM)**

The Contractor shall unload, inspect and clean any identified GFM, including removal of any temporary preservative at the appropriate time. The Contractor shall handle, weigh, store, maintain and

assemble GFM when disassembled for shipping purposes. The Contractor shall test GFM to ensure proper operation before ship delivery.

Articles and equipment furnished by the Government shall be installed by, or have satisfactory stowage onboard the ship provided by the Contractor, to the satisfaction of the Government. The Contractor shall furnish labor and materials, including foundations, wiring, piping and accessories necessary for installation, testing and stowage of GFM.

Where GFM is intended as a part of a system or assembled equipment, the Contractor shall ensure that the installation of the whole system or equipment does not degrade the performance of the GFM.

## *045 CARE OF THE SHIP*

### 045a. General

The ship and construction modules shall be maintained in a safe, clean, and workmanlike condition during the entire period that the ship is in the Contractor's possession. During construction, all parts of the ship shall be kept free of chips, shavings, refuse, dirt, water, and other extraneous matter at all times. Compartments that are to be permanently closed or that may become inaccessible shall be inspected and approved with all rubbish removed before closure. Appropriate measures shall be taken to minimize wear and damage from construction and to prevent corrosion or other deterioration.

[AMENDMENT 0001] Copper debris shall not come into contact with aluminum ship structure. Shot or abrasives which have been in contact with copper materials shall not be used on aluminum materials. Graphite pencils shall not be used for marking aluminum. [AMENDMENT 0001]

Strip heaters, where installed for electric motors, shall be activated. Heat lamps shall be provided for electric motors without strip heaters. Unpainted machine parts, both interior and exterior, shall be protected against corrosion and deterioration during the interval between manufacture and placing in service aboard the ship. If removal of the preservative is required for testing the machinery or equipment before installation, the Contractor shall represerve and protect the machinery or equipment before installation in accordance with manufacturers' instructions. Preservative on working parts shall be removed before the operation of the machinery or equipment.

Equipment, prefabricated parts, furniture, piping, machinery, equipment, and outfit shall be protected from damage at all times, be kept free of vermin and contamination, and be kept clean and protected during manufacture, storage, assembly, and installation. Open ends of pipe, valves, and fittings, shall be sealed during manufacture, storage, assembly, installation, abrasive blasting, and painting.

Before delivery, the interior and exterior of the ship shall be swept, washed down, or otherwise cleaned and the ship put in a habitable condition.

### 045b. Fire and Flooding Protection

The Contractor shall develop and maintain a comprehensive and effective system of fire prevention, fire detection, and fire fighting to protect the ship before delivery. The Contractor shall also develop and maintain a comprehensive and effective system of flooding prevention, flooding detection, and flooding damage control, repair and dewatering capability to protect the ship while it is waterborne before delivery.

### 045c. Organization and Training

Fire and flooding protection organization charts and instructions shall be prepared, and shall be kept up to date. Training drills shall be conducted at the beginning of construction, and at intervals of no more

than six months thereafter, to determine the adequacy of the system. The Contractor shall correct any deficiencies discovered and take prompt action to improve training and equipment.

**045d. Launching**

The Contractor shall be responsible for the safe launching of the ship at a time and manner as agreed upon by the Contractor and the Government. A launching plan including launching calculations shall be prepared by the Contractor.

## *070 GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION*

### 070a. General

The ship, equipment, fittings and workmanship shall be of good marine quality.

The ship shall be designed and constructed in accordance with ASTM F1332, Standard Practice for Use of SI (Metric) Units in Maritime Applications to the maximum extent practicable. The Human Engineering principles of ASTM F1166, Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities, shall be followed for design of compartments, spaces, work and control stations, and facilities including indicators and for interfaces with machinery and gear handling systems. Factors affecting both normal and emergency conditions, such as illumination and environmental conditions, shall be as outlined in ASTM F1337. Ship systems shall be designed to be operated by a range of the specific user population, bounded between the 5$^{th}$ percentile female to the 95$^{th}$ percentile male. Operation, maintenance and repair activities and procedures shall minimize manual handling and shall be designed to be conducted by this range of individual physical capability.

The primary mission of the ship is to conduct full seafloor mapping in coastal areas. Operations will be conducted continuously 24 hours per day with average mission duration of 5 days during all seasons of the year on the Gulf and East Coast, the Caribbean and Great Lakes. Operations areas and transit routes will include those more than 20 miles offshore.

[AMENDMENT 0001] The ship shall be a SWATH vessel capable of performing the following: [AMENDMENT 0001]

a. Conducting basic hydrographic surveys via full seafloor ensonification.

b. Periodic navigational area clearance of fairways and approaches to ports.

c. Diver or small boat resolution of individual significant items deemed hazardous to surface navigation.

d. Conducting research in support of nautical charting and seafloor mapping.

The ship shall be capable of the following speeds [MODIFICATION 0001] at the Design Draft and Displacement: [MODIFICATION 0001]:

| | |
|---|---|
| Design Speed: | 12 knots in calm water at 80 percent maximum continuous rating (MCR) |
| Transit Speed: | 80 percent of design speed |
| Towing Speed: | 3 knots to design speed in 1.9 meter significant wave heights any heading (Tow drag shall be 7.7 kN at 12 knots, varying as the square of the speed through the water) |
| Minimum Continuous Speed: | 1.5 knots best heading, without tow and without the use of dynamic positioning |

The ship shall be designed to function continuously during the longest duration at-sea deployment defined herein without sustaining a system failure that cannot be corrected at sea, or that results in degradation of mission capabilities.

Operating profiles for major missions are defined in Table 070-1. The ship will be operating 240 days per year. The ship shall have a transit range of 1,500 nautical miles at Transit Speed.

**Table 070-1. Mission Operating Profiles**

| Parameters | High Speed High Resolution Side Scan Sonar | Multibeam Bathymetry (SWMB) | Combination Operations (SWMB & HSHR) |
|---|---|---|---|
| Length of mission | 5 days | 5 days | 5 days |
| Time at design speed | 15% | 60% | 30% |
| Time towing at 3 knots | 5% | 5% | 5% |
| Time towing at 6 knots | 5% | 5% | 5% |
| Time towing at 8 knots | 60% | 10% | 45% |
| Time towing at design speed | 5% | 10% | 5% |
| Time at anchor | 5% | 5% | 5% |
| Time on station (less than 3 knots) | 5% | 5% | 5% |
| Total | 100% | 100% | 100% |

**070b. Regulatory Body Requirements**

The ship shall be a SWATH vessel designed and constructed under ABS survey, and classified under ABS ✠A1, Circle E, SWATH Vessel, unrestricted service for the coastal areas of operations (Open Sea Operations Limited to areas noted previously), ✠AMS, ✠ABCU, NBL (Navigational Bridge Layout) and ABS Record of Notation CRC for compliance with ABS Guide for Certification of Cranes (including the requirements of API 2C). A Register of Lifting Appliances shall be obtained for the equipment identified in Section 591.

The ship shall be constructed and certificated in accordance with 46 CFR, Subchapter U, and shall comply with applicable federal regulations. Inspection and certification shall be in accordance with the procedures of NVIC 10-82.

The Contractor shall provide the materials, equipment and outfit items required for the ship to operate in compliance with Regulatory Body requirements, including the requirements of 33 CFR 164, 46 CFR 196 and for operations in latitudes higher than 35 degrees.

Design standards and design guidance include but are not limited to:

U.S. Coast Guard (USCG):

46 CFR Subchapters U, "Oceanographic Research Vessels"

46 CFR 196

33 CFR 164

72 COLREGS as amended

International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW)

American Bureau of Shipping (ABS):

ABS Rules for Building and Classing Steel Vessels under 90 meters in Length

[AMENDMENT 0001] ABS Rules for Building and Classing Aluminum Vessels [AMENDMENT 0001]

ABS Guide for Building and Classing Small Waterplane Area Twin Hull (SWATH) Vessels

ABS Guide for Certification of Cranes (including API Specification 2C)

ABS Guide for Bridge Design and Navigational Equipment/Systems

International Maritime Organization (IMO):

Safety Of Life At Sea (SOLAS), as amended.

International Convention for the Prevention of Pollution from Ships (MARPOL), (note: MARPOL 73/78 Gulf Coast operations place this vessel in a MARPOL "Special Area")

Other:

OSHA

U.S. Public Health Service Vessel Construction Regulations

Clean Air Act

Clean Water Act

IEEE 45

The Contractor shall obtain and provide an International Load Line Certificate. [MODIFICATION 0001]The Winter Load Line assignment shall correspond to the Design Displacement [MODIFICATION 0001]. The ship shall be variable sea water ballast or fuel load compensated for the service life weight allowance.

The Contractor shall obtain and provide United States Tonnage Certificate with convention and regulatory measurement system tonnages, and an International Load Line Certificate and an International Tonnage Certificate for the ship. Tonnage shall not be minimized through the use of tonnage openings.

The Contractor shall obtain and provide Deratting Exemption, Certificate of Sanitary Construction, certificates of compliance with MARPOL Annex I, Annex IV and Annex V, and the following SOLAS certificates:

a. Cargo Ship Safety Construction Certificate.

b. Cargo Ship Safety Equipment Certificate.

c. Cargo Ship Safety Radio Certificate.

The ship shall be designed, constructed and documented such that the Government may obtain a SOLAS Safety Management Certificate.

The ship shall be designed, constructed, equipped and documented such that the Government may obtain a SOLAS International Ship Security Certificate indicating compliance with SOLAS Chapter XI-2 and Part A of the International Ship and Port Facility Security (ISPS) code.

Diesel engines shall comply with the requirements of MARPOL Annex VI and the requirements of 40 CFR Part 89, regardless of implementation date. An International Air Pollution Prevention (IAPP) certificate shall be provided.

Materials shall meet the requirements of SOLAS and IMO Resolution MSC.61(67) (the FTP Code) for installations after 31 December 2003.

The Contractor shall obtain and provide GMDSS certification for Sea Area A3.

Design and installation of electrical and electronic systems shall be in accordance with IEEE Standard 45, IEEE Recommended Practice for Electric Installations on Shipboard, and with the requirements herein.

**070c. Principal Characteristics**

The principal dimensions of the ship shall be as specified herein:

**Design Displacement.** – [MODIFICATION 0001]The design displacement is the displacement corresponding to the Full Load at the end of Service Life Condition draft at level static trim. The Full Load at end of Service Life Condition includes the Light Ship weight, Full Load variable loads, all weight margins and the service life weight allowance. [MODIFICATION 0001]The use of permanent ballast to obtain design displacement, trim and heel is not permitted.

[MODIFICATION 0001] **Design Draft.** – The design draft is the draft at the design displacement. [MODIFICATION 0001]

**Draft Limit.** – [MODIFICATION 0001]The navigational draft shall not exceed 4.5 m (threshold), 3.65 m (objective) with the vessel at the design displacement and including all sonars and appendages[MODIFICATION 0001].

**Length Limit**. – The length shall not be less than 26 meters overall, nor exceed 50 meters overall.

**Beam Limit.** – The beam shall not exceed 18.5 meters overall.

**Variable ballast -** [MODIFICATION 0001] The design draft, trim, and heel shall be maintained within +/- 0.1 meter[MODIFICATION 0001]. Fuel burn off and other consumables shall be compensated for with variable ballast. Counter balancing for small boat, and "A" frame lifts is allowed. Ship shall level out within 10 minutes of worst-case lift/launch. A trim/heel sensor system, that is operable at sea, shall be installed on the bridge. The ballast trim/heel control system is to be operable from the bridge.

**Endurance Range -** Range at transit speed: 1,500 nm.

**Ship's Complement** – 12 persons. [MODIFICATION 0001] Two of these persons shall be considered to be officers for purposes of crew and effects weights. [MODIFICATION 0001]

**Stores Endurance -** The chill, frozen and dry stores spaces and weight shall be sized to support the ship's complement for the maximum cruise duration plus 2 days.

**Service Life** [MODIFICATION 0001] **Weight Allowance. -** The service life weight allowance shall be 1 percent of the full load displacement at delivery applied at the vertical height and forward end of the Aft Working Deck Area. The full load displacement at delivery is the sum of the light ship weight, full load variable loads (except for any service life compensating ballast) and all weight margins other than the service life weight allowance. [MODIFICATION 0001]

**Appendages. -** Rudders, canards and stabilizer fins shall be provided as necessary to meet the performance requirements. Appendage design shall consider fouling or snagging of fishing gear (crab/lobster pots, nets, etc.). Fixed canards shall be provided with power activated trim tabs. Controls shall be on the bridge and activated manually.

**Hydrodynamic Model Tests. –** Hydrodynamic model test data from physical model testing shall be provided for the contract hull form, during the contract design phase. As a minimum, test data shall include flow line tests for canard/stabilizer alignment, bare hull resistance, appended resistance, and stock propeller self propulsion.

**Hull, Mechanical, and Electrical**

The propellers and rudders shall not extend aft of the SWATH box structure. To avoid fouling of the wire and instruments, deployed over the stern, the propellers and rudders shall lie outside of a 20-degree cone whose apex is at the sheave of the extended A-frame.

Small boats will be routinely launched and recovered in support of mission objectives. The vessel shall be designed to allow a small boat to come alongside safely in a seaway. A SOLAS rescue boat and davit shall be provided.

Diesel Fuel Marine, ASTM D975, Grade 2-D shall be used by fuel burning equipment. Fuel rates shall be calculated in accordance with SNAME Technical and Research Bulletin 3-49, "Marine Diesel Power Plant Practices,"

Fuel capacity shall be provided for the operating profiles defined in Table 070-1, or a transit of the design range at transit speed, whichever is the most demanding. Fuel capacity required for each operating profile shall be calculated, assuming calm water conditions. Fuel capacity calculations shall include the 24-hour average ship service electric load for each operating condition. The total fuel consumption shall be calculated based on the fuel rates associated with all fuel burning equipment and their expected operating periods. The required fuel load shall include a reserve fuel allowance of 10 percent. [MODIFICATION 0001]A tailpipe factor of 2.0 percent, to account for unburnable fuel remaining below the tail pipes, shall be applied to all tanks[MODIFICATION 0001].

The electrical generating system shall include a service life electrical growth margin of 15 percent of electric loads, except for propulsion, bow thruster and steering gear loads, at ship delivery.

**070d. Maneuverability**

The ship shall be capable of achieving a tactical diameter of less than 5 ship lengths in either direction at design speed, free route, at full load condition in calm water, in fair weather with a clean bottom, without the use of the bow thruster, differential thrust or differential canard settings.

Each rudder and propeller shall be independently controllable by manual actuators and ganged controllable by joystick controller.

**Station keeping**: The ship shall be capable of maintaining station on best heading within one vessel length in seas up to 1.8 meters significant wave height, with a wind speed up to 25 knots and a current up to 2 knots, both from the same direction.

**Precision trackline:** The ship shall have the ability to maintain track at a speed, through the water, between 3 knots and design speed in any direction over the bottom, in seas up to 1.8 meters significant wave height, with a wind speed up to 25 knots and a current up to 2 knots, both from the same direction. A lateral trackline error shall not to exceed +/- 10 meters. Precision trackline operations shall be performed with and without a tow.

An analysis of maneuvering performance shall be provided to show compliance with all requirements. A maneuvering performance prediction report shall be provided.

**070e. Seakeeping Performance**

The ship's percent time operable (PTO) shall be analyzed based on operating conditions given in the National Data Buoy Center website: http://www.ndbc.noaa.gov. The analysis shall use the annual sea state statistics at buoy stations 44005, 44009, 41005, 42009 and 42001. These statistics can be found on the "Climatic Summary Table (PDF)" for each buoy station. The required ship speeds shall be taken for the missions specified in Table 070-1, except that the time at anchor shall be neglected. All headings shall be considered equally probable.

Operability criteria shall be as follows:

| | |
|---|---|
| Maximum significant roll angle | 10 degrees |
| Maximum significant pitch angle | 5 degrees |
| Maximum significant yaw rate | 3 degree/sec |
| Maximum significant heave period | less than 30 sec |
| Maximum vertical acceleration | 0.40 g |
| Maximum lateral acceleration | 0.20 g |

The ship's responses shall be predicted using an analytical method to be proposed by the Contractor.

[AMENDMENT 0001] The acceleration criteria shall be evaluated at the helmsman's position on the bridge and at a position at the center of the Aft Working Deck Area. [AMENDMENT 0001]

PTO shall be independently calculated for each mission element defined in Table 070-1, for each buoy identified above. The PTO shall be at least 99 percent for the annual aggregate of sea states up to 2.5 m significant wave height, at each of the five buoys. The PTO shall be at least 90 percent for the annual aggregate of all sea states at buoy station 44005.

A seakeeping performance report shall be prepared.

**070f. Accommodations, Ship and Mission Spaces**

The ship shall be provided with properly equipped and outfitted enclosed and open spaces to allow the ship to accomplish all missions defined in Section 070a and satisfy regulatory body requirements. As a minimum, the spaces described in this section shall be provided.

**Accommodations.** - Staterooms with permanent berthing and toilet/showers (T/S) shall be provided for 12 persons, comprised of six double staterooms. Each double stateroom shall share a T/S with another double stateroom.

Complement related facilities, services, lifesaving equipment, stores, and functions shall be based on 12 persons.

**Public Toilets.** - A public washroom/water closet (WR/WC) shall be located near the working deck accessible from the main passageways. A public WR/WC shall also be provided in the immediate vicinity of the Bridge. Public WR/WC and T/S spaces shall be outfitted in accordance with Section 644.

**Leisure Spaces.** - A lounge space shall be combined with the messroom. Outfit shall be in accordance with Section 651.

**Food Service Spaces.** - The following food service spaces, outfitted in accordance with Section 651, shall be provided:

a. Galley. - To serve the ship's complement and located on the Main Deck.

b. Messroom. - Seating shall be provided for 0.75 of the ship's complement at any one time. A minimum area of 1.4 $m^2$ per seat shall be provided. The messroom shall be located on the Main Deck adjacent to the galley.

**Utility Spaces.** - The following utility spaces shall be provided:

a. Trash Room equipped in accordance with Section 593 and Section 656.

b. Laundry outfitted in accordance with Section 655.

c. General Workshop outfitted in accordance with Section 665. This space shall be near the main machinery spaces.

d. Linen Locker- A minimum of one linen locker shall be provided on each deck containing Staterooms, outfitted in accordance with Section 671.

d. Cleaning Gear Locker - A minimum of one cleaning gear locker shall be provided on each deck containing Staterooms or Laboratories, outfitted in accordance with Section 671.

e. Paint Locker of 1.4 $m^2$ deck area collocated with the Bosun's Stores and outfitted in accordance with Section 671.

f. Boat Gear Locker of 2.8 $m^2$ deck area – A boat gear locker shall be provided near the boat and outfitted in accordance with Section 671.

Additional utility spaces, such as fan rooms, vent trunks, refrigeration machinery rooms, battery locker, sewage treatment room and $CO_2$ rooms shall be provided as necessary to meet the requirements of this SOR.

**Storerooms.** - The following stores spaces shall be provided, outfitted in accordance with Section 672:

a. Bosun's Stores with a minimum area of 5.6 $m^2$.

b. Frozen Galley Stores with minimum volume of 0.4 cu ft/man-day, 2 m high, located in or adjacent to the Galley

c. Chilled Galley Stores with a minimum volume of 0.4 cu ft/man-day, 2 m high, located in or adjacent to the Galley

d. Dry Provision Storeroom, with a minimum volume of 0.75 cu ft/man-day, 2 m high, located adjacent to the Galley.

e. Engineer's Stores as required by the requirements for on-board spare and repair parts.

**Damage Control Lockers.** - Two damage control lockers shall be provided with a minimum area of 3.7 $m^2$ each, separated with one forward and one aft, each with direct access to the weather. Damage control lockers shall be outfitted in accordance with Section 664 and regulatory requirements.

**Ship's Office.** - A Ship's Office shall be provided and outfitted in accordance with Section 661.

**Bridge Arrangement.** - The helmsman's position in the Bridge shall be located on the ship's centerline at the SCC. Arrangements shall be as required by the applicable ABS bridge design notation and not less than as follows:

Bridge controls, indicators, instruments, and other displays shall be located in the immediate view of the SCC operator position. Indicators for rudder angle, canard flap angles, and r/min shall be located forward of the SCC and shall be visible from anywhere in the Bridge and from the bridge wings.

The Bridge shall be provided with a Chart Area and a blackout curtain around it.

Exterior access to the forward Bridge windows shall be provided.

The ship shall be provided with open bridge wings, which shall extend to the extreme breadth of the ship. The bridge wings shall be located to permit visibility throughout an arc from abeam on the opposite side, to forward, to abeam on the same side to dead aft.

Bulwarks shall be provided in the bridge wings forward and outboard, and a windbreak or venturi shall be provided on the forward bulwark.

Outfit for the bridge and radio/chart area shall be in accordance with Section 663.

**Charting Laboratory. -** The Charting Laboratory shall be contiguous to the Bridge. The Charting Laboratory shall be contiguous to weather deck areas port and starboard, and shall be provided with at least one window on each side with visibility of the horizon abeam. Laboratory spaces shall be outfitted in accordance with Section 691, and shall be designed for ease of reconfiguration to accommodate differing mission requirements. The minimum required net area for the laboratory is 23 $m^2$.

The Charting Laboratory shall be arranged with two sections. One section shall be configured as a data acquisition and processing space that shall have four workstations for personal computers and monitors powered from the UPS system. The workstations shall have countertops 900 to 1000 mm deep and 920 mm wide. The workstations shall have a minimum of 1500 mm clearance from the front edge of the workstation to allow for personnel traffic flow. Workstations located across a walkway shall have 2440 mm of clearance between the front edges of the workstations. Counter space is required for two large printers and a tape drive (2150 mm total width). Floor space is required for a large plotter with approximate dimensions 1525 mm wide, 760 mm deep and 1525 mm high.

The other section of the laboratory shall be configured as a server and LAN system management area that contains the server CPUs, networking switches and several disk shelf arrays with front and back access, and a work surface for a single personal computer plus monitor. This section shall have restricted access or the equipment shall be secured in a dedicated cabinet, with the exception of the computer and monitor. If the server and LAN system management area is located in the acquisition and processing space, it shall be located away from the personnel traffic flow.

**Mission Features. -** The following mission-related features, facilities and arrangements shall be provided:

a. The Aft Working Deck Area shall:

1. be a weather deck area located on centerline aft adjacent to the A-Frame.
2. have a minimum clear longitudinal dimension of 5.2 m and transverse dimension of 4.6 m.
3. be located at a level to minimize distance to the design waterline.
4. be clear of obstructions that impede over the stern towing operations.

b. A-Frame shall:

1. be located on centerline of the Aft Working Deck.
2. be clear of fixed ship structure throughout the A-frame arc of travel.
3. be in full view of the ACS.

c. Service Area space - shall be located on the Aft Working Deck level, and have visibility of Aft Working Deck when doors are closed. Outfit shall be in accordance Section 691c. The gross area shall be a minimum of 19 $m^2$. The Dive Locker (minimum 3.7 $m^2$) shall be located in the service area space in an expanded metal cage with a lockable access door. The Dive Locker space will be used for gear stowage, tank filling and as a dive air compressor operating space. Dive Locker outfit shall be in accordance with 691d. An air intake terminating in this space shall be provided for the compressor, supplied from an external area not affected by exhaust gases.

d. Aft Control Station (ACS) shall be either a part of the Bridge or an enclosed space located with visibility of A-frame, winches and crane, the Aft Working Deck and the starboard bridge wing. The ACS shall have A-Frame, mission winch controls, and propulsion throttle controls, stowage for the portable crane controls, VHF and NOAA radios, monitor for remote camera system and hands-free interior communication with the Bridge and Charting Laboratory. The ACS shall have separate indicators for rudder angle, r/min, gyro repeater, CTD and Side scan systems winch-wire tension, line speed and wire out, and differential GPS. The arrangement of controls and displays shall permit the operator to face the general direction of the A-Frame and cable payout and have unobstructed visibility of the operating equipment. The design shall permit the ability to operate the aft crane from the ACS using portable crane controls.

e. The outboard hulls shall be free of all discharges except for weather deck drains. All discharges shall be routed to the inboard side of each hull.

**ET Shop.** – An Electronic Technician's workshop shall be provided, with a minimum area of 7.4 $m^2$, located near the charting laboratory and outfitted in accordance with Section 665.

**Transducer Spaces. –** A space shall be provided in each hull for access to cabling for external and internally mounted transducers as required by the arrangement of the mission equipment.

**IMU Area.** - A dedicated area for the Inertial Reference System Inertial Measurement Unit specified in Section 491 shall be provided low in the ship out of traffic flow in each Transducer space.

### 070g. Design Phase Reports

A Feasibility Study Presentation, Preliminary Design Report and Critical Design Review Presentation shall be provided to summarize the design status as completed in each phase of design development (format and schedule as defined in Attachment J-2).

### 070h. Electromagnetic Environmental Effects ($E^3$)

Radiators and receptors of electromagnetic energy and related electronics on the ship shall be designed and installed to ensure electromagnetic compatibility (EMC) and to avoid hazards from electromagnetic radiation to personnel. Personnel at or enroute to normal operating stations shall not be exposed to electromagnetic energy in excess of the limits established in ANSI C95.1, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz."

All HF transmit antennas shall be installed with non-metallic personnel guards located so as to provide a minimum distance of 1200 mm horizontal and 2400 mm vertical separation from any working areas, manned stations, and personnel access areas. All areas within this region shall be designated as hazard areas, by painting the deck, and provided with warning signs in accordance with ANSI C95.2, “American National Standard Radio Frequency Radiation Hazard Warning Symbol.” Areas outside this region that violate the safe levels as defined in ANSI C95.1 shall be identified as personnel "no loiter areas." Warning signs shall be provided to designate "no loiter areas."

Automated control systems, communication systems and scientific electronic systems shall not respond spuriously to electromagnetic interference (EMI) from radiating sources or transients on power lines. Cables interconnecting power equipment items which utilize solid-state high frequency switching devices and cables which carry high amplitude pulses shall be physically separated from more sensitive cables whose signal data would be distorted by induced interference. Minimum required cable separation distances shall be in accordance with IEEE 45. Cableway crossings shall be as nearly perpendicular as practical with maximum practical separation. Cables shall be routed within the ship structure and protected from electromagnetic radiation from on-ship transmitting antennas to the maximum extent practicable. All transducer cabling shall be shielded.

Cables routed in topside areas exposed to the weather shall be shielded. Shielding shall be accomplished through the selection and use of shielded cable or by routing cable through shielding conduit. Shielding conduit shall be rigid pipe, flexible metal hose, or enclosed wireways or trunks. Armored cable does not meet these shielding requirements. The outermost overall cable shield of shielded cables shall be grounded at weather deck or weather bulkhead penetration points. Pipes, metal tubing and waveguides routed in topside areas shall be grounded at deck or bulkhead penetration points. Tubing and pipes shall be grounded by welding or by a welded flange or shall utilize the method specified for cable shield grounding. Waveguides shall be grounded by replacing the weather flange gasket with an electrically conductive gasket.

**Bonding and Grounding.** - Large metal items attached by a low resistance connection to ship's hull are considered extensions of the ship hull and are at ground potential.

The following equipment shall be bonded and grounded to ship's ground potential:

a. Equipment utilizing electrical power.

b. Fuel tanks and pipes.

c. Metallic standing rigging and masts.

d. Metallic cranes, hoisting gear, and A-frame.

e. Removable metallic lifeline stanchions, liferails and ladders.

f. Water tanks.

g. Metal ducts.

h. Engines, rudders and rudder stocks, main shafts, sonar trunks, and sea chests.

i. Resiliently mounted equipment shall be bonded as described herein.

The outermost metallic surface of equipment connected to electrical power of 30 volts or more shall be grounded. A third conductor in the power supply cable, a bond strap or a bracket shall be used to ground electrical and electronic equipment installed on resilient mounts. Other electrical and electronic equipment is considered properly grounded if they have areas of metal-to-metal contact or installation bolts. Slide mounted or roller mounted equipment shall be grounded by a conductor within the equipment cable harness.

Wherever possible, running rigging such as flag hoists, shall be non-metallic. Metallic standing rigging shall be bonded to ground potential through the use of bond strapping.

In each of the preceding grounding requirements, the resistance between each item or equipment and the ground point shall not exceed a dc resistance of 0.1 ohm.

[AMENDMENT 0001] Bonding and grounding straps shall be fabricated from braided cable (aluminum braid for connections to aluminum structures and copper braid for connections to steel structure). [AMENDMENT 0001] Lugs shall be installed on each end of the cable to facilitate bond strap installation. Lugs shall be selected to match the mating surface. Bond strap length shall be the minimum necessary. Surfaces where bond straps and lugs are to be attached shall be prepared for installation by cleaning to bare metal. Bond straps placed in topside areas shall be weather sealed after installation by priming and painting the lugs and areas affected by welding or by coating the bolted lugs and associated hardware with weather sealing compound. Bond straps shall not be painted.

**070i. Operating Environment**

[MODIFICATION 0001]The ship shall operate as required by this SOR [MODIFICATION 0001]. The ship and its subsystems shall have full capability within the ranges of temperature and humidity listed in Table 070-2.

**Table 070-2. Operating Environment**

| **WINTER** | |
|---|---|
| Minimum Air Temperature | -18 degrees C |
| Minimum Seawater Temperature | - 2 degrees C |
| **SUMMER** | |
| Maximum Air Temperature | |
| Dry Bulb | 40 degrees C |
| Wet Bulb | 31 degrees C |
| Maximum Seawater Temperature | 35 degrees C |

Structures not specifically addressed by the ABS Rules, such as masts and foundations, and equipment and machinery mounted on weather decks shall be designed using standard AISC factors of safety to withstand all applicable loads, including the following:

a. **Wind Loading**: 146.5 kg/m$^2$ of projected area. Reduction of projected area because of heel shall be neglected for vertical members.

b. **Snow and Ice Loading**: 36.5 kg/m$^2$.

**Service Operation During Ship Motion in a Seaway.** - Masts, staffs, foundations, superstructure and other structures and fittings shall be designed to withstand dynamic forces produced by motion in a seaway. Stowed equipment and appurtenances shall be secured to prevent damage from motion in a seaway.

Equipment and machinery systems shall be capable of maintaining power and lubrication without loss of oil from machinery or hydraulic systems under the operating conditions required by the Regulatory Bodies.

**Loads Due to Ship Motion.** – Installations shall withstand the effects of loads due to ship motion in storm conditions. These loads shall include the dynamic effects of the ship's motion in a seaway, gravity effects and inertia effects. The dynamic forces shall be calculated using the load factors obtained in the following equations:

Ship Characteristics

| | | | |
|---|---|---|---|
| Roll Period | $T_R$ | Seconds | |
| Pitch Period | $T_p$ | Seconds | |
| Roll Angle | $\Phi$ | Radians | (Note 1) |
| Pitch Angle | $\Theta$ | Radians | (Note 1) |
| Heave Acceleration | H | m/sec$^2$ | (Note 1) |
| Surge acceleration | S | m/sec$^2$ | (Note 1) |

Maximum Load Factors at Specific Locations (Note 2)

Surge $$\eta_x = \text{Sin}\,\Theta + \frac{s}{g} + \left(\frac{4\pi^2\Theta^2}{gT_p^2}\right)x + \left(\frac{4\pi^2\Theta}{gT_p^2}\right)z$$

Sway $$\eta_y = \text{Sin}\,\Phi + ½\left(\frac{4\pi^2\Theta}{gT_p^2}\right)x + \left(\frac{4\pi^2\Phi^2}{gT_R^2}\right)y + \left(\frac{4\pi^2}{gT_R^2}\right)\Phi z$$

Heave $$\eta_z = 1.0 \pm \left[\frac{h}{g} + \left(\frac{4\pi^2}{gT_p^2}\right)\Theta x + \left(\frac{4\pi^2}{gT_R^2}\right)\Phi y\right]$$

Notes:

1. [MODIFICATION 0001]Maximum probable lifetime values to be extrapolated from seakeeping analysis results[MODIFICATION 0001].
2. Dimensions x, y, z, meters-longitudinal, transverse, and vertical respectively, related to the CG.

**070j. General Requirements for Equipment, Machinery and Materials**

Equipment, machinery and materials shall be of good marine quality. Equipment, machinery and materials shall be selected to ensure reliable ship operations for 5,760 hours of annual operation.

Equipment and replaceable parts shall be standardized wherever practicable. Hull, mechanical, electrical and electronics items that can be maintained by the replacement of parts shall be supportable through commercial vendors. Systems shall be designed to use the lowest practicable variety of types and sizes of multi-application items, such as valves, motors, fluids and controllers.

**070k. Workmanship**

Care shall be taken to ensure fair lines, smooth surfaces, sound welding, and well-mated joints.

Plating shall be fair, closely fitted, and free from buckles or uneven sight edges. Formed plates and shapes shall be well-formed, and true to required alignment, shape or curvature. Where flanges are used for

attachments, the faying edges shall be free from hollows, and shall be beveled. Shims may not be used to correct improper fit.

Design and finish of propellers, hull and the appendages thereon shall be such that there is no cavitation at ship speeds up to maximum speed, for the vessel as designed.

Sharp edges exposed to personnel shall be dressed or ground smooth. Use of fairing cement is prohibited.

Construction details throughout shall provide for service in seawater.

Safety guards shall be installed over unprotected moving parts of rotating or oscillating equipment and machinery, including machinery systems assembled on foundation skids by the manufacturer.

Partitions and coamings shall be provided with rounded corners.

Piping, wiring, ducts and equipment shall be located to preserve the appearance of living spaces without unnecessarily obstructing passageways or overhead height.

Deck fittings such as railing, vent pipes, overflows, chocks, bitts and escape hatches shall be kept away from the aft working deck area.

Corners and crevices where water and dirt may collect, and inaccessible void spaces shall be avoided. Materials and construction in outfitting shall be selected to minimize maintenance.

**Hull Form.** – Final fairing and lofting of the hull form is the responsibility of the Contractor. Tolerances for the hull form as built shall be as prescribed by ASTM F1053.

**Reference Planes.** - Longitudinal centers shall be referenced to the forward perpendicular. Vertical centers shall be referenced to a baseline parallel to the design waterline. Frame numbers shall start at the forward perpendicular.

## *071 ACCESS*

Passageways shall have a clear width of at least 900 mm. Access routes shall be kept clear of items that restrict passage or are a source of danger to personnel. Passageways shall be wide enough to turn corners without tilting a level stretcher. In passages where queues for messing or disbursing could form, the passage shall be made 450 mm wider to accommodate the queue.

Headroom shall be 2200 mm wherever practicable. Headroom in walking and working areas shall be a minimum of 2100 mm. Headroom in doors and arches shall be a minimum of 2000 mm.

Weather deck personnel access shall be provided port and starboard and shall permit unobstructed access to the fore and aft extremes of the ship.

Exterior inclined ladders shall be provided between all weather decks.

Tank openings in the Charting Laboratory, electronics spaces, and habitability spaces (offices, mess/lounge, galley), except for passageways, are prohibited.

Swash bulkheads, breasthooks and other nontight structure within tanks, cofferdams, or voids shall have swash holes and openings, as necessary, to permit access to all parts of the space.

## *073 NOISE AND VIBRATION*

### 073a. General

Airborne Noise, Sonar Self Noise, and vibration performance shall be in accordance with the requirements herein. The Contractor shall perform acoustic, sonar self noise and vibration analyses of the ship and ship systems and shall incorporate all noise and vibration control treatments necessary to meet the noise and vibration performance requirements. The contractor shall provide and follow a Noise Control Program Plan.

The Contractor shall correct any noise and vibration excesses detected during testing.

### 073b. Airborne Noise

**Airborne Noise Performance Requirements.** - Ship compartments and topside stations shall not exceed the airborne noise performance requirements in Table 073-1. Noise requirements apply to normal ship operation at design speed and during mission operations. Noise performance requirements for additional spaces not identified in Table 073-1 shall be in accordance with guidance given in Enclosure 6 to USCG NVIC 12-82. In addition, staterooms shall meet the requirements of Table 073-1 with the dive compressor in operation.

**Airborne Noise Analysis.** - An airborne noise analysis shall be performed to demonstrate that the acoustic and structural design of the ship will achieve compliance with assigned compartment and topside station noise criteria given in Table 073-1.

### 073c. Sonar Self-noise And Underwater Radiated Noise

Noise and vibration characteristics of the ship shall not degrade the operation of the mission sonar systems listed in Table 073-2 in sea conditions up to 1.8 m significant wave height at speeds up to design speed.

**Sonar Noise Analysis.** - A sonar noise analysis shall be performed to demonstrate that the sonar self noise, acoustic and underwater radiated noise will achieve compliance with the mission systems manufacturer's noise limits for full functionality throughout the operating depth range listed in Table 073-2 for the missions described in Section 070.

### 073d. Vibration

The ship and all ship components shall be free from excessive vibration. Vibration is excessive when it results in damage, or danger of damage to ship structure, machinery, equipment or systems, or when it interferes or threatens to interfere with the proper operation of any ship component. Vibration is also excessive when it threatens to interfere or interferes with personnel safety, comfort or proficiency, or with scientific operations.

The Contractor shall correct any unsatisfactory conditions resulting from the excitation of a natural frequency in any CFE caused by the propeller or other exciting force.

Longitudinal, torsional and lateral propulsion shafting vibration shall meet the acceptability constraints of Sections 3, 4 and 5 of SNAME Code C-5. The Contractor shall perform vibration analyses during design and after construction to ensure the propulsion system vibration requirements are met.

The Contractor shall perform analyses during design and after construction to assess vibration of the hull girder, masts, A-frame, cranes, other above deck structures and the superstructure.

## Table 073-1. Compartment and Topside Station Noise Performance Requirements

| Space | Noise Criteria (Note 1) | Space | Noise Criteria (Note 1) |
|---|---|---|---|
| Staterooms (Note 2) | 60 | Boat Handling Station | 85 |
| Toilet/Shower Spaces | 75 | Bridge | 65 |
| Galley (Note 3) | 75 | Ship's Office | 60 |
| Mess/Lounge | 65 | Deck WR/WC | 75 |
| Laundry | 75 | ET Shop | 60 |
| Passageway (Note 4) | 65 | Charting Laboratory | 60 |
| Passageway (Note 5) | 75 | MSD Space | 85 |
| Trash Compactor Room (Note 7) | 90 | Dive Locker (compressor secured) | 75 |
| Working Decks (Note 6) | 75 | Engine Room, Generator Room, or Propulsion Motor Room (not continuously manned) (Note 7) | 110 |
| Fan Rooms (Note 7) | 90 | General Workshop | 75 |
| Boat Gear Locker | 85 | Auxiliary Machinery Spaces (Not Continuously Manned) (Note 7) | 110 |
| Service Area | 75 | Steering Gear Room (Note 7) | 90 |
| Engineers' Storeroom | 85 | Emergency Generator Room (with E.D.G. secure) (Note 7) | 90 |
| Damage Control Lockers | 85 | Bosun's Stores | 85 |
| ACS (Note 6) | 70 | | |

NOTES:

1. dBA re: 20 MicroPa.
2. Measure with door to T/S closed.
3. Without food processing equipment operating.
4. Applies to passageways serving mission, berthing, and navigation areas.
5. Applies to all other passageways.
6. With mission handling systems powered on but not operating.
7. Where noise levels in excess of 85 dBA are measured, these spaces shall be designated as noise hazardous areas and appropriate warning signs shall be posted. Hearing protection shall be provided in spaces where noise levels exceed 85 dBA.

**Table 073-2. Operating Frequencies and Depths for Mission Sonar Systems**

| Acoustic Systems | Operating Depth | Depth of Instrument | Frequency kHz |
|---|---|---|---|
| HSHR Side Scan Sonar<br>Towed | 10 to 200 m | Variable | 455 |
| Mission depth sounder | [MODIFICATION 0001]To 100 m or higher [MODIFICATION 0001] | Hull mounted | 24/200 |
| Multibeam echo sounding systems | [MODIFICATION 0001]To 100 m or higher [MODIFICATION 0001] | Hull mounted | 100 thru 900 [AMENDMENT 0001] |
| Acoustic Navigation | To 100 m | Hull Mounted | 50 |
| Velocity/Depth Probe | [MODIFICATION 0001To 100 m or higher [MODIFICATION 0001] | Hull Mounted | 11 |
| ADCP | [MODIFICATION 0001To 100 m or higher [MODIFICATION 0001] | Hull Mounted | 75 |
| Speed Log | 1-200 m | Hull Mounted | 307 |

## *075 THREADED FASTENERS*

Where practicable, threaded fasteners shall be metric in accordance with ISO or corresponding national standards. For cases where this is not practicable, threaded fasteners in accordance with applicable ANSI standards may be used.

Fasteners for metal parts shall be of a material compatible with the part. Fasteners in aluminum shall be CRES. Use of brass fasteners is prohibited except for the deck fittings and tiedowns required in Section 100.

Fasteners exposed to the weather or salt water shall be CRES, where allowed by the specific application.

## *078 MATERIALS*

Where CRES is used, it shall be ASTM A276, A473, A167 Classes 304 or 316, passivated.

Joiner hardware shall be corrosion resisting material and of good marine quality.

Cast iron may not be used in any service where it is exposed to impact loading. Gray cast iron may not be used in pump applications.

Dissimilar metals that are not electrolytically compatible may not be joined directly. Electrolytic corrosion shall be prevented by insulating dissimilar metals from each other with gaskets, washers, and sleeves, or bushings of insulating materials. Use of explosion bonded bimetallic joint material (Deta-clad) is required for aluminum-to-steel structural joints. Faying surfaces between wood, metals and laminates, or any

combination of these materials, except machinery foundation shims, shall be protected by use of bedding compound plus one coat of primer applied to the metal. Faying surfaces between wood and other materials shall be protected by use of wood preservative fortified bedding compound.

Substances listed in Table 078-1 shall not be used in the design, construction, operation and maintenance of the ship. Substances listed in Table 078-2 shall be identified to the Government prior to their selection for use in the design, construction, operation and maintenance of the ship. Lead paint shall not be used.

Ozone depleting refrigerants and agents shall not be used. The use of CFC-12 and CFC-502 is prohibited. HFC-134a and HP-62 shall be used where available. Equipment utilizing HCFC-22 may be acceptable providing no non-ozone depleting substitute refrigerants are available at the time of equipment ordering, with Government approval. Ammonia may not be used as a refrigerant.

Asbestos, radioactive or radium bearing material, magnesium, cadmium plated parts and mercury may not be used in construction applications where a functionally equivalent substitute is available, unless approved by the Government.

**Table 078-1. Prohibited Substance List**

| **Substance Name** [1] | **CAS Number** [2] |
|---|---|
| Asbestos | 1332-21-4 |
| Benzene | 71-43-2 |
| Carbon Tetrachloride | 56-23-5 |
| Mercury (12) | 7439-97-6 |
| Methyl Ethyl Ketone | 78-93-3 |
| Methylene Chloride | 75-09-02 |
| Polychlorinated Biphenyl (PCBs) | 1336-36-3 |
| Toluene (6) | 108-88-3 |
| Tri-N-Butyl Tin Hydride (TBT) | 688-73-3 |
| Xylenes (3) | 1330-20-7 |

Notes:

1. Substance name followed by "(number)" indicates the number of compounds and compound families, or structural arrangements having discrete CAS numbers.
2. CAS Number: Chemical Abstract Service.

## Table 078-2. Government Controlled Substance List [1]

| Substance [2] | CAS Number [3] |
|---|---|
| 3-3' Dichlorobenzidine | 91-94-1 |
| 4-Aminodiphenyl | 92-67-1 |
| 4-Dimethylaminoazo-benzene | 60-11-7 |
| 4-Nitrobiphenyl | 92-93-3 |
| Benzidine | 92-87-5 |
| Beryllium (5) (Note 1) | 7440-41-7 |
| Beta-Naphthylamine | 91-5—8 |
| Cadmium (7) (Note 1) | 7440-43-9 |
| Carbon Disulfide | 75-15-0 |
| Chromic Acid (2) | 11115-74-5 |
| Chromium (Note 1) | 7440-47-3 |
| Cyanide (2) | 57-12-5 |
| Ethylene Dichloride | 107-06-2 |
| Ethyleneimine | 151-56-4 |
| Lead (22) (Note 1) | 7439-92-1 |
| Methyl Isobutyl Ketone | 108-10-1 |
| Nickel (10) (Note 1) | 7440-02-0 |
| N-Nitrosodimethylamine | 62-75-9 |
| Styrene | 100-42-5 |
| Tetrachloroethylene | 127-18-4 |
| Trichloroethylene | 79-01-6 |
| Trichlormethane/Chloroform | 67-66-3 |
| Vinyl Chloride | 75-01-4 |

Notes:

1. Substances listed in this table are to be minimized in ship systems or subsystems to the greatest extent feasible. The substances listed may be allowed for use with prior Government approval when they occur in environmentally benign formulations such as, polymers, or other applications that prevent their release into the environment, do not cause an occupational exposure risk, do not generate toxic combustion products, and are not regulated for disposal or use. Metals when present in environmentally inert forms, such as standard metal alloys, are authorized for use without Government approval. Government approval is required if they are used in a releasable state.
3. Substance name followed by "(number)" indicates the number of compounds and compound families, or structural arrangements having discrete CAS numbers.
2. CAS Number: Chemical Abstract Service.

## *079 STABILITY*

### 079a. General

The ship shall meet all requirements of 46 CFR Subchapter U - Oceanographic Research Vessels, including the requirements of 46 CFR 190.03. In addition, the ship shall meet the following:

a. 46 CFR 173.020(c) - Subpart B, Lifting (alternative compliance method)

b. 46 CFR 28.555 - Freeing ports

c. 46 CFR 170.173 - Criterion for vessels of unusual proportion and form

d. 46 CFR 173.095 - Towline pull criteria.

All criteria, except those for towline pull and lifting, shall be met with ice loading. The ice loading shall be that required in 46 CFR 28.550 for vessels operating between 42 degrees North Latitude and 66 degrees 30 minutes North Latitude.

[MODIFICATION 0001]For all conditions of loading throughout the operating range of the ship, the design draft shall be maintained, trim shall not exceed 100 mm by the bow or by the stern, and list shall not exceed 0.1 degree to port or starboard. Seawater ballast or fuel may be used to meet list and trim requirements. Sufficient variable ballast tank capacity shall be provided to maintain the design draft, trim and list within limits throughout the range of normal operations through the service life and as otherwise required by stability analyses. Counter-ballasting for over the side lifts or boat launching is allowed. The ship shall level out within 10 minutes of a worst-case lift/launch.[MODIFICATION 0001]

Seawater ballasting of fuel tanks is not permitted.

### 079b. Loading Conditions

Stability calculations shall be performed using data from the weight estimate, with updates as necessary to accommodate changes to the weight estimate over time. As a minimum, the stability calculations shall address the following loading conditions:

a. Full load departure condition with full fuel, fresh water, and stores

b. Mid-voyage condition with 50% fuel, 50% fresh water, and 50% stores

c. [MODIFICATION 0001] Light Operating Load condition with 10% fuel, 10% fresh water, and 10% stores[MODIFICATION 0001]

Each loading condition shall incorporate:

a. [MODIFICATION 0001] The service life weight allowance [MODIFICATION 0001]

b. An itinerant load with a weight of 3.4 metric tons (variable ballast compensated) distributed over the area of the aft working deck and charting laboratory.

Each condition shall be evaluated with respect to the limits determined in the stability analyses. Additional conditions shall be evaluated if more critical loading conditions can occur, or for any unusual loading cases that may occur during normal operations.

## *080 LOGISTIC SUPPORT REQUIREMENTS*

### 080a. General

The Contractor shall provide a fully supported ship at delivery certified by regulatory bodies to sail-away. The Contractor shall provide a Logistics Support Plan (LSP).

## *081 MAINTENANCE AND ACCESS*

### 081a. Access

Equipment and machinery items shall have access for operation, maintenance, adjustment, removal or repair. Permanent fittings shall be kept clear of equipment removal routes. Access shall be provided for proper preservation in way of such equipment and in selecting the location of pipes, ducts, wireways and other permanent fittings behind such equipment.

Access and equipment removal plans shall be provided and documented for maintenance, removal and replacement of all resilient mounts.

### 081b. Maintenance Planning

The Contractor shall provide a Maintenance Plan. The maintenance philosophy is planned maintenance with predictive maintenance for those equipment/systems suited for condition monitoring. Planned maintenance consists of maintenance routines performed on a predetermined schedule based on manufacturer's recommendations. Predictive maintenance consists of maintenance routines performed based on monitoring equipment condition over time. Equipment condition monitoring is achieved by sampling and recording critical equipment characteristics such as lubrication, temperatures or performance and comparing those characteristics to previously recorded data.

Planned maintenance shall be based upon the manufacturer's recommended maintenance procedures and schedules and shall be identified in the applicable technical manuals.

**Lube Oil Sampling Points.** – To support predictive maintenance, the Contractor shall provide lube oil sample drain cocks on the following equipment:

a. Diesel engines.

b. Air compressors.

c. Refrigeration and air conditioning compressors (if fitted with oil sumps).

d. Line shaft bearings.

e. Oil lubricated motors.

**Hydraulic Oil Sampling Points.** – To support predictive maintenance, the Contractor provide hydraulic sampling fittings in each hydraulic system installed in the ship, including steering gear, canard system, and hydraulic power unit for crane and A-frame.

## *083 SUPPLY SUPPORT*

### 083a. Required Spares and Repair Parts

The Contractor shall procure and load onboard at ship delivery, the spare parts identified in Part 4-2-1/Appendix 2 of the ABS Rules for Building and Classing Steel Vessels. These parts are included within the scope of the basic ship construction along with any others required for sail-away.

### 083b. Additional Spare and Repair Parts

In addition to the Required Spare and Repair Parts, the Contractor shall prepare a list of additional spare and repair parts, unique tools, support and test equipment necessary to support each equipment, component or system installed onboard based on vendor recommendations to support one year of operations (5,760 hours). The Contractor shall prepare one list for each major equipment, to include the parts list from the technical manual with each item separately priced and vendor recommended quantities identified. The lists shall be provided to the Government for selection and procurement authorization. The Government may specify additional spare and repair parts. Upon Government authorization, the Contractor shall procure, load and stow the additional spare and repair parts onboard at ship delivery.

The list shall include but not be limited to the following:

**Shore-Based**:

| | |
|---|---|
| Propeller | 1 ship set |
| Propeller gauges | 1 ship set |
| Propeller shafting and bearings | 1 ship set |
| Diesel engine overhaul kits | 1 for each type engine |
| Hydraulic power unit repair kit | 1 each type |
| Hydraulic pump repair kit | 1 each type |

**Onboard**:

| | |
|---|---|
| V-Belts (labeled for service) | 2 ship sets |
| Flexible hoses (labeled for service) | 1 ship set |
| Diesel engine fresh water and raw water cooling pump overhaul kits | 1 for each type of pump installed |
| Diesel engine starter repair kit | 1 each type |
| Diesel engine turbocharger | 1 each type |
| Filter elements - lube oil, fuel systems and fresh water systems (labeled for service) | 2 ship sets |
| Fuel injectors | 1 engine set for each type engine |
| Electric lamps (labeled for service) | 1 ship set |
| Fuses (labeled for service) | 5 ship sets |
| Windshield wiper blades | 1 ship set |
| Strainer baskets | 1 each size |
| Fire pump overhaul kit | 1 each type |
| Bilge pump overhaul kit | 1 each type |
| Crane repair kit | 1 each |

The term "**ship set**" means one replacement item for each unit of the parent equipment installed on the ship.

Shore-based spares shall be placed onboard for transfer with the ship during delivery. In the event the shore-based spares are unavailable at ship delivery, the Contractor shall ship to the location requested by the Government.

**083c. Outfitting**

The Contractor shall receive, inspect, identify, label and store spare and repair parts, consumables, tools, test equipment, publications, technical manuals, damage control and other ship support items, as ordered by the Government and as listed in the Initial Outfitting List (Attachment J-8). The Contractor shall prepare Outfitting Summary Statistics to show the status of all ordered spare and repair parts.

**Outfitting Operations Plan**. - The Contractor shall provide an Outfitting Operations Plan for approval by the Government. The plan shall describe the procedures, controls and schedule for procurement of outfit materials during the ship construction.

**Storage**. - Repair parts storage shall be limited to storerooms, designated storage units in operating spaces, and open storage cabinets. Stowage shall be provided for those items specified in the Initial Outfitting List. Bins, racks and shelves shall be designed and arranged to suit the parts. Material and equipment shall be stowed as required in Sections 670 and 672.

**Stowage Preservation**. - Stowed items shall be preserved for a shipboard environment. Shafting and crankshafts, if provided, shall be individually boxed and supported, with integral supports for bearing and shaft surfaces to prevent distortion when stored ashore for long periods. The shafts and crankshafts shall be coated with preservative. Other shore-based spares shall be packaged as recommended by the manufacturer for long-term, non-environmentally controlled warehousing.

**Stowage Integrity**. - Parts shall be secured against coming adrift or moving within storage cabinets due to motion of the ship in a seaway.

**Stowage Markings**. - Stowage locations shall be marked with a permanent identifying symbol from which the stowage location can be easily determined.

**List of Stowage Locations**. - The Contractor shall prepare a listing of equipment which he is responsible for loading onboard the ship, with the applicable designated onboard stowage location indicated. This list shall be included in the Outfitting Operations Plan.

**Loading**. - The Contractor shall load and stow, in the prescribed locations onboard the ship, at the time approved by the Government, authorized CFM and GFM as described in the Outfitting Operation Plan. The Contractor shall retain accountability for the material until the Government signs for, and accepts custody of, such material, utilizing procedures contained in the approved Outfitting Operations Plan. A listing of outfitting material received after ship delivery shall be prepared.

**Identification Marking of Spare and Repair Parts**. - The Contractor shall mark all spare and repair parts with the following information:

a. Part name

b. Manufacturer's CAGE and part number

c. Manufacturer's name

d. National Stock Number (NSN) (if available)

e. Serial number (if applicable)

f. Stowage location

Markings shall be applied either to an identification plate fastened to the item or directly to the surface of the item. When items cannot be physically marked or tagged because of lack of marking space, or because marking or tagging would have a harmful effect, marking shall be applied to the unit container. Identification marking shall be legible and permanent.

**Conferences**. - The Contractor shall attend, and provide facilities for, an Outfitting Guidance Conference, which shall be held within 120 days of Detail Design and Construction Contract Award.

## *085 DRAWINGS*

### 085a. General

**Preliminary Design Drawings. –** Preliminary Design Drawings shall be provided and shall include, as a minimum, the drawings listed in the Contract Data Requirements List, Attachment J-2 for Preliminary Design Deliverables.

**Contract Design Drawings. –** Contract Design Drawings shall be provided and shall include, as a minimum, the drawings listed in the Contract Data Requirements List, Attachment J-2, for Contract Design Deliverables.

**Detail Design and Construction Drawings.** – Detail Design and Construction drawings shall be provided and shall include, as a minimum, the drawings listed in the Contract Data Requirements List, Attachment J-2, for Detail Design and Construction Deliverables. Construction drawings are those drawings and associated lists necessary for the construction of the ship, and other related drawings describing the arrangements, structure, systems, and equipment provided.

**Diagrams.** – Diagrams shall be provided. Diagrams show the relative location of fittings, branches and equipment in distributive systems. Diagrams shall contain complete information such as pump and fan characteristics, pipe or duct sizes, materials, flows, velocities (normal and maximum), pressure drops, and other pertinent design data such as associated components, identification and operation characteristics.

**Equipment Drawings.** – Equipment drawings shall be provided. Equipment drawings are those drawings that permit the disassembly, repair and reassembly of equipment when used in conjunction with equipment technical manuals.

**Final Drawings.** – Final drawings shall be provided. Final drawings are the last revision of construction drawings and data, which illustrate final ship and system arrangement, fabrication, installation, and equipment as actually installed. Final drawings shall reflect the ship at delivery and include Contractor required revisions through the end of the guaranty period.

## *086 TECHNICAL PUBLICATIONS*

### 086a. General

The Contractor shall develop and implement a Technical Manual Organization Plan (TMOP), and shall develop a Technical Manual Status Report (TMSR).

The Contractor shall furnish commercial technical, operation, and maintenance manuals with supplementary data such as configuration drawings and repair and maintenance parts lists for all Contractor-furnished equipment and systems. Technical manuals shall be clearly marked as to equipment model, serial

number(s), and ship applicability. Calibration procedures shall be provided for systems and equipment with such requirements.

Technical manuals shall be placed onboard the ship before Acceptance Trials.

The Contractor shall prepare an Engineer's Operating Manual (EOM), which describes all machinery and machinery control systems.

Equipment and system technical manuals will be accepted based upon verification of operating instructions, maintenance procedures, and spare parts references contained therein. Technical manual troubleshooting procedures, maintenance procedures, equipment operating instructions, spare and repair part references, and repair procedures shall be verified through practical onboard applications of the technical manual during equipment operation and testing. The Government reserves the right to conduct additional verification of technical manuals as necessary to ensure satisfactory operation, troubleshooting and maintenance of equipment and systems.

## *092 TESTS*

### 092a. General

The testing provisions of this section apply to all Contractor furnished hardware, software, documentation, training, test equipment, spares, services and other deliverables. Quality and performance of all items delivered shall be demonstrated by the Contractor by a formal test program. Unless otherwise specified, the Contractor is responsible for witness by Regulatory bodies and the performance of all tests, inspections and analyses. The Government reserves the right to witness all testing.

The Contractor shall establish a Ship Acceptance Program that demonstrates compliance with ship, systems and equipment performance requirements. Tests shall be performed in accordance with SNAME Technical and Research Bulletin Nos. 3-39 and 3-47. The Ship Acceptance Program shall be documented in a Ship Acceptance Program Plan.

The Contractor shall furnish all material, fuel, labor, power, equipment and instruments necessary to perform the tests. Instruments used in performing tests shall be calibrated before the tests by a certified testing laboratory.

Test procedures shall include the light-off, normal, emergency and diagnostic procedures identified in the equipment or system technical manual. Each test shall be performed in the presence of the appropriate regulatory body and the Government, except when the Government provides prior authorization to the Contractor to perform, report, and certify the results of the test in the Government's absence. Technical manuals shall be available during the tests.

### 092b. Navigation, Communication and Mission Systems Electronics

Coaxial cables shall be tested by a time domain reflectometer to the operating frequency, or to the frequency range for which the cable will be used. Testing shall be performed after installation of the cables to ensure that the cables have not been damaged or degraded. For all other systems requiring coaxial cable, testing by time domain reflectometer is required only in the event of degraded performance after installation.

Equipment operational tests shall be performed. All acoustic systems shall be operated simultaneously to the maximum extent possible at the required speeds and when performing stationkeeping and trackline tests. In addition, the Contractor shall perform continuity tests on signal and power cables, and ensure services are operational.

Upon completion of all antenna installations, the Contractor shall identify areas of the ship and conditions where the exposure limits of ANSI C95.1 are expected to be exceeded.

Contractor installed mission systems, including scientific sonar systems, scientific instrumentation and mission handling systems, shall be tested to verify correct installation and system performance in accordance with manufacturer's specifications.

The Contractor shall demonstrate the mechanical alignment and electrical integration of the steering gear, and ship's navigational system elements, including sonars, radar, gyrocompass and repeaters, DPS (if provided), and other navigation equipment and mission sonars.

Optical cable assembly loss testing shall be performed after termination in accordance with method B of EIA/TIA-526-14 at a wavelength of 1300 nm. The optical loss may not be greater than 1.7 dB. Single mode fiber optical cable assemblies shall be tested for return loss in accordance with method 2 of Annex A of EIA/TIA-455-107. The optical return loss of the cable assembly, including both end connectors, shall be less than 30 dB.

### 092c. Hull Fittings

All hull fittings shall be pull tested to two times the working load.

## *094 TRIALS*

### 094a. General

Trials shall be performed in accordance with SNAME Technical and Research Bulletin No. 3-47, and the requirements specified herein. Trials shall include all First of Class and All Ship items, as well as bow thruster (if provided), low speed controllability, automated controllability, dynamic position system and other auxiliary systems tests.

The Contractor shall establish an organization for the administration, supervision, and performance of trials, including service and dockside personnel, and other services as necessary to dock and undock the ship. A competent trial crew shall be provided by the Contractor, and shall include an appropriately licensed master and licensed chief engineer. Operation of the ship and its machinery, equipment, and systems shall be in a safe manner and in accordance with operating instructions. The trial crew shall record data and compute trial performance and results. Trial data shall be readily available to Government observers, and trial results shall be posted in the vicinity of the data collection and computation center. A complete trial report shall be prepared by the Contractor for each set of trials.

The Contractor shall furnish subsistence for Government representatives and observers while the ship is at sea. When the ship is out overnight, berthing accommodations shall be provided. Where transportation between ship and shore is required, and where transportation between points of debarkation and the shipyard is required, the Contractor shall furnish such transportation.

Instrumentation and equipment required for trials shall be furnished and operated by the Contractor. The Contractor shall provide, calibrate and install temporary instrumentation to obtain the required data. The Contractor shall calibrate all permanently installed instruments before trials. The Contractor shall furnish all fittings necessary and modify all systems as required to install all trial instrumentation. After satisfactory completion of the trials, the trial instrumentation shall be removed and all systems restored to their normal operating condition.

Satisfactory operation of the machinery plant components and controls shall be demonstrated dockside and during underway trials. The propulsors shall be operated under partial load at the dock before sea trials, in accordance with SNAME Technical and Research Bulletin No. 3-39.

The underway trials shall be performed with the ship in the full load condition. The longitudinal center of gravity shall be determined by comparison of the draft marks and the Curves of Form.

During propulsion and endurance trials, the ship shall be operated in water depths of not less than ten times the draft. During Acceptance Trials (AT), the Contractor shall perform an endurance trial. The propulsion motor shall be operated at maximum achievable continuous r/min, subject to manufacturer's restrictions. During this endurance trial, the ship shall be run through a certified measured course, once in each direction, at the maximum throttle setting to determine the maximum speed obtainable.

Fuel economy trials shall be performed at Design Speed.

After completion of the quick-reversal tests, the propulsion system shall be checked for loose items, oil leaks, fuel leaks, water leaks, hydraulic leaks, exhaust leaks and structural defects. Engine mounts and foundations shall be checked for defects.

The ship shall be operated to demonstrate the required maneuvering, speed and towing capability.

The satisfactory operation of the ship's systems and equipment shall be demonstrated.

The DPS (if provided) shall be fully tuned at sea before AT by vendor representatives to adjust the system parameters and demonstrate system capability to the Government and to the Contractor.

**094b. Airborne Noise Survey**

Airborne noise measurements shall be made onboard the ship in accordance with Section 073. Measurements shall be made in all compartments, spaces and locations and the sound pressure levels compared to the appropriate specifications. Tests shall be conducted with all ship systems operating. All areas specifically identified as being covered by a noise specification shall be measured.

Before the start of the test, the following items shall be completed:

a. Inspect visually and aurally the compartments and spaces to be measured to finalize measurement locations. These locations shall be the same in all tests.

b. As far as possible, ensure that the staterooms and spaces are essentially complete including carpets, curtains and furniture where fitted.

c. HVAC flow balancing.

d. The acoustic treatment survey, including resolution of deficiencies.

With the ship operating in accordance with normal underway operating conditions for the Design Speed condition, Transit Speed condition, stationkeeping and sidescan towing, the airborne noise levels in the compartments and spaces of the ship shall be measured. Measurements shall be made at locations within a compartment or space that represent the general acoustic condition of the space and that are representative of locations normally occupied.

In staterooms, measurements shall be made at the head of the berth(s) and at the desk. In public areas, measurements shall be made at typically occupied locations. In machinery spaces, measurements shall be made at watch standing positions, and/or gauge board, alarm, telephone, and those areas where extended occupancies can be expected. Weather deck locations defined in Section 073 shall be measured. In passageways, measurements shall be made about every 5 m.

As a minimum, two measurements per space, deck locations and sanitary spaces excepted, shall be taken. Noise measurements are not required in closets and wardrobes. Data log sheets shall be used. Measured levels shall be compared with the specified compartment or space noise criteria where appropriate

and as noted on the data log sheets. When a space fails to meet its criteria, additional measurements and observations shall be made to define the cause of the failure. Comments shall be made in the appropriate part of the data log sheet on any observed conditions that could compromise the noise survey.

**094c. Vibration Survey**

An underway vibration survey shall be performed following the procedures of SNAME Code C-1 and C-4. Single amplitude displacement shall be measured for the hull girder, superstructure and mast with the ship underway in water with a minimum depth of five times the draft of the ship. A steady acceleration run of 5 to 10 r/min shall be conducted to determine critical operating frequencies. Steady speed runs shall be performed in 5 r/min increments from 1/2 full power r/min to full power r/min. Additional runs of smaller r/min increments shall be taken to determine the maximum amplitude at critical shafting resonance frequencies. The vibration survey at the propulsion machinery shall be performed in accordance with SNAME Code C-5. Vibration shall be within habitability limits of SNAME Technical and Research Bulletin 2-25.

**094d. Mission Trials**

All missions described in Section 070 that have Contractor installed equipment or Contractor developed interfaces shall be tested to validate the Contractor's work.

As a minimum, the following mission trials shall be conducted:

a. **Side scan Sonar Tow**. – Operations shall include lifting of a test body with each hydrographic winch and A-frame, deployment of the test body to 200 m, haulback and recovery onto the deck. Proper functioning of the cable between the deck unit and the hydrographic winch slip rings shall be demonstrated with the test body on deck and in the water. Proper function of the metered sheave shall be demonstrated. The test shall test the signal transmission between the sonars and the charting laboratory.

b. **Hydrographic survey**. – Operations shall include demonstration of proper operation of the Contractor installed equipment or Contractor developed interfaces for the scientific sounder system, acoustic doppler current profiler and multi-beam sonar system in conjunction with the normal ship's navigation sonars.

c. **CTD cast**. – Operations shall include testing the signal transmission between the winch and the deck units, lifting of a test body corresponding to a fully outfitted CTD system with each hydrographic winch and A-frame, deployment of the test body to near bottom or as specified by the Government, haulback and recovery onto the deck. Proper functioning of the signal cable between the CTD deck unit and hydrographic winch slip rings shall be demonstrated.

**094e. Acceptance Trials**

The vessel may not be presented for acceptance trials until it is determined by the Government that the Contractor has satisfactorily carried out those parts of its own builder's trials that the Contractor has deemed necessary to conduct a satisfactory acceptance trial for presentation to the Government.

Acceptance Trials (AT) will be witnessed by the Government and other Government observers. Subject to the Government's approval, representatives of manufacturers who have furnished ship components may be invited by the Contractor to witness trials. As a minimum, the SSVs for the propulsion system and the vendor for the integrated bridge system shall attend AT.

**094f. Final Acceptance Trials**

The Government will conduct Final Acceptance Trials 30 to 60 days before the end of the basic guaranty or extended guaranty period (if exercised). See Section C. The Contractor shall attend these trials and demonstrate that all discrepancies identified during prior tests and trials and all remaining guaranty items have been corrected.

**094g. Trial Schedule and Performance**

The trial agenda shall include the required trials and tests, and shall indicate, in detail, the proposed procedure and data to be recorded.

The Contractor shall notify the Government in writing of the desired date to perform the trials and provide the trial agenda. The trial date and trial agenda are subject to the approval of the Government.

Copies of each complete test procedure shall be available for use by Government representatives. A tabulated list of tests not completed shall be provided. After completion of AT and before official delivery of the ship, all Contractor-responsible work shall be completed or resolved to the satisfaction of the Government.

Technical manuals shall be made available to the Government during the trials. Before the trials, the Contractor shall arrange to have onboard electronic technicians and data recorders, as necessary, to perform conclusive performance tests of electronic systems during the trials. Electronic systems (such as communications, radar, and such other systems) whose performance is affected by a restricted environment of the ship, shall be scheduled in the trial agenda for testing during the underway portion of the trials.

## *096 WEIGHT CONTROL*

**096a. DEFINITIONS**

**Acquisition Margins**. - Acquisition margins are weight and KG allowances. These margins include the weight estimate to cover the inherent limits of precision and the undefined variations of component weight and centers of gravity that occur during the design and construction phases. To provide for adequate weight control and configuration control, acquisition margins are divided into three accounts: Detail Design and Building Margin, Contract Modification Margin, and GFM Margin.

**Bimonthly Weight Report (BWR).** - The BWR is a periodic assessment of displacement, drafts, trim, list, GM, and KG as the weight estimate matures during detail design and construction.

**Contract Design Weight Estimate (CDWE).** - The CDWE is the detailed estimate of the weight and center of gravity of the ship developed during the contract design phase. [MODIFICATION 0001]It consists of estimates for the light ship, full load condition, and light operating load condition displacements and the corresponding vertical, longitudinal, and transverse centers of gravity. The estimates for the light ship and load conditions shall contain the full allowances for any contractor's design development margin, Detail Design and Building Margin, Contract Modification Margin, GFM Margin and the Service Life Weight Allowance. [MODIFICATION 0001]

**Contract Modification Margin.** - The Contract Modification Margin is a weight and KG allowance included in the weight estimates and reports to account for increases associated with contract changes issued during the detail design and construction phase. This margin is 1.45 percent of light ship for weight and 1.2 percent for KG.

**Contract Modification Summary.** - The Contract Modification Summary is a complete listing of the weight and moment effects of approved contract changes. This information shall be included as an appendix to the quarterly weight reports, and the final weight report.

**Contractor-Responsible Condition.** - The Contractor-Responsible Condition is the full load condition without the effects of contract modifications, changes in GFM, and other allowable changes after the establishment of the approved Final Contract Design Weight Estimate. This condition is used to measure the Contractor's progress in achieving the weight and center of gravity to deliver the ship within contractual requirements.

**Detail Design and Building Margin.** - Detail Design and Building Margin is a weight and KG allowance included in the weight estimates and reports to account for design changes due to ship construction drawing development; growth of Contractor-furnished material; omissions and errors in the approved weight estimate, as well as differing shipbuilding practices, omissions and inaccuracies in the ship construction drawings; unknown mill tolerances; outfitting details; variations between the actual ship and its curves of form; and similar differences. This margin is to compensate for all Contractor-responsible differences between the approved Final Contract Design Weight Estimate and the results of the inclining experiment, as well as tolerances for experimental variation in the inclining experiment. Values for these margins are to be selected by the Contractor.

**Final Weight Report (FWR).** - The FWR is a detailed final report of weight and moment data for all required loading conditions. This report accurately reflects accumulated values for estimated, calculated, and actual weight data for the detail design, including the net effect of changes to GFM and adjudicated and unadjudicated contract modifications.

**Full Load Condition.** – [MODIFICATION 0001]Light ship plus the variable loads defined in Table 096-1 and variable ballast to maintain the ship at the design draft and within trim and heel limits.[MODIFICATION 0001]

**GFM Margin.** - GFM Margin is a weight and KG allowance included in the weight estimates and reports to account for increases caused by the growth in GFM during the design and construction phase. This margin shall be 1,250 kg, and shall be applied at the center of gravity of the GFM.

**GFM Summary.** - The GFM summary is a complete listing of weight and center of gravity data for material and equipment that will be provided by the Government. This shall include all space and weight reservations. The GFM Summary is continuously updated as the detail design weight estimates mature.

**[MODIFICATION 0001]Light Operating Load Condition.** - Light ship plus the variable loads defined in Table 096-1 and variable ballast to maintain the ship at the design draft and within trim and heel limits[MODIFICATION 0001].

**Light Ship Condition.** - Ship complete, ready for service in every respect, including Space and Weight reservations, GFM, onboard spares, repair parts, outfitting and liquids in machinery at operating levels, but without any items of variable load.

**Regulatory Body, Vendor Recommended, and Specified Spare and Repair Parts Weight Reservation.** - A weight reservation of 7 metric tons shall be provided for spares and repair parts, which are, directed purchases, including the onboard spares listed in Section 083a.

[MODIFICATION 0001] **Service Life Weight Allowance** – is defined in Section 070c. [MODIFICATION 0001]

**Space and Weight Reservations.** - The space and weight reservations for the mission equipment as required in Sections 432, 491, 551 and 591.

**Three-Digit System.** - The three-digit system is a means of classifying mass properties data in a structured order. Every item that comprises the completed ship is included in the weight estimates and reports grouped in accordance with the three-digit system. The three-digit system for weight estimates and reports is the same as the first three digits of the ESWBS (as provided in Society of Allied Weight

Engineers, Recommended Practice RP14, Weight Estimating and Margin Manual for Marine Vehicles, Appendix A).

**096b. GENERAL**

The weight and moment data for all components and material shall be determined. As ship design or ship construction drawings are prepared and as material is selected, acquired, or received, the weight and centers of gravity for all items that comprise the ship shall be determined and reported in the weight estimates and reports. This weight data shall be obtained by a combination of estimation or calculation of design drawings and, later, detail design and construction drawings and weighing.

A weight control plan shall be provided and implemented. The plan shall indicate how the weight and center of gravity of the vessel will be managed as the design and construction progresses.

During the preliminary design phase, a Preliminary Design Weight Estimate shall be developed and provided in accordance with the CDRL schedule.

During the contract design phase, a Contract Design Weight Estimate (CDWE) shall be provided. This estimate must describe the weight and center of gravity of the ship in comprehensive detail, and must be prepared in the Three Digit System. The CDWE shall be provided within 60 calendar days after Contract Design Award. The CDWE shall be updated and provided every 60 calendar days thereafter until the end of the contract design phase. Prior to the end of the contract design phase, the Contractor must submit a final CDWE for approval.

Approval action will consist of reaching a mutual agreement between the Contractor and the Government, prior to the exercise of the option for Detail Design and Construction, on the light ship weight, center of gravity and margins. This shall establish the Contractor-Responsible Condition. Thereafter, the Contractor is responsible for obtaining, in the completed ship, the approved weight and center of gravity characteristics, adjusted for authorized departures from the approved weight estimate.

Modifications in the construction of the ship, such as revisions in ship geometry, equipment and/or vendors that differ from the approved weight estimate, which result in departures from the approved light ship weight and/or center of gravity must be submitted to the Government for approval. Such submittals must include an estimate of the modification's effect on the weight and center of gravity of the ship. Such modifications may not be undertaken until written approval has been granted by the Government. Individual modifications, the effects of which change any one-digit weight group by less than 250 kg, may be considered negligible and do not require written approval. Departures from the approved estimate resulting from corrections of errors or omissions, revised vendor data, actual scale weights, etc. do not require approval but must be incorporated into the next scheduled revision of the weight estimate.

At each 60 days after the exercise of the option for Detail Design and Construction, the Contractor shall submit a Bimonthly Weight Report. This shall be a tabulation of approved departures and corrections and their cumulative effect on weight, center of gravity, and margin of the approved light ship, resulting in a revised weight estimate. Details of corrections shall be included in these submittals.

A final weight report must be submitted at the time of delivery to bring the estimated light ship weight and center of gravity into reasonable agreement with the inclining results.

**Table 096-1 Variable Loads**

| ESWBS No. | Item | Weight (Full load) | Weight (Light Operating Load) |
|---|---|---|---|
| **CREW AND EFFECTS:** | | | |
| F11<br>F13 | Officers<br>Crew/Scientist | 181 kg/person<br>150 kg/person | 181 kg/person<br>150 kg/person |
| F21 | Small Arms Ammunition | 20 kg | 2 kg |
| **PROVISIONS AND STORES:** | | | |
| F31 | Dry<br>Freeze<br>Chill | 1.45 kg / day per person<br>0.50 kg / day per person<br>0.75 kg /day per person | 10% of Full Load<br>10% of Full Load<br>10% of Full Load |
| F32 | General Stores | 359 kg | 180 kg |
| F41 | Fuel (Note 1) | Endurance | 10 percent of Endurance |
| F46 | Lube Oil (Note 1) | Tank Filled | 50 percent full |
| F52 | Potable Water | Tank Filled | Tank Empty |
| F51 | Ballast Water (Note 1) | As required, but not less than the weight of water below the suction inlet | As required |
| **OTHER FLUIDS:** | | | |
| F50 | Hydraulic Fluid | Tank filled | 50 percent full |
| | Sanitary Tank | 1000 kg | 1000 kg |
| **MISSION SYSTEM STORES AND LOADS:** | | | |
| F29 | Itinerant Load (Note 2) | 3400 kg | 3400 kg |

NOTES:

1. Determined by the Contractor.
2. Distributed uniformly on the Aft Working Deck, Service Area and Charting Laboratory.

## *097 INCLINING EXPERIMENT*

### 097a. Inclining Experiment

An inclining experiment shall be performed in accordance with 46 CFR 170.174 through 190, USCG NVIC 17-91 and ASTM F1321. Inclining experiments shall be conducted no earlier than two weeks before Builder's Trials, if conducted, or three weeks before the Acceptance Trials but in any case with the ship as complete as possible. As part of the inclining experiment, the Contractor shall determine the period of roll of the ship and the period of pitch of the ship. An inclining experiment procedure and a report of the results are required.

A Trim and Stability Booklet using the result of this experiment shall be provided by the Contractor and approved by the Government and the Regulatory Bodies.

## *099 PHOTOGRAPHS*

### 099a. Photographs

Color photographs shall be provided, and will become the property of the Government with no restrictions. Digital photography shall have a minimum resolution of 3.2 megapixels. Each photograph shall be dated and identified as to location and view portrayed.

Identification photographs shall be taken before the ship departs the Contractor's facility for delivery to NOAA.

Inclining experiment photographs of the draft readings forward and aft, and the topside arrangements for inclining weight handling and measurement shall be taken at the time of the inclining experiment.

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# 100 HULL GROUP

## *100 GENERAL REQUIREMENTS FOR HULL STRUCTURE*

### 100a. General

[AMENDMENT 0001] Construction of the hull structure may be of either steel or aluminum. Deckhouse structure may be of either steel or aluminum construction. [AMENDMENT 0001]

Mill tolerance for steel and aluminum shall be no greater than one percent.

No scantling reductions shall be taken for protective coatings.

Double continuous welding shall be used in ballast tanks, water tanks, sewage system tanks, wet spaces, chain locker, sumps, transducer voids, bilges, foundations and structure exposed to weather on the stiffener side.

Oil and water stops shall be provided at the ends of tank boundary plating and in continuous framing extending through tank boundaries. For adjacent tanks, stops shall be provided on both sides of their common boundaries.

Except as otherwise specified, fairness of welded surfaces shall be in accordance with ASTM F1053. Decks shall be self draining (there shall be no standing water on deck).

Attachments to bulkheads for supporting local weights may not impair the strength or tightness of the bulkhead. Insert plates, margin plates, special framing, and stiffening shall be installed as necessary to distribute local stress. Where practicable, the attachments shall be made to the special framing and not directly to the bulkhead structure.

Attachments of components to structural members may not reduce the strength of the member. Brackets, margin plates, doubler plates, inserts or special framing shall be attached to the structure, and the components mounted thereto and not directly to the structure. Drilling or tapping flanges of structural members for the purpose of attaching supports for any equipment, foundations, pipe hangers, cableways, or similar items, is prohibited.

Strength members that are subject to high tensile stresses shall be designed so that dependence is not placed on the strength of the metal normal to its plane of rolling. Where this is impracticable, through connections or other means shall be provided to minimize the possibility of failure due to plate delamination.

### 100b. Foundations

Foundations shall be arranged to provide clearance for disassembling parts, such as circulating pumps, filters, air coolers, pistons, stators, valves, and rotors, without dismantling other machinery, structure or piping.

Equipment and foundations in the aft working deck area shall be demountable. A demountable stuffing tube for services shall be provided and shall have flush caps to install when removed.

Foundation designs shall consider the loads imposed by operation of the equipment as well as the loads due to ship motion.

### 100c. Special Structural Requirements

The transom in way of the A-frame shall be designed in accordance with ABS recommendations for vessels subject to impact.

**100d. Bulwarks**

The weather deck area forward of the forward superstructure bulkhead shall be fitted with bulwarks with freeing ports in accordance with ABS Rules.

**100e. Deck Fittings and Tiedowns**

The interior of all laboratories shall be provided with nominal 10 mm diameter deck sockets made of CRES and threaded bolts for use with portable equipment. Interior deck sockets and bolts shall be provided in a UNOLS standard grid pattern (approximate 600 mm spacing), located in line with the overhead Unistrut sections required by Section 691. Deck sockets shall be flush with the finished surface of the deck.

**100f. Openings**

Openings in any part of the ship's structure, including those parts that do not contribute to the strength of the ship, shall have radiused corners. The corner radius of openings in decks, shell and inner bottom tank top shall be generally 1/8 the transverse dimension of the opening, with a minimum of 150 mm and a maximum of 600 mm. Cuts in non-structural bulkheads shall have at least a 25 mm radius. In longitudinal structural bulkheads and in deckhouse sides, the radius shall be 1/8 of the vertical dimension of the opening, but need not exceed 150 mm. In transverse structural bulkheads of considerable extent, such as main transverse bulkheads, the radius shall be in accordance with ABS requirements. In transverse bulkheads of lesser extent, such as racking webs, the radius shall be 1/10 of the vertical dimension of the opening, with a minimum of 25 mm.

**100g. Equipment Removal Plates**

Bolted Equipment Removal Plates (BERPs) or Welded Equipment Removal Plates (WERPs) shall be provided for equipment or components that cannot be removed through hatches or doors. Removal of the BERPs or WERPs shall not require the removal of other fixed ship structure. Ancillary systems shall be kept clear of BERP or WERP openings. If, because of normal operating wear, an equipment can be expected to require removal every eight years or less, a BERP shall be used for removal. Otherwise, a WERP is acceptable.

**100h. Sonar Fairing**

If the multi-beam sonar transducers are mounted externally on the hull, a structural fairing to reduce flow noise to the sonar manufacturers acceptable level shall be provided. The installation of transducers in the fairing shall be in accordance with the manufacturers recommendation.

**100i. Options for Hull Structure**

[MODIFICATION 0001] Space and weight for the following Section 100 Options shall be incorporated in the vessel feasibility and preliminary design. Contract design and detail design and construction of the vessel with the options incorporated shall be priced in accordance with Section B of the contract: [MODIFICATION 0001]

a. **ABS Structural Design Fatigue Life. –** The design fatigue life determined in the structural Fatigue Analysis for ABS shall be at least 30 years.

## *162 STACK*

The stack(s) shall be configured to prevent stack gas impingement on the aft working deck area, diver's air compressor intake and habitability spaces. The stack shall enclose all diesel engine exhaust systems, including the emergency diesel generator if practicable.

## *170 MAST AND FLAGSTAFF*

A mast with signal yardarms, gaff and mounting brackets for navigation and electronic equipment shall be provided. Fittings shall be provided for the hoists required by Section 613. The mast and yardarms shall be designed to permit servicing of navigation lighting, electronic equipment, and scientific instrumentation and shall be equipped with safety features such as climber safety rails and / or tie-off padeyes in all work locations used by maintenance personnel. Service platforms shall be provided for antenna access on the mast.

Masts shall be designed based on a minimum factor of safety of 2.5 of the welded yield strength of the material. Masts and equipment foundations on the masts shall be capable of withstanding the dynamic forces required in Section 070.

A jackstaff shall be provided at the bow, and a removable flagstaff with mounting fixture shall be provided at the transom.

## *184 NAVIGATION SYSTEM ALIGNMENT*

A Navigational System Alignment Report shall be provided. A master reference block (MRB) shall be provided, consisting of a granite or CRES reference block aligned to the design waterline to within 5 minutes of arc in the x, y and z axes. The block shall be mounted on a sufficiently rigid foundation and supported in a steel box by 12 threaded rods, which are also to be used to position and level the block. After installation and alignment of the reference block to the satisfaction of the Government, the block shall be fixed in the box with poured epoxy.

Unless otherwise specified; inertial measurement units (IMUs), navigational antennas, radars, directional finders, gyrocompasses and each sonar projector and receiver shall be aligned in the x, y and z reference plane to the MRB in accordance with the manufacturer's recommendations, but in no case to a tolerance of greater than 30 minutes of arc. Local benchmarks, referenced to the MRB shall be provided at each transducer location, at the inertial measurement units and GPS antennas, at the gyrocompasses, at points on the aft and forward decks visible to the mission navigation antennas and at the center block of the A-Frame (deployed position). Each transducer housing and mission sea chest shall have a forward and aft lineup mark, each consisting of two triangles with a center punch mark, separated by 5 cm. Resulting lineup marks shall be parallel to ship's centerline.

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# 200 PROPULSION PLANT

## *200 PROPULSION PLANT, GENERAL*

### 200a. General

[MODIFICATION 0001]The ship shall be twin screw, with fixed pitch or controllable pitch propellers driven by either a diesel electric, integrated diesel electric or geared diesel propulsion system[MODIFICATION 0001]. Belt, chain and hydraulic propulsion drives are prohibited.

The propulsion plant shall be capable of continuous operation at 3 knots for extended periods of time with both shafts driving ahead at equal steady thrust. Extended low speed operations shall not cause detrimental effects to the propulsion engine and drive train components or result in unreasonable maintenance requirements.

**Single System Vendor.** – If an integrated diesel electric plant is to be provided, the Contractor shall select a Single System Vendor (SSV) to be responsible for the overall engineering design, integration, Regulatory Body approval, testing and supply of the propulsion system including, but not limited to:

a. Main Propulsion Motor(s), Propulsion Motor Controller(s) and interconnecting cabling

b. Main Propulsion Engines, Reduction Gears

c. Ship Service/Propulsion Generators, Emergency Generator

d. Propulsion, Ship Service and Emergency Switchboards, transformers, and SSFCs

e. Machinery Control and Monitoring System

The SSV shall be experienced in marine electrical propulsion plants and controls and shall have experience as a supplier of electrical control system equipment for this type of application. The Contractor is prohibited from acting as the SSV.

The SSV is responsible for the system design and integration of the various system equipment and sensor interfaces. In addition, the SSV shall integrate the main diesel generator sets, emergency diesel generator set, main propulsion motors, main reduction gears and bow thruster motors into the machinery and ship control systems, and take into account the electrical characteristics of this equipment to assure the design of the ship's combined electrical system is fully integrated and meets the electrical performance and noise requirements herein.

The Government shall be notified and invited to witness factory acceptance testing of all equipment and systems for which the SSV is responsible. Test procedures and reports for all factory acceptance tests shall be prepared and submitted to the government.

The SSV shall provide a propulsion system "ship rider" during the guaranty period following ship delivery, to assist the crew with troubleshooting, calibration, adjustment and repair of SSV-supplied equipment. The Contractor shall document field changes and modifications made during the guaranty period. Technical manuals, drawings and other documentation shall be updated to reflect all such modifications.

## *202 MACHINERY CONTROL SYSTEM*

### 202a. General

The Machinery Control System (MCS) shall provide integrated control and monitoring of the machinery plant, including the propulsion system, electric plant, diesel engine prime movers and auxiliary systems.

Switchboards and control system components shall be located in air-conditioned spaces as required.

Monitoring and control panels required by ABS shall be provided in the engineers' stateroom, Mess, and the Bridge. A summary alarm for non-vital conditions shall also be provided on the engineers' stateroom and Mess panels. An engineer call system and dead man timer function shall be provided. Rotating beacons and audible alarms shall be provided in each machinery space to alert watch standers of alarm conditions at the MCC.

The system shall include control and monitoring stations with the capabilities listed in Table 202-1. Bridge wing and ACS controls are secondary control stations and operated with bridge control station manned at all times

### 202b. Control and Monitoring Requirements

The Machinery Control System shall conform to ABS and USCG requirements.

### 202c. System Interfaces

The MCS shall be the interface between propulsion and bow thruster controllers if provided, and the Dynamic Positioning System, if provided.

The MCC shall have the capability to interface with a personal computer to download machinery performance data for trending. This interface shall be by a single cable.

A ballast, list and trim control system shall be provided. The system shall, both pier side and at sea, display trim, list, estimated draft, calculated and monitored tank levels and operator-supplied loading data, at the SCC and MCC on demand. Displays shall include calculated drafts at the forward and aft draft marks on the port and starboard hulls, calculated trim angle, and calculated list angle. Trim and list calculated angles shall be accurate to 0.5 degree.

Controls shall be provided on the SCC and MCC to adjust trim and list using programmed ballast tank pairs. Actuation of the ballast control shall produce correctly sequenced operation of the required valve openings and closings, and pump start and stop operations. Controls shall include automatic stop features to prevent overfilling of tanks and dry-running of pumps.

A canard control and indicating system shall be provided. The controls shall be located near to each other such that they can be operated together by one person. Canard control and indication shall be independent for each canard flap.

**202d. Options for Machinery Control System**

[MODIFICATION 0001] Space and weight for the following Section 202 Option shall be incorporated in the vessel feasibility and preliminary design. Contract design and detail design and construction of the vessel with the option installed shall be priced in accordance with Section B of the contract: [MODIFICATION 0001]

a. **Aft Control Station Steering Control** – The Aft Control Station shall have propulsion and steering controls.

**Table 202-1. MCS Control Station Capabilities**

| Station | Location | Capabilities |
|---|---|---|
| Main Control Console (MCC) | Centralized Control and Monitoring Station per ABS | Control and monitoring of all propulsion plant and auxiliary machinery plant parameters. Control and monitoring of ballast systems. |
| Ship Control Console (SCC) | Bridge | Single lever throttle control/engine order telegraph for each shaft, steering control for each rudder (individual and ganged operation), DPS control (if the DPS option is exercised), bow thruster control (if the bow thruster option is exercised). Monitoring of propeller r/min, rudder angle and bow thruster speed and angle. Monitoring of propulsion and auxiliary machinery plant parameters and alarms. Monitoring and control of Canard flaps. Control and monitoring of ballast systems |
| Aft Control Station (ACS) | Overlooking the aft working deck area, A-frame and winches | Single lever throttle control/engine order telegraph, steering control (if the steering control option exercised), DPS control (if the DPS option is exercised), bow thruster control (if the bow thruster option is exercised). Monitoring of propeller r/min, rudder angle and bow thruster speed and angle as well as controls for the A-frame and winch. |
| Port and Starboard Bridge Wing Control Stations | Bridge Wings (Port and Starboard) | Portable controls that plug in on each wing and stow inside. |

## *233 DIESEL ENGINES*

### 233a. General

For geared diesel propulsion plants, propulsion engines shall be identical, and the generator set diesel engines shall be identical. Propulsion engines and generator set engines shall all be from the same manufacturer and the same series, if practicable.

For integrated electric propulsion plants, the generator set diesel engines shall all be from the same manufacturer and the same series if practicable. The SSV is responsible for the sizing of the generators to meet the design speed requirements at 80% of rated load and the ship-service electric load including a 15% service life margin (on ship service loads). Efficient combinations of generator sizes shall be selected considering missions and power requirements. An automated load management system shall be provided.

For non-integrated electric propulsion plants, the propulsion generator set diesel engines shall be identical, and the ship service generator set diesel engines shall be identical. Propulsion generator set diesel engines and ship service generator set diesel engines shall all be from the same manufacturer and the same series, if practicable.

Diesel engine and generator sets shall be designed and constructed for marine service in accordance with IEEE Std 45, and approved by ABS for continuous service. Engines and generators shall be integrated packages, each mounted on a common subbase.

Engine rating shall be based on ISO 3046, using standard atmospheric conditions of 100 kPa and 25 degrees C inlet losses of 2.5 kPa and exhaust losses of 6.7 kPa, using the fuel oil specified in Section 070.

Diesel engines shall be provided with all accessories recommended by the manufacturer for continuous service at sea.

An engine jacket water heating system shall be provided for each engine, designed to maintain 49$^{o}$ C jacket water temperature when the engine room ambient temperature is 0$^{o}$ C. The system shall automatically shut down when the engine is started, and shall start up when engine jacket water falls below 46$^{o}$ C.

Each air intake filter shall be equipped with a differential pressure indicator which shall remain in the warning position whenever a high differential pressure occurs until manually reset.

Each engine shall be equipped with an emergency shutdown system operable by a mechanical device leading to a station located outside and adjacent to the engine compartment.

Each engine shall be equipped with a thermostatically controlled fuel supply heater designed to heat the supply fuel from the service tank to a maximum of 32$^{o}$ C. Warm fuel, 21$^{o}$ C and above, shall automatically bypass the heater. Each engine shall be equipped with a thermostatically controlled fuel return cooler to limit the temperature of fuel returned form the engine to a maximum of 100 degrees Fahrenheit.

Engine governors shall be of the electronic type, with performance characteristics supporting the electric power quality requirements of Section 300.

If air starting is used, an air starting motor lubricator is required.

Each engine shall be equipped with a motor driven prelube oil pump which shall interlock with the engine starting system to prevent engine starting until main lube oil gallery pressure reaches a preset value as determine by the engine manufacturer. The system shall automatically shutdown upon a successful engine start. The system shall be equipped with a bypass feature to allow for engine starting under emergency conditions, or when the prelube system is down for repairs. A manual prelube pump shall also be provided.

Engines equipped with multiple turbochargers shall be supplied with a flexible exhaust connection between turbochargers and engine common exhaust ducting so that each engine has a single exhaust line leading to its respective muffler. Diesel engine exhaust systems shall contain a normally closed pressure sensing port for a water manometer connection, located as recommended by the engine manufacturer.

Each engine cylinder shall have a thermocouple provided for cylinder temperature monitoring from the MCS.

**233b. Local Instruments, Controls and Alarms**

A local control station shall be provided for each diesel generator and located in the engine room near the diesel engine served. Controls and instrumentation on each panel shall be as recommended by the engine manufacturer and as required by Regulatory Bodies.

## *235 ELECTRIC PROPULSION SYSTEM (IF PROVIDED)*

**Propulsion Motors.** - The propulsion motors shall be rated for continuous operation and provide full speed control, reversing and dynamic braking. Propulsion motors shall be designed for a 5 percent torque overload rating for 30 minutes, and shall have 125 percent stator/armature current and 200 percent field voltage overload capability for 10 minutes.

Propulsion motor bearings shall be provided with a self-contained lubrication system which provides continuous lubrication from 1 r/min to maximum r/min.

The lubrication system shall provide for extended low speed operations.

**Propulsion Drives.** - Static power drive units for propulsion motors shall provide smooth, stepless, speed control over the entire output power range, ahead and astern through zero.

Propulsion drives shall be capable of providing the output power required by the motors for all conditions of continuous steady-state operation, and the overload values for the duration required for maneuvering. Current limiting and current rate limiting shall be provided, with adjustable time delays set to reflect the ship maneuvering characteristics. Protective devices shall not operate on the overloads or overcurrent experienced in a heavy seaway or when maneuvering, for the duration of the time delay. An alarm shall be actuated in the SCC if load limiting is in effect.

Static power drive control sections shall include local manual control for the associated propulsion motors with manual control transfer switch, speed and direction control device, and shaft r/min indicator. The control section shall contain a system control computer with separate control input connections for the MCC and SCC remote control levers. The speed control computer shall control shaft speed, direction and motor power level based upon the remote control lever position in the SCC or MCC. Provision shall be made for protection against excessive propulsion motor overspeeding, severe overloads, excess current or electrical faults likely to result in damage to the plant.

## *241 REDUCTION GEARS (IF PROVIDED)*

Gear designs shall incorporate integral hydraulic and lube oil systems, and clutches and couplings required for operation. Trolling valves for the required low speed operations may be considered.

Reduction gear inspection covers shall be provided with locks.

Airborne and radiated gear noise shall meet the requirements of Section 073.

## *242 PROPULSION CLUTCHES AND COUPLINGS (IF PROVIDED)*

Clutches shall be employed in gears for connecting and disconnecting propulsion engines and auxiliary propulsion drives. Clutches shall be pneumatically or hydraulically actuated. Clutches shall support disengaging the propeller from the propulsion motor and allowing the propeller and shaft to run free.

If recommended by the equipment manufacturer or required to meet noise criteria, flexible couplings shall be provided between the prime mover and the propulsion reduction gear or the propulsion shafting. Flexible couplings shall be provided on the propulsion shafting if the reduction gear is resiliently mounted.

## *243 PROPULSION SHAFTING*

### 243a. General

The main propulsion shafting system shall include all necessary shafting, couplings and components to connect the propellers, propulsion motors and reduction gears (if provided) . The propeller shafts shall be equipped with take-down connections to allow removal through the stern tube without cutting either the shaft or ship's structure.

Shaft brakes shall be provided for each shaft, operable from the local station only. The shaft brake controls shall be interlocked with the propulsion control system so that shaft speed is reduced to zero, at the maximum acceptable rate, when the shaft brake is activated. The shaft brake shall be capable of holding the shaft stationary in a three knot current.

Shaft locks shall be provided.

## *244 PROPULSION SHAFT BEARINGS AND SEALS*

### 244a. General

Line shafts and thrust bearings shall be of the self-aligning type. Line shaft and thrust bearings may be of the hydrodynamic or anti-friction type. If anti-friction type bearings are used, they may only be used as interior bearings. Anti-friction bearing may be tapered or spherical roller bearings. The maximum allowable static bearing load based on projected area may not exceed 515 kPa.

### 244b. Thrust Bearings

Oil lubricated thrust bearings shall be provided. The thrust bearing configuration shall permit ready inspection, maintenance, repair and adjustment of axial clearances. The thrust bearings can be integral with the propulsion reduction gears or independent in the shaft line downstream of the reduction gears.

### 244c. Lineshaft Bearings

Lineshaft bearings shall be oil lubricated. If hydrodynamic sleeve bearings are used, they shall be disc lubricated. ASTM B23 grade 2 babbit metal is required for sleeve type bearings.

The lower half of lineshaft bearings shall be watertight. Bearings shall have an oil vent assembly to prevent pressurization of the bearing cavity.

The number and location of lineshaft bearings shall be governed by the shaft alignment and vibration analyses.

**244d. Stern Tube Bearing**

The stern tube bearings shall be of environmentally safe and acoustically inefficient materials. Bearings shall be of a water-lubricated, synthetic elastomeric polymer alloy, split journal configuration, such as **Thordon Compac**. Bearings shall be selected to ensure that no shaft squeal generates underwater radiated noise signatures at any frequency and at any speed such that the sonar system performance is degraded.

**244e. Stern Tube Seal**

Forward stern tube seals shall be provided.

The seal assembly shall consist of a primary radial hard face mechanical seal that allows for relative axial, radial, and angular shaft motions.

Parts of the seal exposed to seawater shall be made of corrosion resistant material and shall be suitable for easy repair in service. Provision shall be made in the seal mounting ring for cooling and lubricating the seal in accordance with the manufacturer's recommendations.

The seal shall be split to allow for replacement of wearing elements and change of rubber components without shaft removal.

## *245 PROPULSORS*

**245a. GENERAL**

[MODIFICATION 0001]The propulsors shall be open screw fixed pitch or controllable pitch propellers. [MODIFICATION 0001]

The propeller disks shall not extend below the baseline, and shall have a minimum tip clearance of 0.25 propeller diameter from the hull in the plane of the disk.

The propellers shall be outboard turning over the top when going ahead.

The number of blades shall be either four or five, and shall be selected to minimize propeller induced vibration while maintaining the required performance characteristics.

The propellers shall be manufactured and gauged in accordance with ISO Standard 484/1 or 484/2 as appropriate, to Class I tolerances.

The propellers shall be designed to:

a. Be free of face cavitation under all ahead operating conditions.

b. Be free of back bubble cavitation under all ahead operating conditions.

c. Have no thrust breakdown under any operating conditions.

d. Have no more than 5 percent back cavitation at maximum speed in calm water.

Propeller hubs and fairwater caps, if provided, shall be secured by lock nuts or equivalent devices. Securing of hubs or fairwaters using welds is not permitted.

**245b. Line Cutting System**

A propeller hub-mounted line and net cutting system shall be provided and installed in accordance with the manufacturer's instructions.

[MODIFICATION 0001] **245c. CP PROPELLERS (IF PROVIDED)**

CP propellers shall permit disassembly of each blade bearing ring and crank ring for inspection and service without removing the hub from the propeller shaft.

A hydraulic oil system for controlling the flow of oil to and from each servo shall be provided. A positive head, above maximum draft, shall be maintained on the servo and shaft seals under all conditions. The capability of each hydraulic pump shall be such that the time to change from maximum full ahead pitch to maximum full astern pitch or vice versa shall not exceed 20 seconds. The accuracy of the pitch setting system shall be sufficient to position and hold the propeller pitch within 80 mm of desired pitch as measured at the oil distribution box.

A hydraulic oil storage tank shall be provided for storage of CP hydraulic oil. The tank shall be sized to accommodate the manufacturer's recommendations for one complete changeout of hydraulic oil.

A CP hydraulic oil transfer system shall be provided and shall permit filling of the storage tank, transfer of clean hydraulic oil to the CP hydraulic oil system, and transfer of used hydraulic oil to a separate used oil tank or waste oil tank.

Controls shall incorporate provisions for automatic pitch adjustment which shall prevent engine overloading.

Local manual control of propeller pitch and shaft speed shall be located on the same panel. [MODIFICATION 0001]

## *256 MACHINERY COOLING WATER SYSTEMS*

### 256a. Diesel Engine Jacket Water System

Diesels shall be cooled by fresh water circulated through the engine jackets and lubricating oil coolers by attached jacket water pumps. Jacket water shall be cooled by jacket water to seawater heat exchangers. Heat exchangers shall be installed inside the ship, shall be of the flat plate type, and shall maintain jacket water outlet temperature and lubricating oil temperature in accordance with the manufacturer's recommendation. Keel coolers are prohibited.

### 256b. Main Seawater System

The main cooling water system shall be in accordance with Section 505.

The main seawater system shall provide cooling to the diesel engine jacket water system, propulsion motors and the propulsion thrust bearing. The diesel seawater cooling system shall be supplied by two main seawater pumps, one in each hull, from independent sea chests. A duplex strainer and cutout valve shall be provided just downstream of each sea chest cutout valve. The seawater cooling system discharge from the diesel engines jacket water coolers shall be combined and led to a single properly sized discharge main. Isolation valves shall be provided in the supply and discharge line for each diesel engine. A swing-check valve shall be provided in each pump discharge line. A valved sea chest cleanout line shall be provided from the main seawater cooling system discharge piping to each sea chest. A blowdown hose valve shall be provided for each sea chest.

### *259 DIESEL ENGINE COMBUSTION AIR AND EXHAUST SYSTEMS*

The ship shall be provided with air supply and exhaust systems for the diesel engines.

The exhaust gas from each engine shall be discharged into a separate insulated exhaust pipe and a low-noise spark arrester dry-type exhaust silencer and through the stack.

The combustion air supply and exhaust systems shall be sized to be within manufacturer’s respective minimum and maximum pressure limits. Combustion air and exhaust system pressure drop calculations shall be performed for each diesel generator to substantiate that acceptable pressure limits are attained.

### *261 FUEL SERVICE SYSTEM*

A complete fuel service system shall be provided. Fuel service pumps shall take suction from the Fuel Oil Day Tanks through a common suction line fitted with a duplex strainer. If engine-mounted fuel service pumps are provided, filter/separators shall be provided for each pump. The Fuel Oil Day Tanks and fuel service pump suction piping shall be designed to provide positive head at the service pump suction during normal operating conditions. The return line from the diesels shall enter the top of each Fuel Oil Day Tank. The fuel oil supply and return lines shall be fitted with flexible connections at the engines as necessary to meet noise performance requirements. Each day tank shall be sized for at least 24 hours of operation at Design Speed.

### *262 LUBRICATION SYSTEMS*

The lubrication transfer system shall be capable of the following; transfer and purification of oil, transfer of lubricating oil from storage or settling tanks to sumps, transfer of used oil from sumps to waste oil tanks, filling of storage tanks from shore, and discharge of clean and used oil to shore. The transfer system for diesel engines shall be segregated from other lube oil transfer systems.

Lubricating oil storage tanks shall be sized to accommodate the manufacturer's recommendations for one complete change-out of all sumps, plus makeup lubricant for the maximum mission duration.

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# 300 ELECTRICAL GROUP

## *300 GENERAL REQUIREMENTS FOR ELECTRIC PLANT AND CABLING*

### 300a. General

The electric plant shall be designed, constructed and configured in accordance with IEEE-45, "IEEE Recommended Practice for Electric Installations on Shipboard." All definitions used in this section are the definitions of that document. All recommendations in IEEE 45 are mandatory and shall be incorporated.

If an integrated diesel electric propulsion system is provided, the SSV shall configure the electrical generating system with the following control and segregation capabilities:

a. Operation of any number of generators connected in parallel to the integrated propulsion and ship service bus

b. Separate generator(s) dedicated to ship service electric loads and to propulsion plant loads. Propulsion plant loads in this case include the bow thruster (if provided).

c. Segregation of the bow thruster (if provided) and a generator from all other loads

The electrical generating system for geared diesel and non-integrated propulsion plants shall be configured to allow for segregation of the bow thruster (if provided) and a generator for all other loads.

Manual and operator-initiated automatic synchronizing devices shall be provided to allow reconfiguration of the above segregated bus configurations to the integrated bus.

The AC power source and distribution system current carrying conductors and current carrying parts shall be ungrounded.

Ship service power systems shall have the nominal voltage and frequency ratings listed in Table 300-1, as appropriate for size and service. The ship service and emergency power system characteristics shall be in accordance with paragraph 4.5 and Table 4-1 of IEEE Std 45.

The power output characteristics of UPS units and power conditioning devices supplying the Scientific Power System shall be as follows:

| | |
|---|---|
| Voltage regulation | +/- 2% for balanced load |
| | +/- 3% for 20% unbalanced load |
| Voltage transient | +/- 5% for loss or return of ac input power |
| | +/- 8% for 50% load step |
| | +/- 10% for bypass or return from bypass |
| Transient recovery time | Return to steady state-conditions within 100 ms after a disturbance |
| Voltage Harmonic content | 4% total, 3% any single harmonic |
| Frequency regulation | +/- 0.1 Hz |
| Frequency slew rate | Maximum 1 Hz/s |

The UPS and conditioned power equipment shall have a LAN interface and be capable of monitoring from a remote workstation.

If an integrated diesel electric plants is provided, the ship service electric plant design shall be directed by the propulsion plant SSV, and shall include equipment such as control consoles, motor drive converter units, transformers, motors, switchboards, and generators.

Where transformers are provided, they shall be electrostatically shielded, except when such transformers are provided as an integral part of a commercially available item.

Harmonic filters shall be provided with a local monitor to alert operators of out of tolerance conditions and an automatic shut down.

An electric power load analysis (EPLA) shall be prepared and updated as detail design and equipment selection progresses. All operating conditions identified herein shall be analyzed. In the event the Contractor identifies additional operating conditions, which drive equipment selection or plant configuration, such conditions shall be added to the EPLA.

**Table 300-1. Nominal Ratings**

| Power Characteristics | AC | DC |
|---|---|---|
| Voltage | 600 volts<br>480 volts<br>240 volts<br>120 volts | 24 volts |
| Frequency | 60 Hertz | |

**300b. Installation Practices**

Multi-cable compression-type penetrators shall be provided at each watertight and weathertight bulkhead or deck penetration. Bulkhead penetrations for ship service electric power cabling shall include 30% spare cable penetrations. Bulkhead penetrations for Mission/Scientific electric and electronic cable runs shall each have 50% spares.

Power cables shall be marked at each end, at 3000 mm intervals along each cable, and at both sides of bulkheads.

## *302 ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT*

Motors rated above 3 kW, not incorporated in an existing vendor-supplied module or system, with the exception of the propulsion and thruster motors, shall be obtained from a single manufacturer. Motor controllers, except for propulsion motor and thruster drives, shall be obtained from a single manufacturer.

Autotransformer reduced voltage starters shall be used where excessive motor starting voltage dip can be anticipated at the ship service switchboard with a single generator supplying power to the electrical system. The maximum voltage dip shall not exceed the values in IEEE-Std-45, Clause 18.1.2. Motors with aluminum frames may not be used.

Motors driving equipment shall have the performance and environmental features required by that equipment.

Motors equipped with anti-friction bearings shall be provided with tapped holes for lubrication, which shall be closed with screw plugs. Alternatively, sealed bearing motors may be provided.

Solid-state passive insulation monitors shall be installed for generators and motors for propulsion, steering, hydraulic power, seawater and fresh water services, and those motors in the weather subject to moisture condensation. The monitors shall alarm locally and at the Centralized Control and Monitoring Station for a low insulation condition.

## *304 ELECTRIC CABLE*

### 304a. General

Electric cable shall meet the requirements of IEEE 45 as noted herein. Main cableways shall be separated by function and voltage level to the extent possible. Sonar transmission and radio frequency cables shall be routed on individual cable hangers.

### 304b. Scientific Cableway

An open and accessible internal scientific cableway with bulkhead cable tubes shall be provided between the Charting Laboratory, Service Area, Bridge, ET Shop, and the forward and aft working decks. Scientific cableway shall not be used for Contractor installed cabling. Bulkhead cable tubes and weather deck cable tubes shall be a minimum 15 cm ID multi cable transit (MCT).

Within the Charting Laboratory, the cableway shall extend the forward and aft length of the compartment and align to the MCTs. Athwartship sections, as required, shall extend from the center cableway to run above the rack foundations and workstations. The cableway shall be open to provide through visibility and tiedown locations, but shall not allow cables to protrude. Edges shall be smooth and tray brackets shall be L-shaped. This cableway shall be at least 385 $cm^2$, with a minimum cross section width of 300 mm.

Weather deck cable passing MCT shall be provided at the Service Area aft weather bulkhead, weather bulkhead to the forward deck area, and a weather bulkhead of the Charting Laboratory. MCT shall be located at the same height as, and aligned to, the scientific cableway. The MCT shall be 15 cm diameter. Two MCT shall service the aft working deck, one MCT shall service the forward deck area, and one MCT shall service the Charting Laboratory.

The Contractor shall provide an easily accessible and watertight cableway with MCT from the Charting Laboratory to the mast. This cableway shall be a minimum 25 cm ID tube with sweep ells where bends are required.

## *310 ELECTRIC GENERATING EQUIPMENT*

The electrical generating system shall be in accordance with IEEE-45.

The electrical generating system shall include a service life electrical growth margin of 15 percent of electric loads, except for propulsion, bow thruster and steering gear loads, at ship delivery.

The capability to balance the electrical load between individual generators shall be provided.

When the ship is on shore power, means shall be provided to prevent inadvertent paralleling of ship's generators with shore power upon loss of shore power. Scientific power systems shall be protected from power interruption during transfer to or from shore power.

## *312 EMERGENCY DIESEL GENERATOR*

An emergency diesel generator shall be provided in accordance with regulatory body requirements.

## *313 STORAGE BATTERIES AND CHARGING EQUIPMENT*

Batteries shall be of the sealed, maintenance-free, lead acid or gel cell type. A dedicated set of batteries shall be provided for emergency diesel generator electric starting. Except in UPS applications, lead acid batteries may not be connected in parallel.

Battery charging equipment shall be provided.

## *314 POWER CONVERSION EQUIPMENT*

### 314a. Ship Service Power

Transformers or motor generator sets shall be provided to supply 120 volts to normal lighting circuits and to equipment that cannot be operated from the ship service primary voltage.

## *320 GENERAL REQUIREMENTS FOR ELECTRIC POWER DISTRIBUTION SYSTEMS*

### 320a. Ship Service Power Systems

A ship service power distribution system shall be provided, complete with transformers, panel boards, cabling and receptacles.

General purpose 120 volt AC receptacles for portable equipment shall be provided in all spaces and passageways, including open deck areas, but excluding hazardous areas and tanks. Each space and each workbench shall have at least one unassigned receptacle. The ET shop, Mess Room, Steering Gear area, Emergency Generator Room, Galley, offices, ACS, Radio/Chart Area and the Bridge shall each have at least two unassigned receptacles. Large spaces shall have receptacles in numbers and locations adequate to provide complete coverage of the space by portable appliances, tools or lights equipped with cords no longer than 2000 mm, except that cords may be 12 m in length on open decks. Receptacles shall be of the duplex type except that watertight or explosion proof receptacles may be of the single type. Receptacles in spaces where they may be exposed to mechanical damage shall be watertight. All receptacles shall be installed with a safety ground. Panels servicing weather decks shall have a ground fault meter mounted external to the panel door with a test circuit switch.

In addition to the Scientific Power System receptacles, 120 volt ship service receptacles shall be provided in each laboratory. System segregation, grouping and positioning in the spaces shall be as for the Scientific Power System installation in the laboratories. Hardwired NEMA 5-15R outlet strips shall be installed adjacent to each Scientific Power outlet strip, and color-coded white.

### 320b. Scientific Power System

A 120 and 240 volt, three-wire ungrounded Scientific Power System shall be provided for mission electronics and mission electrical services, as described in this section and the individual equipment subsections. Dedicated electrostatically shielded isolation transformer(s) shall be provided for the Scientific Power System. The transformer(s) shall be capable of supplying full load power requirements plus 20% load growth at no more than 90% of rated capacity and shall provide input power to the Scientific Uninterruptible Power System.

Services shall be grouped according to their use and fed from individual transformers. 120 volt transformers shall be supplied for each of the following laboratory and electronics groupings:

a. Bridge, and the intercom system.

b. Charting Laboratory and ET shop.

c. Service Area

d. All staterooms – one unassigned NEMA 5-15R outlet per berth and one unassigned NEMA 5-15R outlet at desk, segregated as appropriate.

e. Offices - one unassigned NEMA 5-15R outlet per desk.

Panelboards shall be provided for each group and fed from an isolation transformer and shall have 50% spare capacity for additional circuits and panel feeder size.

120 volt, single-phase hardwired outlet strips shall be provided in the Charting Laboratory and ET Shop. One outlet strip, fed by a 15 amp circuit breaker shall be provided for every 2500 linear millimeters of bulkhead and shall be installed at a height of about 1200 mm above the finished deck. Each strip shall have six standard NEMA 5-15R outlets which will accept standard NEMA 5-15P plugs. Strips shall also be provided in the overhead of each laboratory on the centerline of the space, spaced longitudinally no more than 3000 mm apart.

Two duplex receptacles shall be provided in each electronic equipment rack. Each pair of receptacles shall be fed by a 15 amp circuit breaker.

Four unassigned duplex receptacles shall be provided on the Bridge and fed by a 15 amp circuit breaker.

Outlets in the Service Area shall be duplex, with watertight covers, fed by a 15 amp circuit breaker, shall be provided for every 3000 linear millimeters of bulkhead and shall be installed at a height of about 1200 mm above the finished deck. Watertight duplex outlets shall also be provided in the overhead of the Service Area, spaced longitudinally no more than 3000 mm apart.

Scientific power system outlets shall be labeled and color coded orange. Power supply shall be grouped by phase at distribution points to enable systems to be powered from a single phase.

**320c. Scientific Uninterruptible Power System**

An uninterruptible power system with battery backup for 15 minute shutdown and maintenance bypass switch energized from transformer power shall be provided for the mission equipment in Section 491, mission electrical services, as described in this section and the individual equipment subsections, and receptacles in the Charting Laboratory and ET shop. Section 491 references GFI that lists mission equipment and power supply requirements. The Scientific Uninterruptible Power System (UPS) shall be capable of supplying full load power requirements plus 20% load growth at no more than 90% of rated capacity.

The ground for the UPS shall be at the same potential as the ground for the Scientific Power System isolation transformer. Uninterruptible power supplies shall be located in air-conditioned spaces with exhaust ventilation located over the power supply.

Uninterruptible power outlets shall be labeled and uniquely color coded.

240 volt uninterruptible power shall be provided to 240 volt equipment in the Charting Laboratory, with one spare circuit provided.

120 volt, single-phase hardwired outlets shall be provided in the Charting Laboratory and ET Shop. One outlet strip, fed by a 15 amp circuit breaker shall be provided for every 3000 linear millimeters of bulkhead and shall be installed at a height of about 1200 mm above the finished deck. Each strip shall have

six standard NEMA 5-15R outlets which will accept standard NEMA 5-15P plugs. Strips shall also be provided in the overhead of each laboratory, spaced longitudinally no more than 3000 mm apart.

Power for one top-to-bottom outlet strip with standard NEMA 5-15R outlets at approximately 150 mm intervals, shall be provided at each electronic equipment rack foundation and workstation location. Each source shall be fed by a 15 amp circuit breaker.

In addition, an uninterruptible power system with battery backup and maintenance bypass switch to transformer power shall be provided to serve equipment and outlets on the Bridge, as follows:

a. Closed Circuit TV System

b. INMARSAT B Terminal (non-GMDSS)

c. Satellite Communications System

d. Duplex receptacles (quantity eight)

**320d. Shore Power**

Dead front interlocked receptacles shall be provided for shore power in number as determined by the maximum load determined from the in-port load condition shown in the EPLA plus a 15 percent growth margin. Receptacles shall be watertight, and shall be located on the 01 Level to permit access from each side of the ship. Each receptacle shall be rated 480 volts, three-phase, 400 amps, maximum. A control switch and a white pilot light to indicate circuit energized and labeled POWER ON shall be included.

Shore power circuit breakers shall be of the current limiting molded case-type.

A watertight phase sequence and rotation detector panel shall be provided at the shore power station. Shore power emergency disconnect pushbuttons shall be provided at the shore power station and in the EOS. These pushbuttons shall trip the shore power circuit breakers.

Two, 30 m shore power cables with appropriate terminations shall be provided, with a stowage locker and cable reels, adjacent to the shore power station. A mating plug with a 3000 mm length of THOF-500 cable pigtail lugged at the free end shall be provided for each shore power cable.

## *324 SWITCHBOARDS AND PANELS FOR ELECTRIC POWER AND LIGHTING*

Spare circuit breakers of 10 percent of the type used for active feeder circuits, but not less than one for each active frame size, shall be provided on the switchboards and panels. Spares are not required for 400 amp frame sizes or larger. Blank panel locations shall be provided for 10 percent of each circuit breaker size on each switchboard and panel.

## *330 REQUIREMENTS FOR LIGHTING SYSTEMS*

The ship shall be lighted throughout with fluorescent fixtures in accordance with the IES Publication No. RP-12 and as required herein.

In crew living and working spaces, general illumination intensity may not vary more than 3-to-1 within the area boundaries.

A photometric survey shall be conducted during hours of darkness. Illumination readings during the photometric survey (when lighting fixtures, lamps and painted surfaces are new) shall be multiplied by a maintenance factor of 0.70 .

Fluorescent lighting fixtures in spaces containing apparatus that is susceptible to electromagnetic interference, such as the laboratories, ET Shop, Radio/Chart Area and Bridge, shall be installed to avoid electromagnetic interference.

Permanent white lighting fixtures shall be installed on weather decks, mounted to permit 2000 mm minimum clear headroom and ready safe passage of personnel. Obstructions on the weather deck such as winches, capstans, low or narrow passageways, abrupt changes in deck level, or walkways having sharp bends or corners, shall have a fixture located to permit visibility from both sides of the obstruction.

Exterior lighting fixtures and receptacles installed in the weather shall have the fixture box and wiring in the interior of the ship whenever possible.

Switching devices for lighting in spaces such as storerooms, lockers, or hazardous spaces, shall be provided outside the space near the access. Switching devices for other spaces shall be located inside the space, near the access where they will not be obstructed by door swing.

Table lamps on fixed furnishings shall be permanently wired to the ship's lighting system using a three-conductor cable, with the third conductor connected to ground.

## *332 SPECIAL ILLUMINATION*

**Laboratory, ET Shop and Radio/Chart Area Lighting.** – The Charting Laboratory, ET Shop and the Radio/Chart Area shall have a minimum lighting level of 535 lux. In laboratory and work spaces containing more than one lighting circuit, failure of an individual circuit may not cause complete loss of illumination of a continuous work area.

**Bridge/Navigation Station. -** The Bridge, adjacent areas and all navigation stations shall be equipped with red illumination in addition to the standard fluorescent fixtures for use at night. A switch shall be installed on the door the Bridge such that when the door is opened, white light in the vicinity of the door is extinguished and red lighting is illuminated.

**Hoisted Load Illumination. -** Fixed, watertight spotlights shall be provided on the outboard end of the crane and on the A-frame to illuminate the hoisted load.

**Exterior Lighting. -** Watertight floodlights shall be provided on the weather deck for the deck machinery, operation of the A-fame, crane, loading and unloading, mission equipment handling, line handling, and anchor handling areas.

Adjustable marine floodlights shall be provided and permanently mounted to illuminate deck machinery and mission equipment, loading and unloading operations, and line and anchor handling areas. Illumination in these areas shall be 320 lux. All other weather deck areas shall be to a lighting level of 110 lux. In addition, the following floodlights shall be provided:

a. two floodlights such as **Phoenix MS-500-QH**, aft on each side of the ship, positioned to provide over-the-side illumination of the retrieval of equipment deployed at the Aft Working Deck.

Visibility of hoisted loads and the water around such loads, and interference with ship's navigational visibility shall be considered during placement of exterior and hoisted load illumination lighting.

Four portable weather deck floodlights shall be provided for localized illumination and shadow elimination. These floodlights shall be equipped with mounting clamps, 3000 mm power cords and watertight plugs.

A waterline security system shall be provided using floodlights installed on adjustable and portable davits around the perimeter of the vessel. The system shall provide no less than 20 lux on the surface of the sea, between six and twenty feet away from the hull around the entire ship.

Permanently installed exterior floodlights shall be individually controlled by switches located in the Bridge.

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# 400 ELECTRONIC GROUP

## *403 GENERAL REQUIREMENTS FOR NAVIGATION, COMMUNICATIONS AND MISSION ELECTRONICS*

### 403a. General

Arrangements shall be as required by the applicable ABS bridge design notation and as follows.

Bridge control and display systems shall be ergonomically consistent, and controls and displays which are used to accomplish the same task shall be operated consistently and displayed identically. All illuminated devices on the Bridge, including video displays, shall have dimming controls or night vision colors to prevent loss of night vision.

Controls and displays shall be arranged by function so that the ship controls and navigational equipment are organizationally separated on the console from mission controls, displays and instruments. Selection of location for the various units and arrangement of controls and displays on the consoles shall be based on visibility, frequency of use, ease of operation and other aspects of human engineering. Control equipment and displays shall have the same look and feel at each control station. The use of overhead mounting above the consoles is desirable for equipment such as radios, and for equipment with displays that are required to be visible throughout the Bridge. Recessing of equipment in the overhead is permissible for local displays.

Electronic equipment cables shall be marked at each end, at 3000 mm intervals along each cable, and at both sides of bulkheads.

### 403b. High Voltage Hazards

High voltage warning signs in accordance with IEEE-45 shall be installed in spaces where personnel could come in contact with exposed energized equipment.

## *404 RADIO FREQUENCY TRANSMISSION LINES*

### 404a. Radio Frequency Transmission Lines

**Coaxial Cable**. - After cutting cables to installation lengths, cable ends shall be sealed until final connections are made. End sealing may be omitted when the interval between cutting a length of cable and attachment of fittings is 48 hours or less, and exposed ends are not subject to moisture or rapid temperature changes.

Coaxial cables shall be installed to permit equipment servicing, equipment deflection, deflection of bulkheads and so that maximum movement of expansion joints and acoustic isolation connections will not subject the cable to tension or shear damage. Sag between hangers shall be limited to that allowed for electric cable in similar runs.

Coaxial cable shall be supported on beams or hangers and may not be secured directly to shell plating.

Coaxial cables that have not been installed within 18 months of the date of manufacture shall be tested for attenuation before installation, and shall meet dielectric strength requirements.

## *405 ANTENNAS*

### 405a. Antenna Installation

Remotely controlled units used in antenna circuits, such as tuners, shall be located to provide the shortest practical length of transmission line between the antenna and the remote unit. Antenna couplers shall be readily accessible and protected from the weather and from contact by personnel.

Coating material may not be applied to any portion of insulation material forming a part of an antenna installation.

HF transmitting and HF receiving antennas shall be located to have the maximum possible horizontal separation, and to prevent being shielded by large solid areas of ship structure. HF antennas shall be supported by non-metallic guys, as necessary.

VHF omnidirectional antennas shall be located to have the maximum possible vertical separation.

Navigational radar antennas shall have unobstructed coverage forward, port, starboard and as far astern as possible.

GPS/DGPS antennas and INMARSAT antennas shall be located as high as possible on the superstructure, and be unobstructed.

A mast-mounted omnidirectional TV antenna and a mast-mounted omnidirectional AM/FM antenna shall be provided for the entertainment system.

Antenna disable switches shall be provided for mechanically rotating antennas. The switch shall be located near the antenna, accessible from outside the swing circle to permit personnel to disable the antenna before entering the swing circle. The disable switch shall also control a red light and a green light, located on or adjacent to the associated equipment control unit, to indicate MAN ALOFT - DO NOT RADIATE when the red light is energized.

## *420 AUTOPILOT AND DYNAMIC POSITIONING SYSTEM (DPS)*

### 420a. Autopilot

An autopilot system shall be provided. The autopilot system shall incorporate trackline capabilities in accordance with the maneuvering requirements of Section 070d.

### 420b. Dynamic Positioning System (OPTION)

[MODIFICATION 0001] Space and weight for the following Section 420 Option shall be incorporated in the vessel feasibility and preliminary design. Contract design and detail design and construction of the vessel with the installed DPS system shall be priced in accordance with Section B of the contract. [MODIFICATION 0001] If exercised, this option would replace the separate autopilot required in Section 420a.

[MODIFICATION 0001]The DPS shall be a commercially available and proven system. The system shall be provided with the ABS classification notation, ✠DPS-1 for the vessel[MODIFICATION 0001].

The DPS shall operate in the following modes: manual, autopilot, and automatic control for trackline and stationkeeping operations. DPS primary control shall be at the SCC. Secondary controls shall be located at the starboard bridge control stations. Station selection shall be located at the SCC. Visual

indications and voice communications shall be provided at primary and secondary stations to effect and accept control hand-off. Full positive control shall be maintained during control transfer.

The DPS control shall include an IBM PC-compatible color video display monitor and keyboard embedded in the SCC. A video display monitor shall be provided at each secondary control station. The video displays shall indicate the following:

a. Commanded and actual ship position and track projected on a grid with axes calibrated in latitude and longitude. Scale of the display shall be user-selectable.

b. The DPS mode which is enabled (i.e. manual, autopilot, trackline, etc.).

c. Ship heading.

d. Waypoint locations.

e. Any additional information needed for operation of the DPS in the various modes.

Propulsion, steering, and thruster control devices shall be configured to accept commands from the DPS. The DPS shall include software for power management and crew training. The DPS shall energize with propulsion controls in manual mode as the default mode. The DPS shall be capable of operating in any mode with the following combinations of main propulsion system and bow thruster (if provided):

a. Bow thruster only.

b. Main propulsion system only.

c. Bow thruster and main propulsion.

Thrusters, when not assigned under DPS system control shall be manually controllable.

**Manual Mode**

In the manual mode, control shall be by dual axis joystick at the SCC, port and starboard bridge control stations. The joystick shall include automatic heading capability. Joystick control response shall be squared curve (instead of linear).

**Autopilot Mode**

An autopilot steering system shall be provided with control at the SCC and at the ACS. The system shall be switchable from hand steering to autopilot steering, and have a sensitivity adjustment for heavy weather in the autopilot mode. Station selection shall be from the SCC.

The autopilot shall automatically control the ship's heading within two degrees of the selected course at speeds from 0.5 knots to maximum. Propeller r/min shall be manually controlled by the SCC controls or the DPS joystick.

**Automatic Control Mode**

The DPS shall automatically control main propulsion system, rudder and bow thruster azimuth angles and r/min to meet the performance requirements of Section 070d (except that lateral trackline error shall not exceed +/- 5 meters).

During trackline operations, the DPS shall provide the capability of accepting at least 40 waypoints. Permissible maximum variation of the ship's heading from the track course (crab angle) shall be user-selectable up to a limit of plus or minus 45 degrees. When following a multiple waypoint trackline that requires a change in course after a waypoint, the DPS shall change the ship's heading automatically to follow

the new course of the next track segment. The DPS shall alert the operator that a turn is impending by sounding an alarm at a fixed time interval before the turn. The DPS shall require an acknowledgment of the alarm before the turn is executed. The DPS shall alert the operator by sounding an alarm when the ship falls off track.

In the automatic mode, the DPS shall be capable of using position information from the following sources:

a. The ship's global positioning system (GPS and DGPS)

b. Two spare input ports (reserved for future use)

## *421 NON-ELECTRICAL AND NON-ELECTRONIC NAVIGATION AIDS*

Pelorus stands for gyro repeaters shall be provided port and starboard forward of the Bridge and aft of the Bridge on the starboard side. Metal repeater covers shall be provided for each stand.

A barometer shall be provided in the Radio/Chart Area.

Trim and heel clinometers shall be installed in the Bridge.

A magnetic compass in accordance with ISO 449, "Shipbuilding - Magnetic Compasses and Binnacles, Class A" shall be installed.

## *422 NAVIGATION LIGHTS, SIGNAL LIGHTS AND SEARCHLIGHTS*

Navigation lights, including lights for towing and restricted maneuverability, shall be provided to comply with 72 COLREGS and as specified herein. Fixtures shall be certified in accordance with UL 1104.

The masthead lights and restricted maneuverability lights shall be fitted with screens attached to the base of the fixtures to ensure that direct or reflected light will not fall into the eyes of lookouts and bridge occupants.

Aircraft warning lights, red, covering 360 degrees, shall be installed on top of the main mast.

Navigation and signal lights shall be monitored from the navigation light indicator panel.

Two 380 mm, 1000 watt, remote operating searchlights such as **Phoenix Model MRS-64/1000 SL** shall be provided on top of the Bridge, one each on the starboard and port side. Searchlight control shall be from the Bridge.

Access for maintenance of the lights shall be provided.

## *423 ELECTRICAL AND ELECTRONIC NAVIGATION SYSTEMS*

### 423a. Global Positioning Systems

One differential GPS (DGPS) receiver shall be provided. The DGPS shall be located at the SCC and shall provide position information for ship's navigation systems and DPS. The antenna shall be located in an unobstructed position on the mast. In addition to the primary display at the SCC, a remote display shall be provided at the Radio/Chart Area.

**423b. Ship's Depth Finding**

A depth finding system shall be provided in accordance with regulatory requirements. The system shall be a digital fathometer with digital readouts located at the SCC, and the port and starboard Bridge Wing stations. The fathometer frequency shall not interfere with mission sonars.

**423c. Speed Log**

A dual axis Doppler speed log system, such as **Sperry Marine, Inc. Model SRD 500,** shall be provided. System control and display shall be located at the SCC. The transducer assembly shall be located in a Transducer Space, and shall include a gate valve for transducer removal. The system shall provide data to the Surface Search Radars and to remote repeaters at the port and starboard Bridge Control Stations, ACS and Charting Laboratory. The Doppler speed log shall also provide input to the mission fiber optic LAN.

Power for the Doppler speed log system shall be provided from the Scientific Power System.

**423d. Gyrocompass Systems**

A gyrocompass system, such as **Sperry Marine, Inc. Model Mk 37 VT**, shall be provided. The system shall consist of a master compass, control unit and bearing repeaters and rate of turn indicators. The gyrocompass system shall provide heading reference input to the Surface Search Radars, DPS, navigation depth finder and INMARSAT terminals.

The system shall include a gyrocompass failure alarm system to give audible and visual indication of gyrocompass failure on the Bridge. The master compass and control unit shall be located on the Bridge. Two rate of turn indicators shall be provided, one port and one starboard forward in the Bridge. Gyrocompass repeaters shall be provided in the following locations:

a. at each pelorus stand. These shall be gimbaled analog repeaters.

b. the SCC. This shall be an open scale type.

c. the ACS. This shall be a digital repeater.

d. the Commanding Officer's Stateroom. This shall be a digital repeater.

e. the Steering Gear Room. This shall be a digital repeater.

f. the Charting Laboratory. This shall be a digital repeater, with digital input to the mission fiber optic LAN.

**423e. Surface Search Radar**

The Contractor shall provide a matched pair of radars capable of integration with an Integrated Bridge System. The radar system shall comply with IMO Res. A.477(XII), Performance Standard for Navigation Radar Equipment and IMO Res. A.422(XI), Performance Standards for Automatic Radar Plotting Aids. The system shall consist of one X-Band ARPA radar with 25 kW X-Band transceiver and antenna plus one S-Band ARPA radar with 30 kW S-Band transceiver and antenna. Display and control shall be located on the Bridge, with separate 340 mm display consoles for each radar. An interswitching subsystem shall be installed between the two radars.

**423f. Ship's Whistle**

A ship's whistle shall be provided in accordance with regulatory requirements. Means for automatically sounding the ship's whistle at adjustable intervals shall be provided on the Bridge.

## *432 INTERIOR COMMUNICATIONS SYSTEMS*

### 432a. Sound-Powered Telephone System

The sound powered telephone system shall include communications between the Bridge, Damage Control Lockers, Machinery Space controls centers, ACS, Steering Gear Room, Bow Thruster Room, Master and Chief Engineer's staterooms, Radio/Chart Area, bow and the Emergency Generator Room. Separate string circuits with headsets and jack boxes shall be provided between the winch control stations, aft working deck area, ACS and the Charting Laboratory.

A fueling sound powered telephone circuit shall be provided. This circuit shall consist of a single system connecting machinery spaces near fuel manifolds, fueling stations, tank sounding tubes outside the main machinery spaces and the Bridge. The fueling sound powered telephone circuit shall be provided with headsets.

### 432b. Dial Telephone System

A digital dial telephone system shall be provided. The system shall provide for operator free dialing and communication for both incoming and outgoing calls between the outside lines, INMARSAT B terminals, satellite communication system terminal, and the station connections identified herein. Permanently installed stations in the weather shall be watertight and have an external bell. Telephone handsets shall have positive restraining devices. The Contractor shall program the system and provide a telephone directory placard and operating instructions for each station.

**Shore Telephone Connection.** - A six-line shore telephone connection box shall be provided. This box shall be a NEMA 4X stainless steel enclosure, located so that it may be served from either side of the ship. Four lines from the shore telephone connection shall be routed to the telephone switch via the patch panel. A 12 conductor, 18 AWG marine telephone cable, 50 m in length, shall be supplied with provision to store the cable in the connection box when not in use.

**INMARSAT Connections.** - INMARSAT B and satellite communication systems shall be connected to the telephone switch via the patch panel to provide operator free dialing and communication via voice, data, and FAX for both incoming and outgoing calls.

**Cellular Connection.** - The cellular phone system compatible with AT&T PCS service shall be connected to the telephone switch via the patch panel to provide operator free dialing and communication via voice, data, and FAX for both incoming and outgoing calls.

**Public Address Connection.** - The Public Address system shall be connected to the telephone switch to provide the capability of making announcements from any phone station.

**RS-232 Connection.** - An RS-232 data line shall be routed from the telephone switch to the ET Shop for system programming.

**AM/FM/SW Receiver Connection.** - An AM/FM/SW receiver with digital frequency display shall be provided and connected to the telephone switch and the AM/FM/SW/TV distribution system.

**Logging Capability.** - The telephone switch shall have the capability to provide a hard copy output of all system activity.

**FAX Connection.** - The plain paper FAX required in Section 441 shall be connected to the telephone system to permit operator-free dialing and FAX communication for both incoming and outgoing calls via phone line, cellular, or INMARSAT B. A manual switch shall be provided to select between phone line, cellular, or INMARSAT B for FAX communication.

**Station Connections.** – The Bridge, Centralized Control and Monitoring Station, Radio/Chart Area, Offices, Mess/Lounge, Service Area, laboratories, Machinery Spaces, aft working deck, Galley, and staterooms shall contain a telephone jack and telephone. All stations shall contain a multi-line capability (four outside line, cellular line and INMARSAT B line). Two additional stations shall be provided as directed by the CONREP.

**Power Connection.** - Power for the telephone system shall be from the Scientific Uninterruptible Power System.

**432c. Public Address System**

A shipwide public address system shall be provided. The system shall transmit voice announcements from the Bridge to the following groups of loudspeakers:

Group 1 - Entire Ship

Group 2 - Weather Deck Forward

Group 3 - Weather Deck Aft

Group 4 - Machinery Spaces, including Bow Thruster Room

Group 5 - Living Spaces, Passageways, Mess / Lounge, Galley

Group 6 - Laboratory spaces, ACS.

The control station on the Bridge shall include a control panel and amplifier, portable microphone with sufficient coiled shielded cord to reach any ship control station in the Bridge, and switches for selecting groups of loudspeakers individually or collectively in any combination. The control station and microphone shall be mounted in the SCC.

The system shall generate and transmit an electronic fog bell signal to the weather deck forward.

Configuration of the loudspeaker installations shall prevent a ground, short or open circuit in a loudspeaker from having a disabling effect on the remainder of the system.

Speaker locations, power output, and quantity shall be such that announcements can be heard and understood over normal underway ambient noise, including noise on the Aft Working Deck. Machinery space speakers shall be provided input from separate amplifiers and shall have volume controls.

The public address system shall have provisions to accept audio input from the telephone system and to mute the entertainment system during announcements.

**432d. Intercom System**

An intercom system shall be provided. The system shall interconnect the SCC, ACS, laboratories, port and starboard bridge wings, hydrographic winch and A-frame local control areas, boat davit control areas, Aft Deck Crane and forward weather deck. Each interior station shall be a master station and each exterior station shall be a slave station. Speaker-microphone stations shall be provided at each station, and shall permit hands free operation. Each master shall be capable of selectively communicating with any other station or combination of stations in the system by activation of appropriate selector switches.

Power for the intercom system shall be from the Scientific Power System.

**432e. Entertainment System**

**Lounge Entertainment System.** – Space and weight shall be provided in the Lounge for a stereo system, television, two DVD players and an entertainment storage cabinet. The stereo system will consist of an AM/SW/FM receiver of at least 35 watts per channel, surround sound, matching speakers, dual drive cassette recorder and CD player. Cabling shall be provided to connect the DVD players with the central entertainment system. The television will be a 690 mm color TV receiver. Lockable, configurable storage will be provided for 1000 units of various formats, including 8mm video, VHS, audiocassette, and audio/video CDs and DVDs.

**Central Entertainment System.** - An AM/FM/SW/TV distribution system, such as **Multiplex Technology Channel Plus,** shall be provided to distribute AM/SW, 88 MHz to 108 MHz FM, VHF, UHF, Armed Forces Radio and TV Service (AFRTS), and cable TV signals to staterooms, Mess / Lounge, and laboratories. Input to the system shall be from FM/TV antennas, AM/SW antennas, a cable TV connection, and space and weight DVD players. Central distribution shall be located in the ET Shop. The distribution system shall permit simultaneous distribution of VCR and DVD players' outputs on four UHF channels. The distribution boxes shall contain the necessary splitters, amplifiers and balance elements to provide signals to each distribution point, while preventing mutual interference / interdependence. Faceplates on the distribution boxes shall be inscribed to indicate the application of each connector. Distribution shall be via a single cable. Input for a future directional FM/TV antenna shall be provided.

**432f. General Alarm System**

A general alarm system with interface to the public address system shall be provided for all spaces.

**432g. Fire Alarm System**

A fire detection and alarm system shall be provided. The ship fire alarm system shall be compatible with the machinery space fire alarm system.

**432h. Closed Circuit Television System**

A closed circuit television (CCTV) system shall be provided. The system shall include a minimum of six cameras with remote controlled pan and tilt capability. The camera viewing areas shall include the aft Working Deck, equipment controlled at the ACS; areas of the working deck which are not directly visible from the ACS; the local control station for the hydrographic winch, the CTD winch and the A-frame; and the sensor seawater surface interface below the A-frame. Cameras shall be environmentally protected.

Three video monitors, approximately 230 mm, each with camera selection switch and controls, mounted in an equipment rack, shall be provided on the bridge. Additional monitors and selector switches shall be provided in the Charting Laboratory. The ACS shall include a monitor for the sensor seawater interface camera.

Power for the CCTV system shall be from the Scientific Power System.

## *438 INTEGRATED BRIDGE SYSTEM (OPTION)*

### 438a. Option for Integrated Bridge System

[MODIFICATION 0001] Space and weight for an Integrated Bridge System (IBS) shall be incorporated in the vessel feasibility and preliminary design. Contract design and detailed design and construction of the vessel with the option installed shall be priced in accordance with Section B of the contract. [MODIFICATION 0001]

The Integrated Bridge System (IBS) shall be a commercially available and proven system. The vessel shall be provided with the ABS classification notation, NIBS for the vessel.

The IBS shall be configured as a SCC with integrated systems in which all navigation digital data sources and ship control commands are interconnected by means of a dual redundant loop data bus. The system shall incorporate a Navigation Workstation for voyage planning at the Radio/Chart Area and a Voyage Management System (VMS) with centralized command and display for real time navigation control.

Arrangements shall be as required by the ABS bridge design notation and as follows.

The IBS shall have the capability to overlay radar and ARPA target data over the chart display. The IBS shall comply with the specification for chart content and display for Electronic Chart Display and Information System (ECDIS), IHO S-52, scheduled to be in effect at ship delivery.

The SCC shall include radar displays, voyage management command station, propulsion, bow thruster, and steering control, required regulatory navigation instrumentation and alarm/data display. The port and starboard bridge wing ship controls shall include propulsion, bow thruster and steering controls, and summary alarm displays.

The IBS data bus shall interconnect all control consoles. It shall exchange data and control commands, as required, between the VMS, MCC and Dynamic Positioning System for initiating shaft speed and direction, bow thruster and steering commands during automatic operations. Feedback acknowledgment and display of orders accomplished shall be provided.

Means for transferring control between control consoles and systems shall be provided as follows:

a. Propulsion control shall be capable of being transferred between the MCC and the SCC.

b. Propulsion, bow thruster and steering control shall be capable of being transferred between the following secondary control stations or systems:

   1. The SCC and port or starboard bridge control units.
   2. The SCC and the VMS.
   3. The SCC and the port or starboard bridge control units, when using the dynamic positioning system.

The SCC shall be capable of overriding ship and propulsion control of all other secondary control stations, DPS, and VMS. The MCC shall be capable of overriding propulsion control of all other control stations, DPS and VMS.

The IBS shall provide propeller speed and direction of rotation data to the Mission Fiber Optic LAN.

## *441 EXTERIOR COMMUNICATIONS SYSTEMS*

An exterior communication system shall be provided in accordance with GMDSS Sea Area A3 requirements, implemented with the INMARSAT B equipment option, and with the duplication of equipment maintenance option. In addition to the GMDSS-required equipment, as well as SOLAS-required items, the following equipment shall be provided:

a. One plain paper laser printing facsimile machine.

b. One 3-watt cellular phone, compatible with AT&T PCS wireless services, with PABX/RJ-11 interface, with an antenna such as **Shakespeare Model 4800**.

c. In addition to GMDSS requirements, one INMARSAT B SES with 56/64 kbaud option, AFRTS RED receiver, dual ID and dial telephone system interface.

d. One satellite communication system, such as **Westinghouse Model 1000+ Wavetalk**.

## *491 MISSION SYSTEM ELECTRONICS*

### 491a. General

The Contractor shall provide space, weight, foundations, seachests, power cables, signal cables, Mission Fiber Optic LAN cables, distributed services, through hull and through deck penetrations and transducer fairings for Government mission equipment. To the maximum extent possible, mission transducers shall be removable and installable by divers. Cables installed by the Contractor terminating in the Charting Laboratory shall have 8 m of spare length. Cables installed by the Contractor shall be terminated into watertight junction boxes at the hull sensor interface with 1 m of spare length.

The Contractor shall determine and provide all installation details and interface control documentation (ICD) to support a fully functional installation (in conformance with the missions noted in Section 070) for the mission equipment listed in Attachment J-7, Government Furnished Information (GFI).

Furnishings for mission spaces supporting Government mission equipment shall be provided by the Contractor in accordance with Section 691. Charting Lab arrangement and mission equipment arrangements drawings shall be provided.

### 491b. Mission Fiber Optic Local Area Network (LAN)

Cabling for a fiber optic computer network shall be provided. Clean power shall be provided at each computer network location.

The computer network shall consist of separate fiber optic cables installed from a common patch panel (GFI) located in the Computer Laboratory to the locations shown in Table 491-1. These connections are in addition to the LAN system interface requirements for the mission equipment listed in Attachment J-7.

The Contractor shall provide and install cables for the computer network. The cables shall be separate from any other electrical system conductors, and shall be located no closer than six inches from any radio and AC power source.

The cabling for the computer network shall be duplex, multimode, graded index fiber optic cable, with 62.5 µm fiber core diameter, and 125 µm cladding diameter. Each fiber end shall terminate in a ST-type connector. Sufficient extra cable shall be provided at each end of the cable run to allow for relocation. Wiring shall be color coded and tagged for identification. A wiring diagram showing all computer network

cable runs must be provided. Bulkhead and panel connector labels must be visible without removal of hardware.

A bulkhead mounted terminal box fitted with two ST-type couplers shall be installed adjacent to the computer workstations or desks in the compartments listed in Table 491-1. Each fiber in the cable serving the space shall be connected to an ST coupler in the terminal box from the back. Watertight terminal boxes must be provided in exposed locations. Cable entrances to terminal boxes must include strain relief devices. A fiber optic cable shall be provided from the Charting Laboratory to the shore telephone connection box.

The fiber optic patch panel will be fitted in a 19-inch standard instrument rack (GFI) that will be installed the Charting Laboratory. Sufficient ST to ST couplers shall be installed in the panel to accommodate all fiber optic cables terminating at the panel. Each of the fibers terminating at the panel shall be connected to the patch panel from the rear.

The Contractor shall provide the services of a trained fiber optic field technician to supervise the installation and testing of the Contractor-supplied fiber optic components.

All components of the installed computer network, including all positions on the patch panels, connectors, and terminators, shall be tested for continuity and attenuation.

**Table 491-1 Fiber Optic LAN Terminal Locations**

| Location | Number of Fiber Optic Terminal(s) |
|---|---|
| Bridge | 1 |
| Radio/Chart area | 1 |
| Aft Control Station | 1 |
| Each Stateroom(s) | 2 |
| Service Area | 1 |
| Centralized Control and Monitoring Station | 1 |
| Mess / Lounge | 1 |
| Ship’s Office | 3 |
| Charting Laboratory | 6 |
| Aft Working Deck | 1 |
| ET Shop | 1 |

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# 500 AUXILIARIES GROUP

## *503 PUMPS*

Rotary pumps shall be in accordance with ASTM F1718 and F1510. Centrifugal pumps shall be in accordance with ASTM F998. All pumps shall have mechanical seals in accordance with ASTM F1511.

Pumps shall be suitable for intended service, shall operate at or near the maximum efficiency point on the head-capacity curve at design conditions, and shall have non-overloading power characteristics. Pumps for fuel and lube oil service shall be positive displacement pumps. Pumps for seawater service shall be of materials suitable for continuous service in seawater, and shall be compatible with the specified piping system materials.

Shafts of horizontal pumps shall be oriented fore and aft.

Where two or more pumps of the same size and type are required for a particular service, they shall be identical.

Bases for pumps handling lubricating oil and fuel shall be provided with troughs and drain to the oily waste system. Bases for pumps handling water and waste water, except for sewage pumps, shall be provided with drains which terminate in the nearest bilge well. Means shall be provided for venting seawater pumps into the nearest bilge well.

## *504 INSTRUMENTS AND INSTRUMENT BOARDS*

### 504a. General

Instruments and gage indications shall be in metric units of measure.

Instruments and their components shall be of rugged construction, for marine service, and not adversely affected by vibration, temperature, moisture, impact or dust and tailored to their particular applications. Instruments shall be waterproof, and protected, to prevent moisture and other corrosive elements from damaging the instruments. Failure or removal of an instrument may not cause the instrument system to be inoperable.

Instruments shall be calibrated no more than three months before ship delivery. The calibration method and date of calibration shall be recorded.

### 504b. Tank Level Indicators

All tanks shall be equipped for local sounding. The following tanks shall be provided with tank level indicators such as **Consilium US, Inc. Metritape, or Gems Sensors, Inc. XM/XT-36490 Series**:

a. Fuel storage tanks.

b. Fuel service tanks.

c. Lube oil storage tanks.

d. Oily waste holding tank.

e. Waste oil tank.

f. Ballast tanks.

g. Potable water tanks.

h. Waste water holding tank.

Readouts for tanks with level indicating systems shall be provided in the MCS, and locally at each tank's operating station as required.

Readouts for tanks with level indicating systems shall be provided in the MCS, and locally at each tank's operating station as required.

High level alarm sensors shall be provided for fuel storage and service tanks, waste oil tanks, lube oil storage tank, oily waste holding tank, waste water holding tanks and ballast tanks. High and low level control sensors shall be provided for the oily waste holding tank. The high and low level sensors shall be integrated into the appropriate tank level indicating unit. Fuel service tanks shall have a low level alarm

Chilled water expansion tanks, potable water hydropneumatic tank and fresh water cooling system expansion tanks, if provided, shall be provided with sight glass level indicators.

Scales shall be graduated in accordance with Table 504-1.

**Table 504-1. Tank Level Indication Graduations**

| Service | Graduations |
|---|---|
| Fuel | Meters, centimeters, and cubic meters |
| Lube Oil | Meters, centimeters, and liters |
| Seawater | Meters, centimeters, and cubic meters |
| Potable Water | Meters, centimeters, and cubic meters |
| Oily Waste | Meters, centimeters, and liters |
| Waste Water | Meters, centimeters, and liters |
| Waste Oil | Meters, centimeters, and liters |

**504c. Shaft Revolution Counter**

Shaft revolution counters shall be provided. The counters shall provide continuous operation with rollover at 10,000,000 revolutions.

## *505 PIPING*

**505a. Design**

Except for the specific free stream velocity limits specified herein, velocity in pipe shall be based on meeting the following criteria:

a. Minimum required inlet pressures of machinery, equipment and components under maximum required flow conditions.

b. Inlet velocity limitations of installed machinery, equipment and components.

The maximum allowable velocities for the various system fluids, in conjunction with the line sizing, shall be based on pressure drop determined by pressure and flow requirements of equipment and appurtenances within a system without imposing an increase in the system's pumping capacities.

Velocity of water in constantly running systems may not exceed 3.7 m/s free stream velocity.

Sea water or brine velocity, in m/s, may not exceed 5 times the square root of the inside diameter of the pipe in centimeters, and may not exceed 3.7 m/s. The velocity of seawater and brine at inlet nozzles of and within tubular heat exchanger units may not exceed 1.8 m/s.

Fuel system velocities shall be limited to a maximum of 4.6 m/s for shipboard operations (suction, discharge and transfer), except that for taking-on and unloading operations, the maximum allowable velocity shall be 7.6 m/s.

**505b. Materials**

Piping system material shall be in accordance with ASTM F1155, as modified by Table 505-1 and as specified herein.

Cu-Ni piping shall be used for all seawater systems.

Hydraulic piping, tubing and fittings exposed to the weather shall be CRES.

[AMENDMENT 0001] For vessels constructed of aluminum, aluminum pipe may be used as allowed by regulatory bodies. [AMENDMENT 0001]

**Table 505-1. Modifications to ASTM F1155**

| |
|---|
| 1. Copper-Nickel or bronze body valves shall be used with Copper-Nickel piping systems. |
| 2. Where ASTM A53 steel pipe is specified, ASTM A106 steel pipe may be used as a substitute. |
| 3. Where plastic pipe is specified, ASTM F1173 fiberglass pipe (FGP) may be used as a substitute provided it meets the requirements of USCG NVIC 11-86. Plastic pipe may not be used in areas exposed to the weather, except that it may be used for deck drains. |
| 4. Where steel pipe flanges are specified, forged steel ANSI flanges may be used as a substitute. |
| 5. Where ASTM B171 copper alloy condenser tube plate is specified, ASTM B467, 90-10 Cu-Ni pipe may be used as a substitute. |
| 6. Threaded pipe may be used only in pipe sizes smaller than 61 mm outside diameter. Where threaded pipe is used, flanged takedown joints shall be provided at the inlet and discharge of each item of equipment installed in the piping system. There may be no threaded joint between the hull penetration and the first flanged takedown joint. |

**505c. Installation**

Piping systems shall be flushed, cleaned and inspected before being put in service. Take down joints shall be provided for removal of equipment and machinery.

The selection, fabrication and installation of flexible hose assemblies and resilient pipe hangers shall be in accordance with regulatory requirements. Piping shall be attached to resiliently mounted machinery using flexible hoses. The installation shall consist of two lengths of flexible hose coupled with 'U' or 90 degree elbow bend fittings, as applicable. Flexible hoses shall permit maximum excursion expected in the resiliently mounted equipment without overstressing piping or expansion joints or bending hoses more sharply than the manufacturer's recommended minimum radius.

## *506 VENTS, SOUNDING AND OVERFLOW ARRANGEMENTS*

All tanks, cofferdams and other non-ventilated spaces shall be provided with venting, overflow capability, sounding arrangements and level indication as required.

Vents, sounding tubes and overflow pipes shall be kept clear of the working areas of the Aft Working Deck and Side Sampling Station as far as practicable.

Sounding tubes shall terminate a minimum of 1000 mm above the highest part of the tank, and shall terminate in the weather as far as practicable. Sounding tube terminations are prohibited in laboratories, aft working deck, electronics spaces, habitability spaces, and under portable equipment.

Vents and overflows connecting to oil-containing tanks shall be confined within deck coamings to contain any tank overflow or spillage and prevent discharge to the sea in accordance with regulatory requirements.

## *507 MACHINERY AND PIPING SYSTEM DESIGNATION AND MARKING*

Systems, associated components, piping and appurtenances shall be readily identifiable as to their function, operational characteristics, service and direction of flowing medium.

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

**Piping Designation.** - Piping systems shall be identified every 4000 mm within a compartment, by markings consisting of bands approximately 75 mm wide of each color identified in Table 507-1, plus arrows indicating flow direction. In addition, each piping system shall have stenciled on it the system type abbreviation in at least one prominent location in each space.

Other piping systems shall be marked with distinguishing color and abbreviations.

**Table 507-1. Piping Designation and Marking**

| System | Color | Abbreviation |
|---|---|---|
| Fresh Water, Machinery Cooling | Dark blue | COOLING FW |
| Fresh Water, Potable | Light blue | POTABLE |
| Seawater | Green | SW |
| Fire Systems and Mains | Red | FIREMAIN |
| Diesel Fuel | Brown | DIESEL |
| Lubricating Oil | Yellow | LO |
| Hydraulic Systems | Orange | HYDRAULIC |
| Ship Service Air | Black | SS AIR |
| Starting and Control Air | White | S/C AIR |
| Sewage | Brown/Yellow | SEWAGE |
| Vacuum | Yellow/Red | VACUUM |
| Chilled Water | Green/Blue | CHILLED |
| Divers Air | Black/White | DIVERS AIR |

## *508 INSULATION FOR MACHINERY AND PIPING*

The Contractor shall provide insulation and lagging in accordance with the requirements specified in ASTM F683. Surface maximum temperatures shall be 52 degrees C.

## *509 THERMAL INSULATION AND ACOUSTIC ABSORPTIVE TREATMENT FOR DUCTS AND TRUNKS*

Heating, ventilation and air conditioning systems (including equipment, access covers, flanges, and recirculation ducts) shall be insulated to prevent seating and external heat transfer. Air conditioning preheaters, ducts, cooling coils, fans and other equipment carrying chilled or recirculated air shall be completely insulated with and approved vapor seal, unless condensation can be controlled by other means.

Acoustic treatment shall be provided to attenuate system generated noise and as required to satisfy the noise requirements of Section 073.

Galvanized metal (or aluminum) sheathing or guards shall be provided in areas where insulation may be subject to damage. Metal sheathing thickness shall be compatible with the area covered, but in no case less than 16 USSG steel.

## *512 HEATING, VENTILATION AND AIR CONDITIONING (HVAC)*

The following spaces shall be air conditioned:

a. Staterooms

b. Offices

c. Galley

d. Messroom / Lounge

e. Bridge

f. Charting Laboratory

g. ET Shop

h. Service Area

i. Passageways within air conditioned zones

j. Dry Stores

k. Centralized Control and Monitoring Station

l. Electronic Equipment spaces

All other interior spaces with the exception of tanks and chain lockers shall be mechanically ventilated and heated.

Thermostats in the Messroom / Lounge shall be provided with locks. Staterooms shall have individually controlled heat and air conditioning.

**512a. Design Criteria**

HVAC systems shall be in accordance with Section 073 and the design criteria of Table 512-1.

HVAC calculation procedures shall be in accordance with SNAME Technical and Research Bulletin No. 4-16. Heat load calculations shall use specific equipment heat dissipation data when available.

Spaces requiring natural supply or exhaust ventilation, without direct connection to the weather, may have doors fitted with louvers in the lower panel or door undercuts. The maximum air velocity through free openings may not exceed 2.0 m/sec. Jumper ducts are prohibited in fire rated boundaries.

In general, passageways within an air-conditioned zone should be used for recirculation air return. The air velocity may not exceed 0.8 m/sec.

Fan motors shall be of the direct drive-type for operation in either a horizontal or a vertical plane, and shall be provided with individually controlled heaters.

Fans shall be marine duty fans modified to incorporate permanently lubricated sealed bearings.

Electric preheaters with a capacity above 3 kW shall have step control (minimum three step) with steps activated by outside air temperature.

Electric reheaters with capacity above 1.5 kW, with 8 degrees C or more temperature rise in air, shall have three step electrical controls. Reheaters shall be controlled by room thermostats. Electric reheaters with less than 8 degrees C temperature rise in air shall be controlled by ON-OFF contact makers.

Systems opening to weather shall be designed and located to prevent shipping seawater, driving rain, or spray.

HVAC fresh air intakes shall be routed such that exhaust gas from the stack and lab spaces will not be drawn into any spaces.

**Table 512-1. HVAC Design Criteria**

| Criteria | Cooling Season | Heating Season |
|---|---|---|
| Seawater Temperature | 35 °C | -2 °C |
| Outdoor Air Temperature | 40 °C dry bulb/31 °C wet bulb | -18 °C |
| Preheat Temperature | N/A | 6-10 °C range |
| A/C Laboratories | 24 °C dry bulb, 55 percent relative humidity (maximum) | 21 °C, 35 percent relative humidity (minimum) |
| All other A/C spaces | 27 °C dry bulb, 55 percent relative humidity (maximum) | 21 °C, 35 percent relative humidity minimum |
| T/S and Public Toilets | 4 minute rate of change | 21°C |
| Galley and Scullery | 41 °C | 10 °C |
| Dry Stores | 29 °C | 16 °C |
| Laundry | 41 °C | 21 °C |
| Ventilated spaces | In accordance with SNAME Technical and Research Bulletin No. 4-16 | |
| Minimum air quantity may not be less than 16.5 L/sec/terminal or space. | | |
| Replenishment Air | In accordance with SNAME Technical and Research Bulletin No. 4-16. | |
| External Boundary Temperature | To be used for all spaces in accordance with SNAME Technical and Research Bulletin No. 4-16. | To be used for all spaces in accordance with SNAME Technical and Research Bulletin No. 4-16. |

**512b. Air Conditioning Systems**

The air conditioning systems shall be of the assembly or built-up type consisting of a throwaway-type filter (preceding the cooling apparatus and housed in a permanently hinged clamshell housing), cooling apparatus and fans. The cooling coils shall be selected for use with 7 degree C chilled water at 0.25 L/sec/ton.

Air conditioning recirculation systems shall be provided with rehumidification equipment to maintain the required minimum relative humidity during the heating season.

The filter media shall be 50 mm thick fiberglass held in place by 50 by 50 mm retaining wire mesh screen attached on both sides of the filter housing. The mesh may not protrude beyond the frame. Means shall be provided to remove and replace filters simply and without extensive disassembly.

For air conditioning plant and duct sizing, the Charting Laboratory shall be considered to produce a 20 kW equipment heat load.

Installation of duct sections, cooling coils or fan coil units over the following and similar equipment shall be avoided:

a. Computers

b. Control panels

c. Electric equipment

d. Generators

e. Generator terminals

f. Load center and power distribution panels

g. Switchboards

h. Transformer terminals

If ducting shall be routed over such equipment, the ducting shall either be of watertight construction or made driptight.

Air conditioning duct runs through non-air conditioned spaces shall be avoided. If ducting shall be routed through such spaces, ducts shall be insulated in accordance with Section 509.

**512c. Heating System**

Heating shall be electric. Electric duct heaters used as preheaters or as reheaters for compartments served by mechanical supply and as reheaters on air conditioning supply branches shall have a temperature rise across the heater not below the heater manufacturer's recommended minimum temperature rise. Convection heaters shall be provided in fan rooms housing chilled water coils, T/S and Toilets, and where required in compartments with natural air supply. Unit heaters shall be provided in machinery spaces, in compartments which require heat but are not served by a mechanical supply, in compartments requiring heat when the ventilation systems are secured, and in non-air-conditioned compartments whose duct heater would require a delivery air temperature greater than 43 degrees C.

**512d. Ventilation System**

The ventilation system fans shall have two speeds: high speed for use in the cooling season, and low speed for use in the heating season. The ratio of the high to low speed shall be 2-to-1. Exhaust fans serving hoods and their companion supply fans shall be single speed.

Ventilation ducting shall be accessible for cleaning.

Ducts and fittings within 5000 mm of the weather intake or discharge side shall be non corrosive material.

Exterior ventilation weather openings in the vicinity of the Working Deck area shall be located a minimum of 3000 mm above the deck.

An exhaust system terminal shall be located approximately 250 mm above the deck in the immediate vicinity of air conditioning and refrigeration machinery.

Ventilation grease interceptor hoods shall be installed in the Galley over cooking equipment. Exhausts from the Galley grease interceptor hoods shall be ducted directly to weather.

Welding stations, soldering stations, paint lockers, and HAZMAT lockers if provided shall have exhausts ducted directly to weather.

The Trash Room shall be provided with a negative ventilation pressure.

**512e. Machinery Space Ventilation**

Mechanical supply and natural exhaust ventilation systems shall be provided for the machinery spaces. Machinery space ventilation shall utilize the concept of spot cooling. The location of the supply fans and ducting shall be such that short circuiting of exhaust air or stack gas is avoided.

The mechanical supply systems shall be provided with non-return dampers if fans are operating in parallel and bypass through a secured or failed fan would otherwise occur.

## *514 AIR CONDITIONING*

**514a. Air Conditioning Refrigeration Plants**

Cooling shall be provided by means of circulating chilled fresh water to air-cooling coils as defined in Section 512. The machinery providing the chilled water shall consist of at least two equally sized chilled water units. The units shall be designed for automatic operation, and for use with non-ozone depleting refrigerant. Ammonia shall not be used as a refrigerant.

The units shall be sized so that the capacity of either unit can accommodate 65 percent of the total connected load, including chilled water pipe and pump losses, under design conditions.

Sea water cooled condensers shall be of the titanium flat plate type, or provided with 90-10 copper-nickel tubes, tubesheets and heads.

The units shall be sized according to Table 514-1.

**Table 514-1. Air Conditioning Plant Design Criteria**

| | |
|---|---|
| Saturation suction temperature | 2 $^{o}$C |
| Condensing temperature | 43 $^{o}$C |
| Chilled water outlet temperature | 7 $^{o}$C |
| Chilled water flow | 13.6 L/min/ton of air conditioning |
| Sea water temperature | 37 $^{o}$C |
| Sea water velocity (maximum) | 1.8 m/s |
| Condenser's fouling factor | 0.0005 |
| Condenser's maximum pressure drop | 34.5 kPa |

**514b. Chilled Water System**

A chilled water system shall be provided to service the cooling coils specified in Section 512.

The system shall consist of chilled water plants, chilled water pumps, a chilled water expansion tank, piping, valves, instruments and controls. A minimum of two chilled water pumps shall be provided (one per air conditioning plant) with the capability of being cross-connected. Each chilled water pump shall be sized for the full capacity of a chilled water plant. The expansion tank shall be sized for a water capacity equal to 10 seconds pumping capacity at the chilled water pumps. The recirculation valve shall be installed between the chilled water pump discharge and the chilled water return to the air conditioning unit maintaining at least 1/3 of the design chilled water flow during periods of low demand. Where air

conditioning plant(s) are installed in a compartment, a vacuum pump, refrigerant receiver tank and purge and pumpout unit shall be installed in that compartment. The receiver tank shall serve a maximum of two air conditioning plants. When selecting size of piping, consideration shall be given to providing both minimum pressure drop and maximum flow capacity. The water velocity may not exceed 3.7 m/sec in the mains, cross-connection and risers, and 2.7 m/sec in the branches.

## *521 FIREMAIN SYSTEM*

The firemain shall be a dry system. The number and size of the fire pumps shall be in accordance with the regulatory bodies. Recirculation lines for the pumps shall be provided.

## *524 AUXILIARY SEAWATER SERVICE SYSTEMS*

### 524a. Auxiliary Seawater Cooling System

An auxiliary seawater cooling system shall be provided for cooling of the chill and freeze storeroom refrigeration plants, the air conditioning plants, the bow thruster motors and other auxiliary machinery as required.

Two auxiliary seawater pumps (one standby), one seachest, one duplex strainer, and one overboard discharge to port shall be provided. Recirculation lines for the pumps shall be provided.

### 524b. Washdown System

Facilities shall be provided for washdown of the ship's anchors and chain, and for washdown of mission equipment on the aft working deck and in the Service Area.

## *528 PLUMBING, DECK DRAINS AND VENTS*

### 528a. General Requirements

Deck drains shall be provided to prevent pooling and accumulation of water on weather decks, decks of sanitary spaces, commissary spaces, food service spaces, Trash Room, Service Area, Dive Locker, Laundry, and other wet areas and spaces.

Waste water collection systems, with the exception of weather deck drains, shall be provided in accordance with Section 593. Where overboard gravity drainage is not possible, vacuum inlet valves shall be installed to allow waste water to enter the sewage system.

### 528b. Weather Deck Drains

Weather Deck areas shall be self draining. There shall be no standing water. Deck drains shall be fitted at the edge of all weather decks and at the head of inclined and vertical ladders.

Hatchway trough drains shall be sized and located to prevent the overflow of liquids into hatches, and shall be installed to discharge directly overboard. Weather deck drains shall be at least 50 mm nominal pipe, sized to accommodate accumulated flow from cascading drains. Brass or bronze removable strainer plates for weather deck drains shall be provided.

### 528c. Traps and Cleanouts

Cleanouts shall be installed in accessible locations. Cleanouts in the overhead of living spaces, food preparation and service areas, passageways, and offices shall be avoided. When cleanouts in the overhead of

such spaces cannot be avoided, the cleanouts shall include a full sized ball or plug cutout valve, or be extended to the deck above.

Cleanouts may not be installed in the Charting Laboratory.

Cleanouts shall be installed in horizontal drain piping at each change of direction greater than 45 degrees and not more than 15 m apart. Cleanouts shall be installed so that the cleanout opens in a direction opposite to the flow of the drainage. For piping up to 50 mm nominal pipe size maximum, cleanouts shall be 38 mm nominal pipe size. For piping larger than 50 mm nominal pipe size, cleanouts shall be 64 mm nominal pipe size. Cleanouts shall be equipped with male hose threads and caps for attachment of a flushing hose. A minimum of 500 mm clearance for rodding shall be provided for drains 75 mm nominal pipe size and larger. Cleanouts for smaller drains shall be installed with a minimum of 300 mm clearance for rodding.

### 528d. Plumbing Drains and Vents

Plumbing drains shall be provided for all required fixtures. All plumbing drains shall be provided with traps and cleanouts. Drains from lavatories, drinking fountains, sinks, and other plumbing fixtures shall be vented. Trap seals of fixtures and deck drains shall be protected from siphonage or backpressure. Vents terminating in the weather shall be installed to ensure that no trap seal is subject to overpressure.

## *529 BILGE AND BALLAST SYSTEMS*

### 529a. Bilge Drainage

A bilge drainage system shall be provided in accordance with regulatory body requirements.

### 529b. Ballasting/Deballasting

The segregated ballast system shall be configured for ballasting and deballasting tanks separately or simultaneously, and shall permit maintenance of draft and trim as fuel is burned, loaded or transferred.

Ballast and trim control systems shall be in accordance with Section 202 and 070.

## *531 FRESH WATER SYSTEM*

Two water making units, each capable of 150 liters/day per person shall be provided. The plant shall be capable of operating in areas of high sediment concentrations with minimum maintenance. A reverse osmosis plant shall not be used.

The design of the water maker system shall ensure the capability for full capacity operation of the unit in all water temperatures.

Stowage in at least two tanks for a total of not less than 6,100 liters of fresh water shall be provided.

The freshwater service system shall have provision for tank filling, stowage, transfer and distribution of hot and cold potable water to fresh water users. Stowage tanks, shore supply connections, a pressure set, and water heaters shall be provided. The system shall operate at rated capacity for all engine loading conditions.

The system shall be arranged to provide a continuous supply from the stowage tanks to the hot potable water system and to cold potable water outlets throughout the ship. The system shall provide cold potable water for chilled water, engine cooling makeup water, sanitary flushing, the Aft Working Deck, and boat stowage locations. Connections shall be provided on the weather decks to permit any part of the ship to be reached with a 15 meter hose. The system shall be arranged to receive and distribute potable water from shore water connection, accessible from both port and starboard, and from the water making unit to fill the stowage tanks. A filling main and service main shall be provided.

Service to the weather decks shall be provided with means to prevent freezing of lines in cold weather.

Pumps for the freshwater service system shall be identical and be sized to provide the required freshwater flows and pressures at all operating conditions.

**531a. Disinfection and Filtration**

A ultraviolet sterilizer shall be provided downstream of the fresh water pumps. Unit shall include a sterilizing chamber with UV lamps located in the Auxiliary Machinery Room and remote monitoring and control in the machinery control console. A chlorine injection system, capable of being fitted after the UV sterilizer, shall be stored onboard.

Water filtration shall be provided at point of use installations as required, such as beverage, water fountain and safety fixtures. Equipment whose water is heated or frozen shall utilize filters with lime scale inhibition.

**531b. Miscellaneous Services**

Fresh water shall be provided to the cable cleaning and lubrication systems at each hydrographic winch. An adjustable nozzle shall be provided at the end of the hose. Similar systems shall be provided in the Trash Room.

Fresh water shall be supplied to the window washing system via a compression tank, serving each window equipped with wipers at a minimum distribution rate of 5.0 l/min per $m^2$ of total window area serviced. The compression tank shall include a fill connection via air gap and capability for adding antifreeze or other agents as required. Washing spray for each window shall be controlled by pushbuttons adjacent to wiper controls.

## *532 FRESH WATER COOLING SYSTEMS*

Diesel engine jacket water cooling systems shall be provided as required by Section 256.

The fresh water in the fresh water cooling systems shall be cooled via heat exchangers in the main seawater cooling system as described in Section 256.

## *534 MACHINERY AND COMPONENT DRAINS*

Drainage shall be collected from machinery and equipment in the main machinery spaces, Auxiliary Machinery Room, Bow Thruster Machinery Room, and other spaces as required to prevent the accumulation of oil and water mixtures in the bilges. Drainage shall be positive pitched and shall be segregated to the waste water and oily waste systems, or to the bilge, as required. Deck coamings, drip pans, or funnels shall be installed around or under components or equipment as required. Drains within the main machinery spaces or the Bow Thruster Machinery Room shall drain to the oily waste system or to the bilge only.

## *541 FUEL FILL AND TRANSFER SYSTEM*

### 541a. General

The fuel system shall provide means for the following:

a. Purification of fuel via a self-cleaning purifier.

b. Stripping of fuel tanks.

c. Transferring of fuel between fuel storage tanks with positive displacement pump.

d. Transferring of fuel to the service tanks serving the diesels via the self-cleaning purifier with positive displacement pump.

e. Off-loading.

f. Fueling the SOLAS Rescue Boat in the stowed position, with the capability of purifying the fuel prior to fueling the Boat.

### 541b. Fuel Tanks

Filling and off-loading connections shall be located on the weather deck, and shall terminate in shut off valves with caps and retaining chains. A sampling connection shall be provided on the tank drain line. One fuel storage tank shall have space reserved for overflow purposes or a fuel overflow tank shall be provided.

### 541c. Fuel Purifier

One self-cleaning centrifugal fuel oil purifier shall be provided for the fuel fill and transfer system. The purifier shall be rated at least twice the combined propulsion and auxiliary full power fuel rate. To cover the possibility of purifier failure, a coalescing filter backup system shall be provided.

## *551 COMPRESSED AIR SYSTEMS*

### 551a. Ship Service and Starting Air

Compressed air and receivers shall be provided for starting air, ship service, ship's whistle, and control air. Two motor driven air compressors shall be provided. Compressors shall be sized so that each is able to provide 12 L/sec of ship service air at 860 kPa, in addition to any starting air requirements. Automatic means of isolating the starting air receivers, if provided, when ship service air is being used, shall be provided. Air compressors shall be of the rotary screw type, equipped for automatic loadless starting. In addition, compressors shall be provided with automatic pressure operated control switches, check valves, pressure relief valves and stop valves. Each compressor shall have the capability of filling the starting air receivers, if provided. The ship service air system shall have an air receiver, moisture separator, piping valves, and other components, as required, to provide air at the required pressures purity, dryness and flows to connected services. A drain connection fitted with automatic trap complete with manual valved bypasses, shall be provided for air receivers at the lowest points.

Ship service air, with 15 m of hose, end fitting, quick-disconnect valve and filter-regulator, located to reach any location in the space, shall be installed in the following locations:

a. Two locations adjacent to the Aft Working Deck area,

b. adjacent to the hydrographic winches,

c. the ET Shop,

d. all Machinery spaces,

e. General Workshop,

f. two locations on the weather deck forward.

g. Service area

h. Dive locker

Compressed air outlets located in the weather shall be enclosed in weatherproof enclosures. All air services shall have local shutoff valves and variable pressure control regulators of between 0 and 100 PSI.

**551b. Diver's Air System**

Space and weight shall be provided for a diver's air system. The system will include one breathing air compressor, similar to MAKO Model AC105, a three bank DOT K bottle air storage system, and a fill station, similar to MAKO Model Open Fill Station. The compressor and components will be located in the Dive Locker and will supply air of Grade E quality in accordance with the Compressed Gas Association.

The compressor shall be provided with suction from the weather in a location free from contamination and seawater spray.

## *555 FIRE EXTINGUISHING SYSTEMS*

**555a. Galley Extinguisher**

A fixed fire extinguishing system shall be provided for the Galley hood installations to extinguish fires in the reservoirs, hoods and ducts. A local manual actuating mechanism shall be located within the Galley space. A remote manual actuating mechanism shall be located outside the Galley space. An instruction plate shall be provided at each actuating station.

## *556 HYDRAULIC SYSTEMS*

Hydraulic oil storage and transfer systems shall be provided. Hydraulic system piping and fittings installed in the weather shall be CRES.

**556a. Hydraulic Fluid**

Hydraulic fluids shall be selected with consideration of the effects of viscosity within the range of operating temperatures and pressures. Wherever practicable, hydraulic fluids shall be standardized for all hydraulic systems.

Petroleum based fluids are preferred and may be used in systems without accumulators or with accumulators where system pressure is less than 40 bar. Petroleum based fluids may also be used with accumulators that are nitrogen or spring loaded and less than 3.85 liters capacity in systems over 40 bar. In systems using larger accumulators over 40 bar, fire resistant fluid is required.

## *561 STEERING SYSTEM*

The steering system shall be sized in accordance with regulatory requirements and the maneuvering requirements of Section 070.

The steering system shall be configured to accept control from the Autopilot or DPS (if provided).

## *562 RUDDER*

Rudders shall be provided, sized to meet the maneuvering requirements of Section 070.

Rudder bearings shall be of the self-lubricating, non-metallic type, such as **Thordon SXL.**

## *565 CANARDS AND STABILIZER FINS*

### 565a. GENERAL

Canards and stabilizer fins shall be sized, configured and actuated and provided as required to meet the seakeeping requirements of Section 070.

Canards shall incorporate trimmable control surfaces providing sufficient authority to change the trim of the ship by at least plus and minus 200mm when the ship is running at 10 knots in calm water. The Canards are to be separately controlled to allow for differential control. Fouling of fishing gear and lines shall be a consideration in the design of canards and stabilizer fins.

### 565b. TRIMMABLE CONTROL SURFACE ACTUATION

Each trimmable control surface shall be provided with a powered actuating system providing a range of travel as determined by the Contractor, and shall be fitted with internal stops at the angles.

Each actuator shall be provided with a lock, which shall be capable of holding the trimmable control surface against the design load torque at any flap angle. The design load torque is defined as the torque resulting from the design load applied to the movable blade area and acting at its centroid.

Each actuating system shall be capable of moving the control surfaces at a rate of 2 degrees/sec over the entire range of travel, under a torque equal to one half of the design torque, or at the maximum torque occurring when the control surface is deflected from the neutral position while going ahead at maximum power in calm water, whichever is greater.

Hand-operated backup actuators shall be provided for each trimmable control surface, capable of moving the control against a torque equal to one half the design load torque.

Each trimmable control surface shall have an emergency mechanical locking mechanism, capable of holding the fin against the design torque at any position.

The actuators shall be located to allow inspection and maintenance without drydocking.

### 565c. TRIMMABLE CONTROL SURFACE INDICATORS, CONTROLS AND ALARMS

The trimmable control surface actuating system shall be manually controlled and provided with the following indicators and controls for each, located at the SCC:

a. Analog flap angle indicator.

b. Hydraulic Power Unit On/Off Switch (if applicable)

c. Hydraulic Power Unit Status Indicator Light (if applicable)

d. Summary fault indicator light

e. Control of canard flap angles.

Local direct indication of control surface angles shall be provided.

**565d. Options for Canards and Stabilizer Fins**

[MODIFICATION 0001] Space and weight for the following Section 565 Options shall be incorporated in the vessel preliminary design. Contract design and detail design and construction of the vessel with the option installed shall be priced in accordance with Section B of the contract: [MODIFICATION 0001]

a. **Automated Actuation System** – The trimmable control surface actuating system shall be automated to maintain the trim and heel limits of Section 070 when the vessel is moving at transit speed or above.

## *568 BOW THRUSTER (OPTION)*

**568a. Option for Bow Thruster System**

[MODIFICATION 0001] Space and weight for the following Section 568 Option shall be incorporated in the vessel preliminary design. Contract design and detail design and construction of an installed bow thruster system shall be priced in accordance with Section B of the contract. [MODIFICATION 0001]

A bow thruster (or thrusters) shall be provided. The thruster shall be driven by an independent electric motor sized to meet the maneuvering requirements of Section 070 and to provide assistance in docking maneuvers. The docking maneuver design environment shall be a 2 knot current and a 30 knot wind from the same direction. The thruster shall be bottom suction, bottom thrust, and thrust directable.

Thruster controls shall accept both manual and DPS input. Thruster controls and indicators shall be provided at the SCC and the port and starboard Bridge wing control stations.

## *581 ANCHOR STOWAGE AND HANDLING*

Anchors, anchor stowage and an anchor handling system shall be provided and installed in accordance with regulatory requirements and SNAME Technical and Research Bulletin No. 3-15.

Lightweight anchors are prohibited. One anchor shall be located above each hull. Both anchors shall be located as far forward as practicable to avoid fouling underwater hulls and appendages. Separate handling systems shall be provided for each anchor. Each anchor windlass shall be provided with a warping head sized for the required mooring lines.

Anchor stowage shall ensure that the anchor will not shift in a seaway. A double plate shall be provided where the anchor rests against the hull in the stowed position. The bitter end of the anchor chain shall be secured to the chain locker with a weak link. A chain locker sump shall be provided, with means for drainage and cleanout

Visibility shall be provided for the anchor operation between the waterline and the bolsters.

Chain stoppers shall be provided. Deck covers shall be provided for hawse pipes if provided.

Controls shall be mounted away from the anchor windlass on a separate stand on the foredeck, adjacent to the clutch and brake controls. The wildcat clutch bar shall be secured in a bracket on the windlass. The windlass shall be provided with a NEMA D high slip motor and an electric parking brake rated for 200 percent overload. The wildcat shall be in a accordance with ASTM F765.

## *582 MOORING AND TOWING FITTINGS*

Cleats, bitts, chocks and towing pads shall be provided and arranged to simplify line handling arrangements and to preclude interferences. Bitts and chocks shall be compatible with hawsers.

Double bitts shall be provided port and starboard, at forward, aft, and midships locations.

Bitts, chocks and capstans shall not impede scientific equipment handling operations.

Bitts shall be designed with a factor of safety of 1.5 on the yield stress of the material, based on the maximum moment that would be produced in the bitts. The moment shall be equal to breaking strength of the mooring line times one-half the height of the barrel above the base plate. Insert plates and stiffening of the deck shall be provided, as required, to allow the fittings to develop full strength.

Closed chocks shall be provided for line handling and sized so that an eye splice of the largest size line to be used with the chock will pass through the opening with two parts of the line already in the chock.

Six polyester hawsers shall be provided, each with a minimum length of 50 m. Breaking strength shall be as recommended by ABS Rules.

Cleats shall be provided to facilitate boat launching as well as mission operations on each working deck.

**Mooring Capstans.** - Capstans shall be provided port and starboard, on the Working Deck level, aft. Each capstan shall be capable of 12.5 kN line pull at a warping speed of 0.15 m/sec, and shall have a below deck motor. Capstans shall be located so that the lead of the mooring lines from the chocks they serve shall be clear of, but close to the mooring bitts.

## *583 BOATS, BOAT HANDLING AND STOWAGE*

### 583a. General

A SOLAS certified rescue boat and handling system shall be provided.

Encapsulated liferafts shall be provided in accordance with regulatory requirements.

## *591 MISSION HANDLING SYSTEMS*

### 591a. Aft Working Deck and Mission Handling Arrangements.

The Contractor shall provide mission handling equipment and arrangements in accordance with Section 070 and the following. Mission handling systems shall integrate the equipment defined in the Government GFI and be capable of performing the mission deck operations listed in Table 591-1. Arrangement drawings and supporting documentation shall be provided.

**Table 591-1. Summary of Mission Deck Operations**

| OPERATION | AFT HSHR SIDE SCAN SONAR | NON-EXPENDABLE WATER COLUMN PROFILER |
|---|---|---|
| ACTIVITY | Deploy/tow/recover | Deploy/recover |
| LOCATION | Aft Working Deck | Aft Working Deck |
| PACKAGE BEING HANDLED | HSHR Towfish | CTD |
| REQUIRED DECK EQUIPMENT | Either of two Government winches, A-Frame | Either of two Government winches, A-Frame or Crane supported over the side |
| SPEEDS | Deploy/Recover: Steerage<br>Tow: 3 knots to Design Speed | 0 kts |
| COMMENTS | Towed from A-Frame<br>Towfish shall be stowed and moved about the Aft Working Deck and into the Service Area | |

**591b. Cranes**

One general purpose pedestal mounted hydraulic articulated (knuckle boom) crane shall be provided aft to support requirements as specified herein. The crane shall be for offshore use, ABS certified and provided with an API monogram. The crane shall meet the rating and outreach requirements without the use of a jib boom. Load rating charts shall be posted for both Pierside and At-Sea loads. The Contractor shall provide space and weight on the opposite side for a similar crane.

The crane shall have a 1,360 kg SWL capacity, at sea (2.5m significant wave height, 35 knot wind), at a radius to lift from above the center of the A-frame in its fully deployed position, to a spot 3.4 m perpendicular away from the side of the hull.

The crane shall be capable of the following operations:

a. Transferring a load of 570 kg from the locations of the hydrographic winch drums to the pier, and to or from all portions of the aft working area of the deck.
b. Lifting the accommodation ladder from its stowage location to its deployed position.
c. Handling sampling gear over the side at sea.
d. Transferring ship's stores from pierside.

The crane shall provide continuous rotation at a speed variable from zero to 1.5 revolutions/min.

The crane shall be provided with a load hoist (winch) capable of providing a hook drop to 3 m below the keel with the boom extended and topped. The hook speed shall be variable from zero to approximately 20 m/min at safe working load. The hoist shall include a mechanical means to lower the load in the event of a power failure.

Lights which illuminate the hoisted load shall be provided on the crane.

In the stowed position, the crane boom shall be secured with no exposure of the cylinder rods.

Hand carried crane local controls shall be provided with at least 20 m reach with a watertight plug-in receptacle located adjacent to the crane. Controls shall provide for simultaneous operation of at least any two functions.

**591c. Towing Equipment**

**A-Frame**. - An A-Frame shall be provided for towing HSHR side scan sonar and handling scientific equipment over the stern.

The A-Frame shall provide a clear height of 5.1 m over the deck edge, and provide a clear width of 3.6 m at the deck and a clear width of 3.6 m at the cross member. The A-frame shall have a SWL of 454 kg at-sea in 2.5m significant wave height, 35 knot wind.

The A-frame shall pivot on a transverse axis, such that the cable shall plumb 5.1 m inboard to 3.4 m outboard of the deck edge at a variable speed up to 20 seconds, full range, at SWL.

The A-Frame shall be provided with 3 padeyes at the centerline and at the quarter points of the cross member of the A-Frame. Two blocks for handling the tow cables shall be provided at the padeyes. The sheaves in the blocks shall be compatible with the cable used for the CTD and HSHR side scan hydrographic winches specified in the GFI. Sheaves shall be metered for line out, line tension and line speed. Sensor cables shall be run under the deck to the local control station, ACS, Charting Laboratory and the Bridge.

Structural stops shall be provided in both the aft (working) position and in the forward position. The A-frame shall withstand the SWL applied up to 30 degrees from vertical in any direction by a wire over the sheave, on any heading in 2.5 m significant wave heights. For the cases in which the A-Frame is against the structural stops, the yield stress of the material in the A-Frame, stops, and foundation shall be at least 1.5 times the calculated stresses resulting from application of a load equal to the nominal breaking strength of the strongest wire to be used.

The A-Frame shall be hydraulically actuated. The A-Frame shall stow with the cylinders closed and the rods protected from the weather. Hydraulic controls shall be provided locally in a position from which the operator will have a clear view of the A-Frame, and the load supported throughout the arc of travel and of the water surface at the stern of the ship. Controls shall also be provided remotely at the ACS.

Displays for metered sheaves shall be provided locally, in the ACS, Bridge and in the Charting Laboratory.

Lights which illuminate the hoisted load shall be provided on the A-frame.

**Mission Winches** - The Contractor shall provide space, weight, foundations, power cables, signal cables, through deck penetrations, demountable stuffing tubes, distributed services, and local controls and remote controls from ACS and Charting Laboratory for Government mission handling equipment. Cables installed by the Contractor terminating in the Charting Laboratory shall have 8 m of spare length. Cables installed by the Contractor shall be terminated into watertight junction boxes at the hull, sensor interface with 1 m of spare length. Remote controls shall be provided in accordance with Section 070f.

The Contractor shall determine and provide all installation details and interface control documentation (ICD) to support a fully functional installation (in conformance with the missions noted in Section 070) for the mission handling equipment listed in Attachment J-7, Government Furnished Information.

Government mission handling equipment includes:

a. Side Scan Sonar winch with slip rings

b. CTD winch with slip rings

c. CTD cable (0.820 cm Electro-mechanical wire (0.322 inch))

d. Side Scan cable (Klein Electro-mechanical wire 0.40 inch)

e. Spare reels with cable

**591d. Options for Mission Handling Systems**

[MODIFICATION 0001] Space and weight for the following Section 591 Options shall be incorporated in the vessel preliminary design. Contract design and detail design and construction for the installed options shall be priced in accordance with Section B of the contract: [MODIFICATION 0001]

a. **Crane Safe Working Load** – The crane shall have a SWL of 3,000 kg SWL at-sea, 2.5m significant wave height, 35 knot wind.

b. **A-frame Safe Working Load** – The A-frame shall have a SWL of 4,500 kg SWL at-sea, 2.5m significant wave height, 35 knot wind.

## *593 POLLUTION CONTROL SYSTEMS*

**593a. Waste Water System**

Waste from laundry equipment, sinks, showers, lavatories, other similar fixtures, and from the deck drains specified in Section 528 shall be drained to the waste water system. Waste drains shall be connected by a common main that shall convey to the waste water holding tank.

Treated effluent from the marine sanitation device shall also be discharged to the waste water holding tank. The waste water holding tank shall be capable of holding waste water and treated effluent generated during the design mission duration (for operations in no discharge areas). The tank shall be drained by a waste water discharge pump. The discharge line from the pump shall contain a diverter valve which shall allow selective discharge to an overboard discharge to port, or to port and starboard shore connections on the Main Deck.

**593b. Sewage Systems**

Waste generated from the ship's toilets and garbage grinders shall be drained to the vacuum-driven sewage system. Toilets and vacuum interface valve assemblies for the fixtures shall be provided. Local isolation valves shall be provided for each toilet to allow for repair and maintenance.

Sewage drains shall be connected by a common main with a diverter valve. The diverter valve shall allow selective discharge via a vacuum system ejector(s) for processing by the marine sanitation device (MSD), or to an auxiliary seawater-driven eductor. The diverter valve shall be located downstream of the eductor and shall allow selective discharge to an emergency port side overboard discharge, or to a shore connection on the Main Deck. The MSD shall be sized to process sewage generated within a 24 hour period, and its discharge pump shall discharge treated effluent to the waste water holding tank.

The MSD shall be a Type II system certified by the USCG. The MSD shall be capable of operation when the vessel in operating in brackish and fresh water.

A powered vent system shall be installed between the MSD sewage tank and the top of the stack. A ventilation failure alarm and a hydrogen sulfide indication alarm shall be provided for the exhaust ventilation system serving the Sewage Treatment Room.

A coaming shall be provided around all sewage treatment equipment. A sump shall be provided within the coaming for drainage collection via the bilge system in Section 529. A service sink in accordance with Section 644 shall be provided in the Sewage Treatment Room, and shall drain to the sump.

The drain for the in-sink garbage grinder required by Section 651 shall be configured such that its discharge is routed directly overboard during normal operation and to the vacuum collection system during periods of zero discharge via a full pipe diameter two-way diverter valve. A removable strainer plate or basket with retaining device shall be provided for the sink drain for use during periods of zero discharge. A sign shall be provided at the garbage grinder, reading as follows:

**DO NOT OPERATE GARBAGE GRINDER**

**DURING ZERO DISCHARGE PERIODS**

A grease trap shall be provided for all galley sinks. The grease trap shall be in accordance with the MSD manufacturer's recommendations.

An eye/face wash fountain shall be provided in the Sewage Treatment space, located as near as practicable to the exit from the space.

**593c. Oily Waste System**

An oily waste system shall be provided which shall include an oily waste transfer pump, oily waste holding tank, oily water separator, and waste oil tank. The oily waste transfer pump shall permit selective suction from the oily waste holding tank or the Bow Thruster Machinery Room(s), Main Machinery Spaces and Auxiliary Machinery Rooms bilge wells via the bilge system.

An oily water separator with 15 ppm oil content monitor and alarm shall be provided. The separator shall take suction via the separator pump from the oily waste holding tank and bilge wells. The separator shall discharge oil effluent to the waste oil tank. The separator pump shall discharge water effluent selectively to the oily waste holding tank or overboard via an oil content monitor and diverter valve. The oily waste holding tank shall be sized for waste generated during the design mission duration (for operations in no discharge areas).

The oily waste transfer pump shall discharge selectively to the oily waste holding tank, or overboard. The overboard connection utilized by the oily waste transfer pump and the separator pump shall discharge to an overboard discharge or shore connection via a diverter valve which shall be normally locked closed.

A waste oil tank shall be provided, designed to accept waste from oil leaks and residues, including from tank drains, filters, greases and waste oil from the oily water separator as well as used oil from the sumps. The tank shall be equipped with a circulation pump and electric heater. The circulation pump shall discharge to a shore connection via a diverter valve.

**593d. Trash Compactor and Trash Storage**

A trash compactor shall be provided in the Trash Room.

Compacted waste storage for the duration of the longest mission shall be provided in the Trash Room.

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# 600 OUTFITTING GROUP

### 600a. Color Scheme

The Contractor shall prepare a Color Coordination Manual for the ship. The color scheme shall be approved by the Government before fabrication.

### 600b. Furniture Construction and Installation

Furniture, unless otherwise required, shall be commercial marine furniture such as **Hopeman Brothers, Inc. or Jamestown Metal Marine Sales, Inc**.

Fixed furniture shall be secured to decks or bulkheads and shall be installed level with the baseline. Portable furniture and furnishings shall be provided with fittings for securing in the stowed position. Portable chairs shall be provided with lashing assembly and flush deck plate.

Inaccessible spaces in way of furniture and furnishings shall be flashed.

Furniture shall be of steel or aluminum construction, finished in baked enamel, fluidized epoxy, or chrome plated. Case good panels shall be insulated with sound deadening material. Decorative metal trim and hardware shall be CRES dull finish, white bronze satin finish, or aluminum anodized.

Drawers and doors shall have positive means to prevent opening due to ship motions. Spring, bullet, magnetic, or bayonet catches may not be used. Furniture doors and drawers in berthing and office spaces shall be fitted with key operated built-in locks.

Legs of portable furniture shall be fitted with non-marking, non-skid neoprene glides retained in CRES cups.

End table and coffee table tops shall be finished with high-pressure plastic laminate.

## *602 HULL DESIGNATION AND MARKING*

### 602a. General

Label plates shall be plastic, metal photo, or engraved on metal. Label plates for any specific purpose shall be uniform in size, of the same material and with the same style lettering. Each label shall be clear and concise with a minimum of abbreviations with a symmetrical and well-balanced arrangement of letters and lines.

Corrosion resistance commercial label plates, provided by the equipment manufacturer, are acceptable providing they furnish the required information. Commercial label plates that are deficient in any portion may be used if augmented by Contractor provided label plates containing the necessary information.

Label plates shall be located to ensure visibility and may not be located where they can be obscured by furniture, pipes, or other fittings. All label plates shall be attached with CRES screws or suitable marine adhesives. Aluminum plates shall be insulated to prevent contact with dissimilar materials. Label plates in the weather or in areas exposed to seawater shall be sealed to prevent seepage behind the plates. Where the use of a label plate will interfere with the use of the labeled item, the labeling may be accomplished by painting the required wording in a color which contrasts with the surface color on, or adjacent to, the item. Label plates shall less than 2 meters above the deck shall have smooth edges and rounded corners and be adheres sufficiently to not snag clothing.

In addition to label plates specifically required herein, other information required for the operation of the ship, such as the designation of frame numbers, stowage locations, lubrication instructions, warnings, and the designation of access panels shall be provided.

**602b. Warning, Caution, Operating and Instruction Plates**

Warning, caution, operating and instruction plates shall be inscribed with the following instructions, as applicable:

a. Safety precautions
b. Starting procedures
c. Operating instructions
d. Securing procedures
e. Emergency procedures

Warning, caution, operating and instruction plates shall be provided for the following equipment:

a. Engines and generator sets
b. Propulsion machinery and switchgear
c. Bridge controls
d. Auxiliary machinery and equipment
e. Electronic equipment
f. Piping system controls
g. Shore power connection
h. Fire pumps
i. Steering gear
j. Workshop
k. Deck machinery
l. Non-electrical workbenches, electrical workbenches
m. Electrical equipment

**602c. Space Labels**

Space label plates shall be at least 25 mm high with letters 13 mm high. Label plates shall be provided for each doorframe identifying the space within and for all hatches and manholes designating the compartment to which access is made. Each door shall be labeled with service, Frame number and coded for location (port, starboard, center) of compartment served. No smoking plaques shall be installed on each space containing a smoke alarm. A Frame label shall be provided on a forward/aft bulkhead near the center of each space and every 10 frames if compartment or passageway is of sufficient length.

**602d. Deck Fitting Labels**

Deck fitting labels shall be CRES. Deck fitting labels indicating tested deck fitting working load shall be provided attached to structure close to the fitting.

**602e. Lifting Gear Labels**

All rigging and lifting gear, including spares, shall be marked with safe working load in accordance with regulatory requirements. The markings shall be made in a conspicuous location in a durable manner.

**602f. Anchor Chain Markings**

The anchor chains shall be painted and marked to identify the length of chain paid out as follows:

a. One link on each side of the 15 fathom detachable link shall be painted white.

b. Two links on each side of the 30 fathom detachable link shall be painted white.

c. Three links on each side of the 45 fathom detachable link shall be painted white.

Marking shall continue in this fashion to the bitter end of the chain.

Detachable links shall be painted as follows:

a. 15 fathom detachable link, red.

b. 30 fathom detachable link, white.

c. 45 fathom detachable link, blue.

d. 60 fathom detachable link, red.

Subsequent detachable links shall be painted in colors that continue this color sequence.

The first link at each side of the 15 fathom detachable link shall have one turn of galvanized wire tightly wound around the stud. The second link at each side of the 30 fathom detachable link shall have two turns of galvanized wire tightly wound around the stud. The third link at each side of the 45 fathom detachable link shall have three turns of galvanized wire tightly wound around the stud. Wire marking shall continue in this fashion to the bitter end of the chain.

**602g. Historical Data Plate**

A brass ship historical data plate with engraved upper case letters no less than 7 mm in height shall be installed on the Bridge. The letters shall be filled with black paint.

**602h. Ship's Name**

The word "NOAA" and the assigned NOAA hull number, in block letters, shall be painted on both sides of the bow. The ship's name shall be painted on each quarter. All letters shall be outlined in continuous welds. The height and style of lettering shall be in accordance with NC Instruction 9602A, dated 22 May 1992.

**602i. Name Boards**

Ship's name boards, 400 mm high, shall be provided port and starboard at the Bridge top and shall be hardwood with the letters 280 mm high.

**602j. NOAA Logo**

The two-color NOAA logo shall be painted on both sides of the bow. Templates for the logo will be provided by the Government as GFE.

## *603 DRAFT MARKS*

**603a. General**

Draft marks shall cover the draft of the ship under all probable conditions of loading and corresponding trims. The centerline of each set of draft marks shall be in a plane perpendicular to the ship's centerline plane and to the molded baseline.

Draft marks shall be in block Arabic numerals, 150 mm in vertical projected height, the bottom of each figure being the height in even increments above the reference plane. Draft marks and load line markings shall be painted figures outlined by weld bead, painted in a color contrasting with the hull.

**603b. Calculative Draft Marks**

Calculative draft marks shall be located port and starboard, inboard and outboard of each hull, forward and aft. Forward and aft draft marks shall be equidistant from the plimsoll marks and as far forward and aft as practicable. The reference plane for draft marks shall be the molded baseline or baseline extended. Draft marks shall be located by a surveyor and witnessed by the government and regulatory bodies as required.

**603c. Appendage Draft Marks**

Appendage draft marks shall be provided, port and starboard, above each appendage location. The letters PROJ shall be provided in 150 mm high block letters, with the bottom 150 mm above the top of the uppermost draft marks.

**603d. Other Hull Markings**

Thruster marks shall be provided port and starboard above the bow thruster location (if provided).

The locations and frame numbers of all major transverse bulkheads shall be indicated port and starboard, in 150 mm high block letters.

## *604 LOCKS, KEYS AND TAGS*

**604a. General**

Locks and keys shall be provided for closures (except for escape scuttles) providing access to the interior of the ship from the weather and for interior closures where required for security, such as storerooms, lockers, staterooms, laboratories, workshops and operating spaces. Escape scuttles shall be provided with a latching device operable from below only.

**604b. Locks**

Joiner and non-tight doors shall be fitted with built in mortise type locks, all made by one manufacturer. Interior doors to working areas, with locks and not fixed with holdbacks, shall be equipped with key lock having a positive retractable latch. Doors for public washrooms shall be provided with a lock operated by thumb turn on the inside and by emergency key on the outside. Locking covers shall be provided for thermostats in public spaces and laboratories.

**604c. Padlocks**

Padlocks shall be 45 mm size, cylinder type with solid bronze casing or of the solid or laminated type with hardened brass or bronze shackles. Brass or bronze keep chains shall be fitted to all padlocks. Hasps and staples shall be welded and fitted so that when the closure is opened or closed padlocks cannot be caught between the closure and the frame.

All watertight doors, weathertight doors, hatches, manholes and scuttles to compartments used for stowage of equipment or stores shall be provided with hasps, staples, and padlocks.

The gun locker shall be secured with a high-security hasp and padlock, Type II MIL-P-43607D, NSN5340-00-799-8248, or MIL-P-43951, NSN 5340-00-799-8016.

**604d. Keys**

Each door lock shall be provided with three keys. The keys to each lock shall be different from the keys to other locks, except where there is more than one door into a single compartment, in which all doors to that compartment shall be keyed alike.

Door locks and padlocks shall be master keyed in the following groups according to their service:

D – Deck Department

E – Engine Department

S – Stewards Department

M – Laboratories and Offices

N – Navigation Spaces

Three master keys shall be provided for each of the groups and three grand master keys for all groups.

Keys shall be numbered and have a tag of heavy fiber or plastic with the name of the department, space and ship inscribed thereon. A key tag index shall be prepared.

A key cabinet shall be provided in the Ship's Office.

## *611 HULL FITTINGS*

**611a. General**

Eyebolts, ringbolts, cleats, and other hull fittings necessary for the attachment, working, belaying, and securing of all parts and appliances shall be provided.

**611b. Padeyes**

[AMENDMENT 0001] Padeyes shall be of strength to the purpose intended. [AMENDMENT 0001] Padeyes shall be located and installed so that the load will be applied in the plane of the eye or shall be designed for side loading when required by the handling arrangement. Padeyes shall be load tested and labeled with the safe working load. Fittings shall be tested to 200 percent of rated load without failure or deformation of adjacent structure.

Padeyes shall be provided in number, location and capacity as necessary for convenient and rapid handling of stores and equipment to and from storerooms and stowage locations. Padeyes and lifting fittings shall be provided over machinery as may be necessary for lifting parts of the machines and for transferring machinery parts to the Engineer's Workshop or out of the machinery space to the Aft Working Deck.

## *612 LIFERAILS, LIFELINES AND STANCHIONS*

**612a. General**

[AMENDMENT 0001] Railings, stanchions and associated fittings in exterior and utility spaces shall be steel or aluminum as appropriate for the deck on which they are installed, except within 3000 mm of the compass, where they shall be non-magnetic material. [AMENDMENT 0001]

**612b. Liferails and Handrails**

Liferails shall be provided around all deck edges except where bulwarks are provided or where a clear deck edge is required for over the side handling or other operations. Liferails shall meet all regulatory body requirements.

Pipe handrails shall be provided on each side of all inclined ladders.

**612c. Lifelines**

Removable stanchions and lifelines shall be provided around all deck edges not protected by bulwarks or liferails. Lifelines shall be three courses high of 12 mm diameter polymer jacketed Kelvin rope fitted with anodized aluminum end fittings, turnbuckles, and sister hooks. Removable stanchions, where provided, shall be spaced no further than 2500 mm apart. Stanchions shall use bolt-down sockets with CRES 316 attachment fittings.

**612d. Portable Guard Rails**

Portable guard rails of 10 mm closed link chain and removable stanchions shall be provided around all hatches which are flush or which have low coamings and elsewhere as necessary for protection of personnel.

**612e. Machinery Space Railings**

Railings shall be provided in machinery spaces as necessary for protection of personnel. Where necessary to facilitate access and removable of equipment, railings shall be removable. Except in way of electrical equipment, such as switchboards, where non-conducting material shall be used, railings shall be 25 mm diameter galvanized steel pipe. Stanchions shall be 30 mm diameter with a spacing not to exceed 1500 mm. [AMENDMENT 0001] Alternate arrangements and materials may be acceptable if they provide equivalent strength and are accepted by regulatory bodies. [AMENDMENT 0001]

## *613 FLAG HOISTS, FABRIC COVERS AND CURTAINS*

### 613a. Covers

Covers shall be provided for topside hardware when not in use, such as signal searchlights, anchor windlass, winches and other deck machinery and controls.

All covers shall fit neatly, without wrinkles or pockets, and shall be fitted with all hooks, lashings, thimbles, grommets, etc. necessary for complete installation. At locations of accelerated wear such as in way of sharp edges of machinery and equipment fittings, covers shall be double canvas and provided with means for controlling wear such as internal padding. Covers of less than 1.0 $m^2$ shall be fabricated of white commercial marine grade coated nylon cloth, 0.41 $kg/m^2$. Covers larger than 1.0 $m^2$ shall be fabricated of white commercial marine grade coated nylon cloth, 0.50 $kg/m^2$. Each cover shall have stenciled markings to indicate it use and location.

A storage bag of synthetic fabric, with stenciled identification markings, shall be provided for each cover.

### 613b. Curtains

Curtains shall be of synthetic material and shall be lined and weighted. Curtains shall be provided with tracks and all necessary hardware. Curtains shall be provided for each fixed light, airport, and window in all staterooms, offices, the Messroom and lounge. Curtains shall overlap by at least 50 mm.

Blackout curtains shall be black and shall be fitted to exclude light emission into, or from, the space. They shall slide to the open and closed positions and shall be provided with straps to retain curtains in the open position. Blackout curtains shall be provided between the Radio/Chart Area and the rest of the Bridge.

### 613c. Flag Hoists

Signal flag hoists and retrievers shall be provided on the signal yardarms.

Flag hoists shall be provided on the after part of the mast for the national ensign, on the jackstaff and on the ensign staff. Belaying pins for signal flags shall not be located in RADHAZ areas.

### 613d. Dressing Lines

Dressing lines shall be rigged from the jackstaff to the masthead and to the ensign staff. Dressing lines shall be equipped with sister hooks and swivels to prevent turns in the line.

Gantlines shall be 50 to 75 percent of the breaking strength of the dressing lines.

## *621 NON-STRUCTURAL BULKHEADS AND PARTITIONS*

### 621a. General

Where access is required for maintenance, inspection, repair, or operation, hinged and latched panels shall be provided and labeled to indicate the item concealed.

Expanded metal and other non-structural bulkheads shall be provided as required.

**621b. Joiner Bulkheads and Linings**

Joiner bulkhead and lining panels shall be lightweight and faced with decorative high pressure plastic laminate with a total thickness of 22 mm for bulkhead panels and 16 mm for lining panels. The plastic laminate shall incorporate the final color.

Joiner bulkhead and lining panels surrounding spaces with terrazzo shall be provided with 150 mm high CRES cove. Joints of panels in these spaces shall be caulked.

In laboratories, linings shall be installed between and flush with the Unistrut mounting channels provided on the bulkheads.

Joiner bulkheads and linings shall be provided in the following spaces including linings on structural bulkheads (stiffened side only):

a. Passageways in accommodations and laboratory areas
b. Staterooms
c. Offices
d. Lounge
e. Galley
f. Messroom / Lounge
g. Bridge
h. Charting Laboratory
i. ET Shop

**621c. Ceilings**

Ceilings shall be integrated with lights, speakers and air terminals. Ceilings shall be provided only in the following spaces:

a. Staterooms
b. Offices
c. Passageways in accommodations areas
d. Galley
e. Messroom / Lounge

**621d. Toilet and Shower (T&S) Spaces**

T&S spaces shall have built-in or prefabricated shower enclosures with coamings. Built-in enclosures shall be made up of joiner panels and ceilings.

Shower enclosures shall be complete with fixtures, fittings, and accessories.

## *622 FLOORPLATES, HANDRAILS AND HANDGRABS*

**622a. Floor Plates**

[AMENDMENT 0001] Machinery space floor plates shall be diamond pattern plates secured with flush CRES machine screws. [AMENDMENT 0001] Floor plates shall be no larger in size than can be

conveniently handled by one person and shall each weigh less than 33 kg. Hinged portable plates shall be provided in the way of areas under the floor plate level requiring frequent inspection and for access to valves, strainers, manifolds and other equipment located below the floor plate level. Coaming bars shall be provided along the edge of all permanent openings.

**622b. Machinery Space Gratings**

[AMENDMENT 0001] Machinery space walkways and platforms shall be provided with removable gratings as necessary for ventilation and visibility purposes. [AMENDMENT 0001] Gratings shall be secured with flush CRES machine screws. Each grating panel shall weigh less than 33 kg.

In selecting grating areas for ventilation purposes, the probable path of the return airflow and its effect on the ambient conditions surrounding important items of machinery shall be considered. These grating areas shall be located away from main traffic paths and operating stations.

## *623 LADDERS*

**623a. General**

Inclined ladders, vertical ladders and stairways shall be provided as necessary to provide access to all portions of the vessels. Means of access, such as vertical ladders or rungs, shall be provided to tanks, voids, mast and other areas where access may be required for maintenance.

**623b. Inclined Ladders**

Inclined ladders shall have a clear width of 24 inches unless otherwise required by regulatory bodies. Inclined ladders shall be bolted to the structure so as to allow relative motion between supporting fastenings at the head and foot. Exterior inclined ladders may be fiberglass. Where ladders are attached to the deck in way of coamings, the coamings shall be cut away to eliminate a tripping hazard. Inclined ladders over stowage spaces or other inclined ladders shall have sheet metal shields underneath. Pipe handrails shall be provided on stanchions or bulkheads on each side of inclined ladders. Doorways shall not open into ladder wells.

**623c. Vertical Ladders**

[AMENDMENT 0001] Vertical ladders shall be provided under escape windows and airports as necessary, in access trunks, and elsewhere as necessary. [AMENDMENT 0001] Where conditions do not permit installation of a vertical ladder, ladder rungs shall be welded to the structure. [AMENDMENT 0001] Vertical ladders and ladder rungs shall be constructed in accordance with ASTM F840 and ASTM F783 and shall be removable. [AMENDMENT 0001]

Notch type climber safety rails shall be provided on ladders over five meters long. Climber safety rails located in the weather shall be CRES.

**623d. Portable Ladders**

Portable ladders shall be provided in storerooms where upper shelves are not accessible from the deck.

A pilot boarding ladder shall be provided on the main deck.

**623e. Accommodation Ladder**

An accommodation ladder with a rotating upper platform shall be provided in a location to be approved by the Government. The ladder shall be suitable for a 3 m tidal range with an average pier height above high tide of 2 m. When in use, the ladder shall be located to permit access to the ship whether the ship is docked port or starboard side to the pier. In use, the ladder shall have direct visibility from the Bridge. Stowage for the ladder shall not be on the Aft Working Deck and shall not restrict Bridge visibility. [MODIFICATION 0001] The stowage position shall permit shipping and unshipping of the accommodation ladder by the ship's crane to one side of the vessel and shall permit a similar crane on the opposite side of the vessel (space and weight as called for in Section 591b) to ship and unship the accommodation ladder to the opposite side of the vessel. [MODIFICATION 0001]

## *624 DOORS, HATCHES, SCUTTLES AND MANHOLE COVERS*

**624a. General**

Closures shall be provided for all spaces and shall be appropriate to the location, use, and watertight integrity of the space served, and shall be equivalent in strength to the adjacent structure. All mechanical parts shall be equipped with rugged corrosion resistant bearings and pins and shall be provided with means for proper lubrication. Holdbacks shall be provided for all doors except where prohibited by Regulatory Body requirements.

Exterior Bridge doors shall have rectangular windows. The Bridge door window shall align with Bridge windows when the door is open. If a hinged door is provided the hinge shall be located at the forward side of the door.

Doors in traffic areas shall be provided with a fixed light.

Dogged doors to passageways shall be quick-acting.

The exterior Aft Working Deck access to the Service Area shall be weather tight doors with a 3m clear opening with a minimum clear height above deck of 2 m.

Exterior doors shall have watersheds over them, where not otherwise protected. Tops of doors shall be at least 1980 mm above tops of deck coverings or step.

Minimum clear opening door widths shall be 760 mm, except as follows:

| | | |
|---|---|---|
| a. | Double (interior and exterior) | 1070 mm |
| b. | T&S (private and semi-private) | 610 mm |
| c. | Staterooms | 660 mm |
| d. | Utility spaces (linen locker, cleaning gear locker, etc.) | 660 mm |

Coaming heights shall be as follows:

| | | |
|---|---|---|
| a. | Watertight / weathertight companionway | as required by regulatory bodies |
| b. | [MODIFICATION 0001] NOT USED [MODIFICATION 0001] | |
| c. | Toilet spaces | 50 mm above deck covering |
| d. | Shower enclosures | 150 mm above deck covering |
| e. | Laundry space | 150 mm above deck covering |

f. Staterooms (main and second decks) 50 mm above deck covering

Coamings are not required for other interior spaces, and may not be provided for interior entry into other laboratories.

**624b. Joiner Doors**

Joiner doors shall be in accordance with ASTM F821 and shall satisfy the test requirements of IMO Resolution A.754. Kickout panels shall be provided where there are no secondary means of escape.

Joiner doors shall be provided to enable interior access for all staterooms, T&S spaces, Ship's Office, Lounge, and Messroom. The doors to the ship's office and messroom / lounge shall have fixed lights. Main deck, messroom / lounge and stair tower doors shall have lever type handles.

**624c. Non-tight Doors**

[AMENDMENT 0001] Non-tight doors shall be in accordance with ASTM F1070. [AMENDMENT 0001] Non-tight doors shall be provided to enable interior access for Laboratories, Workshops, the Galley, the Laundry and the Bridge. In addition, non-tight doors shall be provided in passageways to separate laboratory spaces from other spaces and to separate accommodations spaces from public and working areas. Additional non-tight doors shall be provided as required to meet structural fire protection or other regulatory requirements. Fire screen doors shall have fire hose ports on bottom opening edge. All doors, except to secure spaces, staterooms, sanitary spaces, shall have fixed lights.

**624d. Hatches and Scuttles**

Watertight hatches and scuttles in walking and working areas shall be flush. Scuttles shall be quick acting. Hatches for personnel access shall be quick acting or provided with a scuttle. Each hatch shall be provided with a wrench or other tool for undogging the closure. The wrench shall be stowed adjacent to the hatch.

Hatches and scuttles shall be provided with a means of securing the closure in the fully open position. The securing device shall be located and designed to be accessible and operable in a seaway. Handgrabs shall be provided on hatches and scuttles to assist personnel in opening and closing the closure. Handgrabs installed on flush hatches and scuttles shall be hinged, and provided with a recess within the closure for stowage. All hatch and scuttle openings with coaming height less than 600 mm shall be fitted with portable guardrail stanchions and chains.

Flush weather deck hatches shall be provided with troughs and 25 mm diameter drains. The minimum number of drains is one for each 2500 mm (or fraction thereof) of trough length, plus at least one drain for every isolated deck recess or hinge pocket which is not completely drained by the hatch or scuttle trough. Panel edges, recessed hinges, troughs, and fittings for flush hatches and scuttles shall be fabricated of CRES 316. Drains shall be in accordance with Section 528.

Hatches and scuttles shall be provided where required to provide access and escapes.

**624e. Manholes**

Manholes shall be provided for access to all tanks, voids, and other spaces with no other openings, in locations and of the type that the spaces may require. Access may not be made through accommodation spaces. Manhole covers shall be watertight or oiltight, as required. Minimum clear opening shall be 380 mm by 584 mm.

Manholes and covers shall be in accordance with ASTM F1142. Studs shall be of CRES 300 and nuts of bronze. Gaskets for watertight covers shall be neoprene. Gaskets for oiltight covers shall be cork/rubber.

## *625 WINDOWS, FIXED PORTLIGHTS AND AIRPORTS*

### 625a. General

Airports, fixed portlights and windows shall be watertight. All glass shall be thermally tempered with a minimum thickness of 13 mm and shall be readily replaceable aboard ship. Fixed lights, airports, or windows shall be provided to each of the following spaces in which there is an exterior boundary:

a. Staterooms
b. Offices
c. Galley
d. Messroom / Lounge
e. Bridge
f. Charting Laboratory
g. ET Shop

There shall be one fixed light, airport, or window for each 3000 mm of exterior boundary length or portion thereof. The Bridge shall be provided with windows around the entire exterior boundary. Exterior doors and interior stair and passageway doors shall be provided with fixed lights or windows.

### 625b. Fixed Lights and Airports

Fixed lights in doors shall be 250 mm in diameter. Fixed lights elsewhere and airports shall be 400 mm in diameter. All shall be centered 1600 mm above the finished deck. All fixed lights and airports shall be fitted with dead lights.

Airports shall be provided for spaces located on the main deck and on forward facing bulkhead for spaces located above the main deck.

### 625c. Windows

Opening windows shall be weathertight. Opening windows shall be provided for spaces located on and above the 01 level, except for forward facing bulkheads.

### 625d. Bridge Windows

Windows on the Bridge shall be sloped outboard at the top. Bridge windows shall be equipped with roll-down tinted sunshades that secure at the bottom of the window.

Clearview screens shall be installed on the forward face of the Bridge as required for the applicable ABS Bridge design notation. Clearview screens shall be heated.

An electric, variable speed, window wiper with encased heating element shall be installed for each forward-facing window on the Bridge, except where clearview screens are provided.

In addition, each window not in way of direct exterior access for cleaning shall be provided with a window wiper.

Each window equipped with a window wiper shall be heated. Each window wiper shall be provided with a window washing system nozzle.

**625e. Aft Control Station Windows**

One aft window of the ACS shall provide the operator with a full view of the Aft Working Deck operations. The aft windows of the Aft Control Station Control Booth shall be sloped outboard 10 degrees at the top. Aft windows shall be heated and provided with a window wiper.

## *631 PAINTING*

**631a. General**

The Contractor shall prepare a paint schedule that identifies each surface of the ship, type of paint to be applied, mil thickness, and number of coats to be applied to the surface. All paint systems shall be selected for 30 month service periods and provided in accordance with the paint manufacturer's recommendations. Exterior colors shall be approved by the Government.

The entire ship, including, fittings, ventilation ducts, rails, stanchions, hatches, flagstaffs, masts, and light foundations, shall be painted. Painting of equipment not mentioned herein shall be as normally provided by the manufacturer for that equipment. All paint, except for the underwater body ablative coating system, shall be from a single manufacturer.

Finish painting of compartments before testing is prohibited.

For painting purposes, the painted waterline is defined as a line 300 mm above the full load displacement waterline of the ship over the entire waterline length.

The Contractor shall comply with the manufacturers' printed recommendations and instructions for all aspects of handling, mixing and application of the paint materials.

The following items may not be painted:

a. Cathodic protection anodes.
b. Heat exchange surfaces.
c. Gasket seats.
d. Lubricating fittings.
e. Nameplates, labels and signs.
f. Threads and working surfaces.
g. Rubber and other elastomers.
h. Discharge nozzles.
i. Decorative and finished parts of furnishings and equipment.
j. Isolation mounts.

**Surface Preparation.** - Before abrasive blasting, items or surfaces that may be damaged by abrasive contact or ingestion, or are not to be coated, shall be covered, masked or removed.

Coatings applied to prevent corrosion during material storage or ship construction shall be removed to bare metal unless they are compatible with the final system and are free of corrosion, peeling or other contaminants detrimental to the life or appearance of the final system.

Coatings that are compatible with the final system and are free of corrosion, peeling or other contaminants detrimental to the life or appearance of the final system, either temporary or permanent, shall be applied to prevent corrosion during material stowage and ship construction, including tanks not required to be painted. Coatings containing zinc shall be removed from the underwater body of the hull, and fuel and potable water tank interiors.

Where aluminum will be joined with other metals, including galvanized steel, or wood, the aluminum surface shall be protected by two coats of epoxy primer. Wood in contact with aluminum shall be given one coat of phenolic varnish.

After assembly, joints of dissimilar metals exposed to the weather, seawater, or in wet spaces shall be sealed with caulking compound to prevent the entrance of moisture or water. Crevices shall be sealed with caulking compound. Absorbent material may not be used in contact with aluminum. Threaded parts in aluminum shall be coated before assembly with an anti-seize compound.

Unless otherwise specified, all steel surfaces shall be prepared by sandblasting to a "near white" surface in accordance with SSPC-SP 10-85.

Surfaces to be painted shall have the specified surface preparation at the time of application of the paint. If the surface is degraded or contaminated after surface preparation and before painting, the surface shall be restored before paint application.

To prevent degradation or contamination of the prepared surfaces, the first coat of paint shall be applied as soon as possible after the surfaces have been prepared. The first coat shall always be applied the same day as surface preparation is completed. Succeeding coats shall be applied before contamination of the under surface occurs.

After surface preparation, surfaces shall be brushed with clean brushes, blown off with compressed air, or cleaned by vacuum to remove all traces of blast products and dust.

**Application.** - Application methods, coat thicknesses and equipment used for application shall be as recommended by the coating manufacturer's representatives. Acceptance of the surface preparation by the paint manufacturer’s representative is required before application of coating systems.

**631b. Underwater Body Ablative Coating System**

[AMENDMENT 0001] For steel hulls, the ablative anti-foulant coating system shall be a copper-based tributyltin-free system.

For aluminum hulls, the composition of the coating system is to be compatible with aluminum. Coatings containing copper, lead, mercury or other metals that can induce galvanic or other forms of corrosion, are not to be used.

In either case, the coating system is to be selected and installed in strict accordance with manufacturer’s recommendations, for a 30 month service period. [AMENDMENT 0001]

The underwater body is defined as the entire underwater hull plating and all appendages up to the upper boot-topping limit. The underwater ablative paint system may not be applied to sonar transducers or other underwater scientific and navigation sensors.

**631c. Topside Primer**

The coating system primer used on all exterior steel surfaces and appendages shall be an organic, zinc-rich epoxy paint. The primer shall extend from 100 mm below the full load displacement waterline to the top of the mast.

**631d. Non-Skid Deck Coating**

All exterior decks and walking surfaces shall have a non-skid topcoat surface.

## *633 CATHODIC PROTECTION*

[AMENDMENT 0001] For steel hulls, a zinc anode cathodic protection system shall be installed to protect the underwater hull, appendages, sea chests, and other external seawater exposed components. For steel hulls, [AMENDMENT 0001] Selection and location of anodes shall be in accordance with the manufacturers recommendations for a minimum service life of 30 months between drydockings.

Anodes shall be bolted and permit replacement by divers. Anodes shall be installed, long axis fore-and-aft, and butted end-to-end in locations where more than one anode is installed.

Anodes shall be provided on the exterior hull in areas where the anodes will be continuously submerged under normal operating conditions. Anodes shall be located in areas most protected against physical damage from anchor rode, bottom scraping, and mooring bumpers, among others.

Anodes near transducers shall be located aft of these items in a position not to disturb the flow.

## *634 DECK COVERING*

**634a. General**

Deck coverings shall not be installed under furniture and under equipment with enclosed foundations.

Deck coverings shall be installed to allow for proper deck drainage. Adjustment of deck covering thickness or underlay shall be used to slope the deck for drainage in built in shower stalls, within coamings, and in the immediate vicinity of drains. Underlay shall be used to smooth over deck welds to prevent wear spots. Lightweight underlay such as **Cufadan** is permitted, provided all applicable regulatory and contract requirements are satisfied.

Decks in spaces for which deck coverings are not otherwise required shall be painted.

Deck coverings shall be protected to prevent wear or indentation before ship delivery.

**634b. Terrazzo Deck Covering**

Epoxy based terrazzo deck covering such as **Selby Battersby Selbalux** shall be installed in the following spaces:

a. food preparation areas

b. laundry

c. built in sanitary spaces

A 150 mm CRES cove, made watertight by continuous weld, shall be provided where terrazzo is installed.

**634c. Vinyl Composition Deck Covering**

Vinyl composition deck covering such as **Armstrong Standard Excelon** shall be provided in the following spaces:

a. Messroom

b. passages

c. Bridge

d. Ship's Office

A 100 mm cove shall be provided where vinyl deck covering is installed.

**634d. Carpeting**

One hundred percent wool, single level, loop woven through the back carpeting shall be provided in the following spaces:

a. Staterooms

b. Ship's Office

**634e. Safety Treads**

Safety treads shall be of the fiberglass reinforced type, weather resistant with a non-skid surface. Treads shall be adhered to bare metal by applying an epoxy adhesive to all faying surfaces.

Treads shall be provided at the head and foot of all inclined ladders and stairs, on each step on inclined ladders and stairs, on each side of weather doors, and on each side of doors with sills higher than 100 mm. Treads on ladders and stairs shall approximately cover the entire area of each step. All other treads shall be 150 mm by 600 mm.

**634f. Electric Grade Flooring**

Electric grade smooth flooring shall be permanently installed in the front and rear of all switchboards, control consoles, control boards, and on deck areas on which personnel stand when servicing electrical equipment where shock hazards may exist. Electric grade flooring shall also be provided in the following spaces:

a. Charting Laboratory

b. ET Shop

c. Radio/Chart Area of the Bridge

## *635 THERMAL, ACOUSTIC ABSORPTIVE AND FIRE PROTECTION INSULATION TREATMENT OF COMPARTMENTS*

**635a. General**

The surfaces to which insulating material is applied shall be cleaned and given a protective coating as required in Section 631. Insulating materials shall be installed to prevent them from coming adrift under the ship's movement and vibrations. Installation may be by weld studs with clips or by adhesives. Abutting edges of insulation shall be sealed with adhesive, and the seams shall be covered with 50mm wide tape in accordance with the manufacturer's recommendations. Free edges of insulation shall be sealed with adhesives and covered with tape in accordance with the manufacturer's recommendations.

**635b. Thermal Insulation**

Except where required herein, insulation U-factors (heat transmission factors), thickness and application of insulation shall be in accordance with SNAME Technical and Research Bulletin No. 4-7. Advanced lightweight insulating materials may be used. When such advanced insulating materials are used, U-factors, thickness and application shall be in accordance with the manufacturer's recommendations.

Boundary thermal insulation shall be board or blanket. Thermal insulation shall have a thermal conductivity 'k' of no greater than 0.043 at a mean temperature of 24$^{o}$C.

Where both thermal and acoustic insulation are required, 25mm thick thermal insulation with vapor sealing shall be installed under the acoustic insulation, except that the thermal insulation need not be installed provided condensation will not occur under the acoustic insulation, and the U-factor of the acoustic insulation alone is not greater than that afforded by thermal insulation.

Except where joiner bulkheads form the boundary, all boundaries between air-conditioned and non-air-conditioned areas shall be thermally insulated. [AMENDMENT 0001] Where structural bulkheads with joiner lining form the boundary, a minimum insulation thickness of 25 mm shall be provided. [AMENDMENT 0001] Decks between air-conditioned and non-air-conditioned spaces shall be provided with a minimum insulation thickness of 25 mm on plane surfaces and around webs and flanges of structural members. Insulation on weather boundaries shall extend at least 300 mm beyond exposed surfaces.

**635c. Acoustic Insulation**

Acoustic insulation shall be as required by the analyses developed for Section 073.

**635d. Antisweat Protection**

Antisweat treatment shall be applied on the warm side of uninsulated boundaries, including webs and flanges of beams and stiffeners.

Anti-sweat treatment shall be provided on all decks and bulkheads forming boundaries between heated spaces and either tanks or the exterior. Anti-sweat treatment need not be applied on bulkheads or decks that are insulated or sheathed.

**635e. Vapor Barriers**

Vapor barriers shall be applied to insulation located within the Laundry and Galley, and to the insulation on the warm side of refrigerated stores spaces.

## *637 SHEATHING*

**637a. General**

Access panels shall be provided in sheathing for maintenance and inspection.

**637b. Sanitary Sheathing**

Sanitary bulkhead and overhead sheathing shall be installed in the Galley and the Trash Compactor Room. Sanitary sheathing shall be CRES 304, satin finish, USSG 16 for the bulkheads, and USSG 20 for the overhead.

**637c. Sheathing**

Protective sheathing shall extend 1500 mm above the finished deck. Protective sheathing shall be installed over insulation wherever it may be subject to damage by personnel, material handling or storage and is not otherwise protected by the installation of linings, sanitary sheathing or perforated sheathing.

Perforated aluminum sheathing shall be of nominal 3 mm thickness with 5 mm holes on 9 mm staggered centers and shall extend a minimum of 1200 mm above the deck, floorplates, or grating. Perforated aluminum sheathing shall be installed over acoustic treatment in machinery spaces and workshops.

## *640 REQUIREMENTS FOR LIVING SPACES*

**640a. General**

Means shall be provided to secure freestanding furnishings to the deck or bulkhead. Fixed furniture and furnishings shall be installed level to the baseline. Inaccessible spaces in way of furniture shall be flashed. Portlights or windows in accommodation spaces shall be fitted with curtains.

**640b. Berths**

Two high berths shall be provided in all double staterooms. Berths shall be a minimum of 990 mm wide and shall be provided with inner spring mattresses. There shall be a minimum of 900 mm clearance above the mattresses. Privacy curtains shall be provided for each berth in two berth staterooms. Berths may not be obstructed by pipes, ducts, or other obstructions. Berths shall be fitted with reading lamps and utility shelves positioned so as not to interfere with occupying the berth.

**640c. Double Staterooms**

Double staterooms shall be furnished in accordance with Table 640-1. Stowage for other Regulatory body required equipment shall be provided.

**Table 640-1. Double Stateroom Furnishings**

| Qty | Item | Type | Remarks |
|---|---|---|---|
| 1 | Berth | Double, Two High, with drawers under | |
| 2 | Desk | Flat top, single pedestal with drawers | |
| 2 | Desk lamp | | |
| 2 | Side chair | | |
| 2 | Clothes locker | With shelves and hanging section | |
| 1 | Chest of drawers | 6 drawer keyed in groups of three with 2 different key sets | |
| 1 | Waste basket | | |
| 2 | Book rack | | |
| 4 | Coat and hat hook | | |
| 2 | Life jacket, EEBD and survival suit stowage | | |

## *644 SANITARY SPACES, AND FIXTURES*

### 644a. General

Plumbing fixtures and fittings shall be provided in accordance with Table 644-1.

### 644b. Built-in Toilet and Shower (T/S) Spaces.

Lavatories shall be vitreous china. Shower stall enclosures shall be at least 750 mm by 750 mm inside dimensions, and provided with a sill. Showerheads shall be installed so that the minimum distance between the finished deck and the shower head is at least 1850 mm. Shower control valves shall include constant temperature regulator and flow regulator. Showerheads shall be fitted with restricting devices which limit the flow of water to 0.15 L/sec at 275 kPa. One handgrab shall be provided for each shower and one for each toilet.

Toilets shall be commercial quality vacuum flush vitreous china jet elongated rim type and installed complete with bulkhead mounted hand operated flush valve and solid plastic open front seat with cover and self-sustaining hinge.

### 644c. Prefabricated Toilet and Shower Enclosures.

Prefabricated toilet and shower enclosures shall be provided with plumbing fixtures and fittings of equal quality and function as those required in Table 644-1.

**644d. Service Sinks.**

Service Sinks shall be made of 14 gauge CRES, type 304, No. 4 finish.

**644e. Emergency Safety Equipment.**

Portable eye/face wash fountains shall be provided in machinery spaces, the Service Area, the workshops and the battery charging area and as required by regulatory bodies.

**644f. Drinking Water Fountains.**

Drinking water fountains, such as **Halsey Taylor Model S1000-10D**, shall be provided, and located as follows: one in the Pilot House, one in the passage near the Messroom area, and one aft near the aft working deck.

**Table 644-1. Plumbing Fixtures and Accessories**

| Item | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Lavatory, 15x18 inches | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| Shower | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Toilet | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Cabinet, toilet w/mirror, light and outlet | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Dispenser, paper towel | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| Receptacle, surface mounted | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Dispenser, handcleaner, liquid | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| Soap dish for lavatory | 0 | 2 | 1 | 0 | 0 | 1 | 0 |
| Soap dish for shower | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tumbler and toothbrush holder | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Towel bar | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| Handgrab, 24 inches | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| Hook, robe | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Toilet paper holder | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Dispenser, soap, powder | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Service Sink | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| Light, mirror with receptacle | 0 | 0 | 1 | 0 | 1 | 0 | 0 |

LEGEND:

1. Shared T/S
5. Workshop(s) and Service Area

2. Stateroom
3. Public Toilet
4. Cleaning Gear locker
6. Sewage Treatment Room
7. Galley

## *651 FOOD SERVICE SPACES*

### 651a. General

The galley shall be furnished and equipped to provide cafeteria style food service to the ships complement. All equipment shall be of good commercial design modified as needed to suit shipboard conditions.

Cabinets, dressers, counters, shelves and stowage racks shall be provided. The number and type shall be adequate to provide proper food preparation and clean-up areas as well as stowage for all portable equipment, including china, silverware, utensils, trays, spare parts, etc.

The Galley shall be provided with the equipment listed in Table 651-1 as a minimum, and shall provide cafeteria-style service.

The Galley and Mess/Lounge shall be located on the same deck, and shall be arranged to provide an orderly traffic pattern for fast and efficient service.

The Galley shall be provided with a serving window and soiled dish window. Serving and soiled dish windows shall be provided with a roller curtain capable of being closed and secured from inside the Galley. Passages may be used for queues.

Stowage shall be provided in food service spaces for portable equipment and serving supplies, including china, glassware, utensils, trays, linen and condiments.

Deck mounted equipment and dressers shall be installed on 150 mm legs and equipment mounted on dresser tops shall be provided with legs 100 mm high.

Dresser tops and built-in sinks shall be CRES, finish No. 4, with a minimum thickness of 1.9 mm. Cabinets located above dressers shall be located with a clear working surface under the cabinet. Sinks, as specified in Table 651-1, shall be welded into the dresser tops and welds ground flush.

The Mess/Lounge shall be provided with the equipment listed in Table 651-2. Cabinets, dressers, counters, shelves and stowage racks shall be provided as required. The Mess/Lounge shall be provided with either:

a. Booths, and booth tables, and/or,

b. Tables and chairs.

The tables or booths shall provide a total seating capacity for at least 0.75 of the ship's complement, with no more than 8 seats provided in booths. Within the Mess/Lounge, mess aisles shall be 750 mm wide or greater.

The Dry Provisions Storeroom shall be provided with the equipment required in Table 651-3.

### 651b. Materials and Workmanship

All surfaces which may come in contact with food and drink shall be CRES 304, Finish No. 4. All welding shall be flush, ground smooth and polished on exposed surfaces. No solder or rivets shall be used. Sinks shall be CRES 304, USSG 14, No. 4 Finish.

**651c. Equipment**

The galley shall be fully equipped to provide food service to the ship's complement. Marine grade galley equipment shall be provided, in sizes and quantities to allow meal service to the entire ships' complement within 90 minutes. As a minimum, equipment in accordance with Tables 651-1, 651-2, and 651-3 shall be provided.

**Table 651-1. Galley Equipment**

| Item | Description | Type | Quantity |
|---|---|---|---|
| 1 | Refrigerator under counter | Such as Cospolich | 1 |
| 2 | Convection oven with griddle | Such as Hobart | 1 |
| 3 | Convection oven-range, with legs | Such as Hobart | 1 |
| 4 | Double sink, vegetable preparation, 350 mm x 450 mm x 300 mm deep | Fabricate | 1 |
| 5 | Toaster, 4 slice | Such as Hobart | 1 |
| 6 | Oven, microwave | 1500 w – variable power and time | 1 |
| 7 | Ventilation grease interceptor hood (over range, griddle, kettle and deep fat fryer) with Fire Suppression System and Hood Washdown System | Such as Gaylord, self cleaning | As Required |
| 8 | Dishwasher, with side panels | Such as Jackson | 1 |
| 9 | Sink, pot wash, 600 mm x 600 mm x 300 mm deep | Fabricate | 1 |
| 10 | Garbage grinder, with control panel | Such as Hobart, | 1 |

**Table 651-2. Messroom / Lounge Equipment**

| Item | Description | Type | Quantity |
|---|---|---|---|
| 1 | Microwave oven | 1500 w – variable power and time | 1 |
| 2 | Coffee maker | Such as Bunn-O-matic, Model T-35 with pot racks | 1 |
| 3 | Dispenser, ice maker | Such as Crystal Tips | 1 |
| 4 | Refrigerator with Freezer compartment | Such as Cospolich | 1 |
| 5 | Entertainment console | See Note 1 | 1 |
| 6 | Hat/Coat rack | Such as Hopeman Brothers, Inc. | 1 |
| 7 | Magazine rack | | 1 |
| 8 | Dispensary Cabinet | Lockable cabinet | 1 |

NOTE:

1. Sized for mounting the entertainment equipment required in Section 430, and shall include integral speakers and stowage for 0.6 $m^3$ of tapes and cassettes.

**Table 651-3. Provisions Storeroom**

| Item | Description | Type | Quantity |
|---|---|---|---|
| 1 | Refrigerator | Such as Cospolich | As required |
| 2 | Freezer | Such as Cospolich | As required |
| 3 | Dry | In accordance with Section 672 | As required |

## *652 MEDICAL FACILITIES*

A stokes litter and a first aid box, such as Hopeman Brothers, Inc. FCM-40-02, shall be provided and stowed in a passageway.

## *655 LAUNDRY*

All laundry equipment shall be good commercial quality, suited for marine service. Equipment shall be provided in sizes and quantities to allow complete weekly laundry service for the ships' complement. As a minimum, the laundries shall be outfitted in accordance with Table 655-1.

**Table 655-1. Laundry Equipment**

| Qty | Item | Type | Remarks |
|---|---|---|---|
| 2 | Washer / Dryer | Combination Units | |
| 1 | Ironing Board | 1350 mm x 400 mm | with padded top |
| 1 | Iron | | |
| 1 | Stowage cabinet | | |
| 1 | Jackrod | | 2000 mm linear measure |
| 1 | Service sink | | |
| 1 | Waste Basket | | |

## *656 TRASH COMPACTOR ROOM*

A Trash Compactor Room shall be provided, and shall include the following:

a. Trash compactor in accordance with Section 593.

b. Locker, such as Hopeman Brothers Inc. FMM-01-99, bulkhead mounted, 760 mm by 760 mm by 405 mm.

c. Stowage for duration of maximum cruise for compacted trash based on the following trash generation rates:

1. plastics 0.10 kg/person/day
2. paper 0.51 kg/person/day
3. glass and metal 0.25 kg/person/day

d. Bulkhead securing eyes for stowage for four trash cans.

e. Four plastic trash cans, 120 liter capacity each.

The Trash Compactor Room shall be located adjacent to the aft working deck and shall not be contiguous with living and messing areas.

Compacted trash stowage shall consist of full height vertical shifting tubes with deck and overhead sockets and gratings. Fixed vertical battens shall be provided along the enclosed perimeter of the stowage area.

## *661 OFFICES*

### 661a. Ship's Office

The Ship's Office shall be outfitted in accordance with Table 661-1.

The safe shall be mounted to prohibit tampering or ready removal.

**Table 661-1. Office Furniture**

| Quantity | Description | Type |
|---|---|---|
| 2 | Desk, single pedestal with pullout for keyboard | Such as Hopeman Brothers Inc. |
| 1 | Shelf, bulkhead mounted, for computer monitor | |
| 1 | Safe, floor, with combination lock | Such as Hopeman Brothers Inc. |
| 2 | Chair, swivel, arm with casters | Such as Hopeman Brothers Inc. |
| 4 | Cabinet, file, legal size | Such as Hopeman Brothers Inc. |
| 1 | Locker, key | Sized for the number of keys provided |
| 1 | Storage cabinet with minimum 1.4 $m^2$ deck area | Such as Hopeman Brothers Inc. |
| 2 | Bookrack, double w/light under | Such as Hopeman Brothers Inc. |
| 1 | Tackboard | Such as Hopeman Brothers Inc. |
| 2 | Desk lamp | Such as Hopeman Brothers Inc. |

## *662 CENTRALIZED CONTROL AND MONITORING STATION FURNISHINGS*

### 662a. Centralized Control and Monitoring Station

If a separate space is provided, the Centralized Control and Monitoring Station shall be furnished in accordance with Table 662-1.

**Table 662-1. Centralized Control and Monitoring Station Furnishings**

| Qty | Item | Type | Remarks |
|---|---|---|---|
| 1 | Computer Workstation | 1050 mm wide x 750 mm deep | With adjustable keyboard mount, shelf, and drawer unit |
| 1 | Swivel Arm Chair | | |
| 2 | Side Chair | | |
| 1 | File Cabinet | Four drawer legal size | With lock |
| 1 | Bookcase | Two shelf, 1200 mm long | |
| 1 | Cork Bulletin Board | Aluminum frame 1200 mm x 900 mm | |
| 1 | Markerboard | 1050 mm x 1500 mm | |
| 1 | Waste Basket | | |

## *663 BRIDGE AND RADIO/CHART AREA FURNISHINGS*

### 663a. Bridge Furnishings

In addition to the racks, shelves and cabinets required to house electronics, navigation and control equipment, the Bridge shall be provided with the furnishings listed in Table 663-1.

**Table 663-1. Bridge Furnishings**

| Qty | Item | Type | Remarks |
|---|---|---|---|
| 4 | Bookrack | 1200 mm length each | |
| 2 | Ship Status Board | 1800 mm x 1000 mm | |
| 1 | Pilot Chair | | |
| 1 | Flag Stowage Locker | | |
| 2 | Desk Lamp | | With red filter |
| 1 | Stool, with back | | |
| 1 | Chart Table | 2290 mm x 1120 mm with six drawers | With chronometer stowage |
| 2 | File Cabinet | Two drawer, legal size | With lock |
| 1 | Waste Basket | | |

## *664 DAMAGE CONTROL LOCKERS*

Two Damage Control Lockers shall be provided on the main deck (one forward and one aft). The Damage Control Lockers shall be provided with the outfitting as required by regulatory bodies. Stowage racks, bins, stowage clips and brackets shall be provided to efficiently stow the damage control equipment items listed in Table 664-1 as well as any additional regulatory required items. Bins shall be provided with adjustable shelves to accommodate various sized components. Equipment storage locations shall be labeled.

Both sides of the Damage Control Locker doors shall be stenciled in 75 mm high red letters "DAMAGE CONTROL LOCKER". A checklist identifying all damage control equipment shall be mounted in each Damage Control Locker. An additional 25 percent of unassigned bins and rack storage area shall be provided in each DC locker.

**Table 664-1. Damage Control Locker Outfitting**

| Qty | Item | Type | Remarks |
|---|---|---|---|
| 2 | Fireman's Suit | Waterproof/Heat Resistant | |
| 2 | Sets of Boots & Gloves | Rubber or other electrically non-conductive material | |
| 2 | Rigid Protective Helmet | | |
| 2 | Self Contained Breathing Apparatus (SCBA) | with 30 minutes air | |
| 2 | Spare Air Cylinders | for SCBA | |
| 2 | Fireproof Lifeline | | |
| 2 | Flashlights | Type II or III | With spare batteries |
| 6 | B-II CO2 Fire Extinguisher | | Spares |
| 2 | B-II Dry Chemical Fire Extinguisher | | Spares |
| 2 | Fire Hose | | Spare |
| 1 | Grounding Wand | FSN 1H-5920-01-029-4176 | |
| 4 | Metal Patches | | Various Sizes |
| 4 | Damage Control Shoring | | Various Sizes |
| 1 | Portable Electric Fire & Dewatering Pump | | |

## *665 WORKSHOPS*

### 665a. General

A General Workshop shall be provided and shall include the equipment listed in Table 665-1.

A workbench with a purifier cleaning sink shall be provided near the purifiers. The sink shall drain to the oily water separator system. The sink shall be CRES, approximately 500 mm by 610 mm by 450 mm deep and shall be welded in the workbench. A vise shall be installed on the bench.

The location of equipment shall provide an efficient working arrangement. Workbenches, lockers, and other tall equipment shall be fastened securely to bulkheads or other structure or otherwise stiffened to provide lateral stability.

**Table 665-1. General Workshop Outfitting**

| Quantity | Description |
|---|---|
| 1 | Grinder, 250 mm, pedestal |
| 1 | Drill press, 500 mm stand with titling table |
| 1 | Service sink |
| 1 | Vise, 6 inch, combination, bench and pipe, bench mount |
| 1 | Workbench, metal, 2000 mm x 700 mm |
| 1 | Cabinet, modular drawer |
| 1 | Stool, general purpose, with back and foot rest |
| 1 | Lathe, 325 mm, geared head, 650 mm between centers |
| 1 | Workbench, electrical/electronics, 2000 mm x 700 mm, with two cabinets under |
| 1 | Press, arbor, hand-operated, 12 tons |
| 1 | Milling machine, bench mount |
| 1 | Locker, tool stowage |
| 1 | Eye/Face Wash Fountain |
| 1 | Rack, stowage, bar and pipe, 2.5 m by 0.3 m, 2 m high |

**665b. Electronic Technician's Workshop**

The ET Shop shall be equipped in accordance with Table 665-2. The electrical workbench shall be faced with non-conductive material, shall have a soldering station with vent to atmosphere and remote mounted power shut-off.

**Table 665-2. ET Shop Equipment**

| Qty | Item | Type | Remarks |
|---|---|---|---|
| 1 | Workbench, Electronics | 2000 mm x 700 mm, with two modular drawer units under | Lock-in/lock-out drawers |
| 2 | Cabinet | Modular Drawer, locking | 1500 mm height, with lock-in/lock-out drawers of various heights |
| 1 | Desk | single pedestal with drawers | Such as Hopeman Brothers Inc., FDC-03-01 |

## *670 STOWAGE REQUIREMENTS*

### 670a. General

Stowage aids shall be provided for portable articles, repair parts, food service equipment and similar items as required herein. Stowage aids shall be designed and installed to retain the stowed material without damage under the maximum dynamic conditions of roll, pitch, list, and trim. Bin, rack, and shelving compartments, with vertical compartment clear openings of 125 mm or more, shall be provided with removable horizontal battens. Front flanges of lower shelves of bins, racks and shelving shall be stiffened, as necessary, to prevent damage from persons climbing to upper bins or shelves. Stops shall be provided on backs of shelving and bins.

Modular drawer type stowage, with lock-in/lock-out drawers, shall be used where practicable.

## *671 SPECIAL STOWAGE*

**Sewage Treatment Locker.** - A locker shall be provided for stowage of supplies for sewage treatment.

**Boat Gear Locker.** – The boat gear locker shall be provided with shelves, pipe, jackrods and clips.

**Cleaning Gear Locker.** - Cleaning Gear Lockers shall be provided with a service sink, louvered door, shelving, and swab and broom rack. One locker shall be provided on each deck with habitability spaces.

**Linen Locker.** – A Linen Locker shall be provided on each deck with staterooms, each with three courses of 1000 mm deep shelving.

**Gun Locker.** - A Small Arms Locker shall be provided in the Commanding Officer's stateroom. The locker shall be built of 14 gage steel and shall be welded to the deck or bulkhead. The locker shall meet or exceed GSA requirements for security containers.

**Paint Locker.** - A paint locker with a 1.4 $m^2$ deck area shall be provided, collocated with the Bosun's Stores. Metal shelving and all required fire suppression and ventilation systems shall be provided.

**Deck Gear Lockers.** - Two deck gear lockers shall be provided, one forward and one aft, with a minimum area of 4.4 $m^2$ each. Stowage bins and racks shall be provided. Swab and broom racks shall be installed.

## *672 STOREROOMS*

Storerooms or portions thereof designated for bulk stowage shall be fitted with fixed battens adjacent to structural boundaries and with removable stowage stanchions. The ends of the stanchions shall be compatible with fittings on the deck and overhead. Fixed battens shall be fitted on shell plating, framing or structural bulkheads in bulk stores area, and shall prevent stores from contacting surfaces on which condensation is likely to occur. Installation of fixed battens shall permit circulation of air and protect insulation, piping and wire cables from being damaged by stores. Remote operating mechanisms shall be protected from stores interfering with their operation. The ends of the battens shall be closed.

**Dry Provisions Stores.** - The Dry Stores shall be provided with storage bins, 600 mm deep by 2000 mm high, with six shelves and vertical supports drilled on 75 mm centers so shelves may be adjusted vertically.

**Bosun's Stores.** - Shelves, pipe, jackrods, portable metal battens and hooks for blocks and tackle shall be provided in the Bosun's Stores. Line stowage shall be provided below the weather deck, fore and aft.

**Engineer's Stores.** - The Engineer's Storeroom shall be provided with shelves, pipe, jackrods, portable metal battens and hooks. Modular drawer-type stowage shall be used where practicable. A separate locker shall be provided for high value stores.

## *691 MISSION SPACE OUTFITTING AND MISCELLANEOUS EQUIPMENT*

### 691a. General

The location of equipment shall provide an efficient working arrangement. Workbenches, lockers, and other tall equipment shall be fastened to bulkheads or other structure or otherwise stiffened to provide lateral stability. Electronic equipment racks shall be securely mounted top and bottom using shock mount hardware. Shock mounts shall be sized for the weight of the rack plus approximately 200 kg of installed equipment.

Heavy duty steel **Unistrut** sections shall be provided on bulkheads and overheads for the support of benches, cabinets, shelves, instruments, and other equipment. Bulkhead Unistrut sections must be mounted at UNOLS standard grid intervals (approximately 600 mm spacing) to conform to the bolt grid required in Section 100e. These Unistrut sections shall be anchored to the deck and secured and braced to the overhead structure. Overhead Unistrut sections must be installed in line with the deck bolt grid pattern. Unistrut sections in the Service Area shall be CRES.

### 691b. Charting Laboratory

The Charting Laboratory outfitting and miscellaneous equipment shall be provided in accordance with Table 691-1. Foundations for racks, to house electronic equipment, shall be provided. Bulkhead mounted cabinets in the Charting Laboratory shall be mounted on the Unistrut system and shall be capable of being removed from the space through doors. Contractor provided cables into the space shall be located in overheads above foundations.

**Table 691-1. Charting Laboratory Outfit**

| Quantity | Description | Type |
|---|---|---|
| 4 | Computer work station | Such as Hopeman Brothers Inc., or Unistrut Components |
| 2 | Bookcase | Such as Hopeman Brothers Inc., FCC-09-02 |
| 4 | Lamp, desk, with red light | Such as PAULUHN FE21516RV |
| 2 | Cabinet, stowage approximately 900 mm wide | Such as Hopeman Brothers Inc., FMM-01-10 |
| 4 | Swivel chair, arm w/casters (chocking), ergonomic | Such as Hopeman Brothers Inc., FSA-16-039 |
| 5 | File cabinet, legal, 3 drawer | Such as Hopeman Brothers Inc., FCM-23-06 |

### 691c. Service Area

The Service Area shall be capable of stowing and performing maintenance on the HSHR and CTD units, and provide stowage for the velocimeter, bottom grab sampler, foul weather gear and A-frame metered sheaves.

The Service Area furnishings shall be provided in accordance with Table 691-2.

**Table 691-2. Service Area Furnishings**

| Quantity | Description | Type |
|---|---|---|
| 1 | Workbench | Such as Equipto Model 255U6 |
| As reqd | Shelving | |
| As reqd | B - Bins, 610 mm x 610 mm | Such as Hopeman Brothers Inc. |
| As reqd | K - Rack, 910 mm x 910 mm | Such as Hopeman Brothers Inc. |
| As reqd | Stowage system for bulk storage | Unistrut |
| 1 | Bench | Suitable for seating and outfitting two divers |
| 10 | Hooks for foul weather gear | |

**Stowage Aids**. - Unistrut sections, or equal, shall be provided on bulkheads above counters for the support of cabinetry, shelving and instruments in the Service Area. Unistrut sections shall be mounted vertically at UNOLS standard intervals (approximately 600 mm spacing).

### 691d. Dive Locker

The Dive Locker shall be located in a lockable expanded metal cage in the Service Area. The Dive locker shall be provided with hanging stowage for 4 dry suits and 10 sets of foul weather gear, a bulkhead mounted 400 mm diameter oscillating fan, and a CRES dive gear storage cabinet.

The Dive Locker shall be provided with a SCUBA bottle rack for horizontal stowage of twelve 2.27 $m^3$ (80 $ft^3$) SCUBA bottles. The dive compressor shall be in accordance with Section 551.

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