



296 PASSENGER/VEHICLE FERRY

Technical Specifications

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Revisions

REV	DESCRIPTION	DATE	APPROVED
-	Initial Issue	7/6/26	MEJ 49387
A	Added allowance for alternative switchboard and generator arrangements in Sections 310 and 324.2	7/17/26	MEJ 49387

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Group 000 – Requirements for Design and Construction

010 Intent

It is the intent of these Specifications and the accompanying Contract Plans to describe the construction of a passenger and automobile ferry to be built for the Beaver Island Transportation Authority (BITA). The Vessel is to be complete in all respects, fully equipped and fitted out in accordance with these Specifications, and complying with all applicable requirements of the U.S. Coast Guard (USCG). It is not the intent of these Specifications and the accompanying plans to cover every minor detail of construction and equipment. Therefore, any material or parts, the omission of which would be detrimental to the seaworthiness or serviceability of the Vessel and the inclusion of which is generally accepted good shipbuilding practice, shall be provided by the Contractor to the satisfaction of BITA's Representative and without increase in cost to BITA. The requirements of these Specifications shall apply to each and every Vessel to be constructed by the Contractor.

011 Principal Characteristics and General Description

The Vessel shall be a single-ended, steel-hulled, automobile and passenger ferry, outfitted for service between Charlevoix, MI and Beaver Island, MI. The Vessel shall be compatible with existing terminal facilities at those locations. The Vessel shall be capable of transporting 296 passengers and 24 standard vehicles. It shall also be capable of transporting two tractor trailer trucks (maximum length 65') and 17 standard vehicles.

The hull of the Vessel shall be welded steel construction using the transverse system of framing. There are six transverse watertight bulkheads including the collision bulkhead at Frame 3. The Vessel superstructure Upper Deck and below shall be welded steel construction. The superstructure above the Upper Deck shall be welded aluminum construction. The Engine Room is located amidship between bulkheads at Frames 21 and 31. Propulsion will be provided by two diesel engines rated at 1341 BHP per engine. Drive will be through reversing reduction gears and fixed-pitch propellers. Electric power requirements will be met by two diesel driven generators.

The principal characteristics of the Vessel are given in Table 1.



Table 1: Principal Characteristics

Characteristic	Value
USCG Certification	46 CFR Subchapter K
Service Restriction	Great Lakes
Gross Tonnage	<100 GRT
Length Overall	150'-0"
Length on Waterline	134'-0"
Molded Beam	47'-0"
Depth at Main Deck Side at Amidships	16'-0"
Draft at Design Waterline (DWL)	10'-0"
Lightship Weight, Estimated	758.5 LT
Design Displacement, Estimated	900.9 LT
Vehicle Capacity	24 Cars or 17 Cars and Two Trucks
Maximum Vehicle Load	106 LT
Maximum Passenger Capacity	296
Service Speed	14 knots

012 Definitions

Owner, Owner's Representative, or BITA	Where the term "Owner," "Owner's Representative," or "BITA" is used in this Specification, they refer to the Beaver Island Transportation Authority or its authorized representatives, who shall have exclusive authority to approve purchases, work performed, changes, substitutions, etc.
Contractor or Shipyard	Where the terms "Contractor" or "Shipyard" appear in this Specification and Contract Plans, such terms refer to the individual, firm, or corporation undertaking the execution of the work under the terms of the Contract.
Contract	The document which binds the Contractor with the Owner for the construction and delivery of the Vessel.
Specification	This document.
Contract Plans	Contract Plans include Contract Drawings, Contract Guidance Drawings, and Supporting Documents as further defined and delineated in Section 030.
Functional Design	Developed by the Contractor and the Contractor's subcontractors for submittal to USCG Marine Safety Center (MSC) for approval; based on this Specification and Contract Plans and Supporting Calculations.
Detail Design	Developed by the Contractor for purpose of construction, to include shop drawings and other working drawings that are derived from USCG-approved Functional Design.



Naval Architect	Where the term "Naval Architect" appears in this Specification, this term refers to Elliott Bay Design Group LLC (EBDG), Naval Architects and Marine Engineers, Seattle, WA.
Regulatory Body, Regulatory Bodies	These terms refer to the appropriate cognizant national and international maritime authorities, which have rules and regulations that apply to this Vessel, including but not limited to USCG and other applicable local, state, and federal agencies.
USCG	United States Coast Guard

030 Contract Plans

This Specification and the Contract Plans referenced herein form a part of the complete Contract Documents for construction of the Vessel. In case of any conflict, difference, discrepancy, or ambiguity between documents or other information contained in this Specification, the order of precedence shall be:

1. Contract Agreement
2. Technical Specifications
3. Contract Drawings
4. Contract Guidance Drawings

These Contract Documents are complementary, and the content of any of those documents is deemed to be included in the applicable portions of the others. If information is shown in one of the Contract Documents but not in another, it shall be deemed to be equally present in all.

In case of conflict, difference, discrepancy, or ambiguity between this Specification and the Contract Plans, the Contractor shall call that conflict, difference, discrepancy, or ambiguity to the attention of the Owner as soon after its discovery as feasible. The Contract Plans are intended to supplement each other. Items contained in one, but omitted from the other, are intended to be provided and installed by the Contractor.

The Contract Drawings and Contract Guidance Drawings show acceptable arrangements, basic technical information, performance requirements, and features to guide the Contractor in development of additional details required for construction, regulatory agency approvals, and Owner review.

Contract Drawings, as set forth in Table 2 below, shall not be deviated from without prior written approval from the Owner in accordance with the provisions of Article 4 of the Contract. The Lines Plan showing the design of the Vessel's hull form is a Contract Drawing. The shape of the hull shall conform to the Lines Plan, and the hull shall be carefully faired. Except for fairing, deviations from the Lines Plan shall not be made without prior written approval from the Owner.

Contract Guidance Drawings, as set forth in Table 3 below, are not intended to show a completed and detailed design, nor are they intended to restrict the Contractor to the details shown therein, however, those details shall be used to the maximum extent possible. Equivalent Contractor-developed details, which may make use of more readily available material or permit use of the Contractor's standards and



procedures of equal merit and quality are acceptable provided those details are in accordance with the Contract Documents. Equipment and materials specified by manufacturer and/or product name shall be assumed as also specifying "or equal" as that term is defined in Section 040.4. Changes to major features, functionality, and materials, as set forth in subsequent sections of this Specification, shall not be made without written approval of the Owner prior to start of construction.

Contract Guidance Drawings illustrating piping, mechanical, electrical, and other systems are generally diagrammatic in nature. The Contractor is required to develop and finalize the systems, as well as and conduct its own interference survey. Machinery and equipment shall be arranged such that there are proper clearances for convenient operation, regular maintenance, and repair.

The Supporting Documents, as set forth in Table 4, were developed with and in support of the Contract Plans. Any calculations provided therein support the Contract Design. As the Contractor develops the Functional and Detail Design, the Contractor shall develop, update, and verify the supporting calculations as necessary.

Using the Contract Plans as the basis for the Functional Design and Detail Design, the Contractor shall develop and submit the drawings and information required by USCG for review and certification of vessels under 46 CFR Subchapter K (Small Passenger Vessels Carrying More Than 150 Passengers or with Overnight Accommodations for More Than 49 Passengers), in compliance with MSC Plan Review Guidelines, to the USCG Marine Safety Center (MSC) for regulatory review and approval. In particular, the contractor shall produce all drawings, calculations, and information required by 46 CFR §116.202 and as required to fully define the structure, mechanical, and electrical systems on the vessel.

The vessel will not be classed, however the structure shall be designed and constructed to the requirements of ABS Rules for Building and Classing Marine Vessels

The ABS Rules and USCG shipping regulations valid on the date the contract is signed shall be applied as a base for the contract price

These Contractor-developed Functional Design and Detail Design drawings and information are to comply with the regulatory requirements as set out in Section 072 of this Specification. Any work undertaken in advance of receipt of USCG approval shall be solely at the Contractor's own risk. Regulatory approval of any submittal shall not constitute approval to deviate from the Contract Documents unless the deviation is specifically pointed out to the Owner, and Owner approval has been given in writing. In addition to submittal to USCG, these drawings shall be submitted to the Owner for review as described in Section 810.

The Contractor shall develop detailed design and construction drawings (Construction Drawings or Working Drawings) as appropriate and necessary for Vessel construction, and for installation of components, equipment, machinery, appurtenances, etc., associated with same. In developing these Construction Drawings, the Contractor shall utilize sources of information that were not available during the Contract Design phase. This includes certified vendor drawings, templating from actual equipment, and more detailed information provided by equipment vendors under contract to the Contractor. Detailed design and construction drawings shall be submitted to the Owner for review as described in Section 810.

The Contractor is cautioned to check and verify dimensions and sizes from the manufacturer's certified drawings or the actual machinery or equipment itself, to ensure that the customary growth in machinery



and equipment size does not cause interferences. Large changes in equipment size that may significantly affect the arrangement of the equipment must be promptly called to the attention of the Owner.

All Contract Plans were developed by EBDG unless specifically noted otherwise. Electronic format files of the Contract Plans listed in Table 2 and Table 3 will be provided to the Contractor for use on this project.

The Supporting Documents listed in Table 4 will be provided to the Contractor after Contract Execution.

Table 2: Contract Drawings

Reference ID	Document Number	Title
(A)	24120-002-100-1	Lines Plan

Table 3: Contract Guidance Drawings

Reference ID	Document Number	Title
(B)	24120-002-101-1	Profiles and Deck Arrangements
(C)	24120-002-101-6	Evacuation Plan
(D)	24120-002-101-7	Fire Zone Plan
(E)	24120-002-110-1	Scantling Decks Plans
(F)	24120-002-110-3	Scantling Sections
(G)	24120-002-201-0	Machinery Arrangement
(H)	24120-002-256-2	Freshwater Cooling System
(I)	24120-002-261-0	Fuel Oil System
(J)	24120-002-320-0	Electrical One Line Diagram
(K)	24120-002-522-0	Vehicle Deck Sprinkler System
(L)	24120-002-528-0	Black and Gray Water System
(M)	24120-002-529-1	Bilge and Firemain System
(N)	24120-002-533-0	Potable and Sanitary Flushing Water System
(O)	24120-002-543-0	Lube Oil, Oily Waste, and Oily Water System
(P)	24120-002-551-0	Compressed Air System
(Q)	24120-002-551-0	Insulation Plans

Table 4: Supporting Documents

Reference ID	Document Number	Title
(R)	24120-002-050-0	Speed and Powering Calculations
(S)	24120-002-061-0	Scantling Calculations
(T)	24120-002-065-0	Piping & Mechanical Calculations
(U)	24120-002-300-0	Electrical Loads Analysis
(V)	24120-002-514-0	HVAC and Machinery Ventilation Calculations
(W)	24120-002-833-0	Weight Estimate
(X)	24120-002-835-1	Tonnage Calculations
(Y)	24120-002-843-5	Stability Calculations



040 Administrative Requirements

040.1 Construction Schedule

Within 30 calendar days after execution of the Contract, the Contractor shall submit to the Owner a preliminary copy of a Schedule of Work showing the Contractor's plan, construction sequence, and resource loading proposed to accomplish the work within the Contract period. The Owner will review this document, comment, and return a marked-up copy within 10 working days to the Contractor. The Owner will then meet with the Contractor to discuss comments. The Contractor shall schedule the review meeting to be held within 10 working days after receipt of Owner comments. The Schedule of Work shall be updated by the Contractor within two working days after the review meeting and then resubmitted to the Owner for final approval as the working document.

The Schedule of Work shall sequence and schedule all work detailed in the Contract Documents, in accordance with generally accepted practices for project management. The Schedule of Work shall be a time-phased and resource loaded Gantt Chart. The Contractor shall decompose the activities indicated in the Contract Documents down to a sufficient number of discrete tasks to adequately control and monitor the work and to clearly report progress for the duration of the project. Progress shall be shown as a percentage by task and by overall project completion. The Schedule of Work shall also:

- Indicate, by table or directly on the Gantt Bar Chart, the start and stop dates, free float, and total float for each task.
- Indicate, by table or by link lines, all predecessor and successor dependencies for each task.
- Develop and clearly indicate the critical path through the project.

The Contractor shall schedule and chair a monthly progress meeting, starting the first week, with the Owner, Naval Architect, and the Contractor's key production staff. Prior to the meeting, the Contractor shall provide a copy of an updated Schedule of Work, a progress report (expressed as a percentage of work complete) by activity in a tabular form, a list of items requiring Owner direction, a list of completed milestones, and a Buy America status report as defined in Section 040.3. The updated Schedule of Work shall reflect open items, additional work, deleted work, and modifications, in addition to work progress and completions.

Attendees at each meeting may attend locally or remotely. The Contractor shall utilize an electronic conference system (Microsoft Teams, Zoom, or equivalent) with video and audio for remote attendees.

In the last 120 calendar days of the scheduled performance period, the Contractor shall additionally prepare and submit an Open Task Report. The Contractor shall update and submit the Open Task Report monthly at each subsequent progress meeting and then daily starting the first day of the last thirty (30) calendar days of the scheduled performance period.

The Schedule of Work shall additionally indicate the starting and/or completion dates for the following items:

- A. The Contract award date.
- B. Commencement and completion of engineering.
- C. Regulatory body submittal dates for calculations and drawings.



- D. Long lead time purchase order submittals, including the anticipated date of delivery of all long lead time equipment, components, and all major equipment.
- E. Construction of the main hull erection jig.
- F. Prefabrication, fabrication, assembly, and erection of all structural components.
- G. Installation of major machinery components and packaged subassemblies: Piping, rudders, mechanical, electrical, ventilating, coating, and outfitting systems installation.
- H. Component and System Testing
- I. Builder's trials.
- J. Dock trials.
- K. Sea trials.
- L. Delivery of the Vessel to the Owner.
- M. Owner's acceptance of the Vessel.
- N. Start, duration, and completion of all significant task items.
- O. Anticipated date of all items described in this Specification for the Owner's approval.
- P. Milestone dates for each of the progress payment submittals.

Review of the Schedule of Work by the Owner does not relieve the Contractor of the responsibility to adjust the labor force, equipment resources, or work schedule, as necessary, to anticipate and ensure completion of the work within the prescribed contract period.

040.2 Plan Schedule

Within 20 calendar days after execution of the Contract, the Contractor shall submit a Plan Schedule of documents to the Owner for review. The Plan Schedule shall include all Functional Design Drawings and Supporting Calculations as well as Construction Drawings prepared by the Contractor or its subcontractors and vendors. The Plan Schedule shall be provided to the Owner in PDF and Excel spreadsheet formats and shall include the following for each document on the Plan Schedule:

- A. Document number.
- B. Revision designation.
- C. Document title.
- D. Scheduled submittal date of document to Owner by Contractor.
- E. Columns for recording the actual submittal date to Owner, Owner return date, and status of document.
- F. Scheduled submittal dates of documents to USCG MSC by Contractor.
- G. Columns for recording the actual submittal date to USCG, USCG return date, and status of document.
- H. As-built Drawing designation to identify whether the drawing is to be updated and provided to the Owner as a final As-built Drawing.



The Contractor shall revise and submit the schedule by the first of each month to show all changes, progress, and delays. Prior to Vessel Acceptance, the Contractor shall furnish a final copy of the Plan Schedule to the Owner.

040.3 Buy America Compliance

This project is funded in part by the Federal Transit Authority and is therefore subject to Buy America Compliance in accordance with 49 U.S.C. § 5323(j) and 49 CFR Part 661. The Contractor agrees to comply with 49 U.S.C. § 5323(j) and 49 CFR Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR Part 661.7 and include microprocessors, computers, microcomputers, software, or other such devices, which are used solely for the purpose of processing data and small purchases (per 49 U.S.C. § 5323(j)(13)).

As defined in 49 CFR Part 661.3, ferry boats are included in the definition of Rolling Stock. Separate requirements for rolling stock are listed in 49 CFR Part 661.11. Rolling stock must be assembled in the United States. As amended by the FAST Act, projects commencing in FY 2020 and later shall have greater than 70 percent domestic content (see <https://www.transit.dot.gov/funding/grants/buy-america-fact-sheet>).

The Contractor further agrees to comply with 49 U.S.C. § 5323 and FTA's implementing regulation 49 CFR Part 663 and to submit the following certifications for pre-award and post-delivery audit requirements for all purchases of rolling stock:

The Contractor shall complete and submit a declaration certifying compliance with Buy America. The Contractor shall submit documentation which lists all foreign items including:

Component and subcomponent parts of the rolling stock to be purchased, identified by manufacturer of the parts, their country of origin and costs; and

The location of the final assembly point for the rolling stock, including a description of the activities that will take place at the final assembly point, and the cost of the final assembly.

The Contractor shall submit pre-award evidence that it will be capable of meeting this requirement in its bid.

The Contractor shall be responsible for ensuring that its subcontractors also comply with these requirements.

The Contractor shall monitor the Buy America compliance throughout the duration of the Contract. The Contractor shall provide a monthly written status report detailing current status of contract percentages and updates of Buy America certification, which shall include the purchase log specified in Section 040.5. The report shall be submitted to the Owner prior to each monthly progress meeting for review during the meeting.

040.4 Material Substitutions

Names of certain manufacturers and items, where mentioned in the Contract Documents, are included as a means of describing the general character and quality of the design and construction of various



items and articles. Further, specific equipment identified may have been selected as a basis for the development of the Contract Design guidance. Substitutions for such items must satisfy the "or equal" requirement as defined below. An "or equal" product or material is one which exhibits the same general age, size, weight, characteristics, performance, reliability, maintainability, and cost as the product or material identified in the Contract Documents. The Contractor shall be wholly responsible for demonstrating the "or equal" status of any product or material offered as a substitute for those cited in this Specification and also must be approved by the Owner in writing in advance of purchase.

Requests for substitutions of "or equal" products shall be made in writing to the Owner setting forth the reason for the proposed substitution and providing documented evidence of the substitute's equivalence or superiority to the specified product or material. The request shall also provide the Contractor's assurance that the substitution, if approved, will not result in any increase in the Total Contract Price (as defined in the Contract) nor an Owner-responsible extension of the project's duration.

Requests for substitution must include:

- I. Regulatory Body approval (as applicable).
- J. Compliance with Buy America requirements (as applicable).
- K. Construction to marine appropriate recognized standards (UL, IEEE, ANSI, ASTM, etc.).
- L. Comprehensive comparison of construction features, quality of fabrication, and materials of construction between the specified item and the proposed item. Complete drawings and dimensional data shall be substituted for each item. The weight of each item shall be provided.
- M. Comprehensive comparison of the performance and functional characteristics between the specified item and the proposed item, including capacity, safety features, rated service duty life, maintenance life cycle, and requirements.
- N. Comprehensive list of impacts that the substitution will cause to arrangements, structure and interfacing piping, ventilation, electrical, and control systems.
- O. Valid manufacturers price quote for the specified and the proposed substitute item.
- P. Location of nearest distributor stocking parts for the items and providing field service for the proposed substitution and the specified item (as applicable).
- Q. Statement from Contractor indicating that the proposed substitution will not be a cost increase and will not extend the project's duration.

040.5 Purchase Technical Specifications, Requisitions, and Purchase Orders

All purchase technical specifications, requisitions, purchase orders, and similar descriptive data shall be submitted for review and approval of compliance with the Contract requirements by the Owner prior to purchasing equipment. Each document shall contain a full technical description of the material to be ordered. If the Contractor wishes to purchase or supply equipment, fittings, or outfit other than that specified, the Contractor shall first submit the details of the intended purchase and secure specific written Owner approval in each such instance as described in Section 040.4 above.

Electronic copies of all vendor drawings or literature shall be delivered to the Owner no later than the date the equipment is delivered to the Contractor's facilities.



All correspondence and technical data affecting design features of vendor items shall be furnished along with the submittal of the drawings showing these items.

A purchasing log shall be created and maintained that shows the date purchase orders were approved, date materials ordered, date items received in the warehouse, weights, Buy America certification status, receipt of mill/ABS certificate, etc. The log shall be submitted monthly as supporting documentation for the Buy America status report.

071 Access, Headroom, and Clearances

The minimum headroom for crew and passengers shall be 7 feet unless noted otherwise. Deviations may be approved by the Owner on a case-by-case basis where this minimum headroom requirement is impractical.

Aft of Frame 27, overhead clearance above the Main Deck shall be 17 feet above the Main Deck for vehicle clearance. Forward of Frame 27, overhead clearance shall be at least 8 feet 5 inches above the Main Deck

Machinery and equipment shall be installed to allow access for operation, maintenance, and disassembly. Strainers, pump packing glands, lubrication fittings, and other items that require regular service shall be readily available. Adequate air space meeting manufacturer's requirements shall be allowed around machinery for cooling air circulation. The final location of all machinery shall be subject to review by the Owner's Representative. Equipment shall be removeable without cutting foundations or attachments.

Drip pans shall be provided to collect normal oil leakage under engines, filters, pumps, strainers, and other equipment requiring maintenance or likely to drip fuel or lube oil and similar equipment. Drip pans shall be removable, fabricated from stainless steel sheet metal, and equipped with 3/4-inch drain plugs with adequate clearance for one-gallon capacity bucket type container. Drip pans surrounding large pieces of equipment may be integrated with the equipment's foundation at the Contractor's option provided the resulting drip containment has a valved drain at its low point, prevents oil from entering the bilge, and provides sufficient access for maintenance.

Obstructions or interferences shall be avoided to the maximum extent possible. The Contractor shall pay particular attention to sharp edges, corners, protruding appendages, and other hazardous aspects of equipment or structure where operating personnel are likely to pass or work. Such obstructions, where unavoidable, shall be provided with guards or other means to protect personnel from injury.

Removable personnel safety guards shall be installed over shafting and other exposed rotating components. The safety guards shall be expanded metal or aluminum with stainless steel fasteners. All safety guards shall be painted safety yellow.

To facilitate machinery removal and re-installation, piping, wiring, and ducting in the overhead shall be routed clear of the Bolted Equipment Removal Patches (BERPs) and welded soft patches.

072 Regulatory Requirements

The completed Vessel, as detail designed and constructed by the Contractor, shall meet all applicable regulatory requirements in force at the time of bid submission unless otherwise specified. Applicable



Regulatory Bodies and requirements include, but are not limited to, those listed in Table 5 and throughout the Contract Documents.

Except for the Owner's crew demonstrating familiarity with the Vessel's operation, including lifesaving and firefighting capabilities and procedures, the Contractor shall be entirely responsible, inclusive of any related fees and expenses, for obtaining all certifications, documentation, and regulatory approvals. The Contractor shall be responsible for providing all testing, failure analyses, components, and signage as necessary for the Vessel to be put into passenger- and vehicle-carrying service as described above.

Table 5: Partial List of Applicable Regulatory Requirements and Bodies

Reference ID	Requirement or Regulatory Body
(R1)	46 CFR Subchapter K, "Small Passenger Vessels Carrying More Than 150 Passengers or with Overnight Accommodations for More Than 49 Passengers" and other CFR Chapters and Subchapters referenced within 46 CFR Subchapter K
(R2)	USCG policy and interpretation including, but not limited to, Navigation and Vessel Inspection Circulars (NVIC), Plan Review Guidelines (PRG), Marine Safety Center Technical Notes (MTN), and Policy Letters (CG-ENG", "CG-CVC)
(R3)	ABS Rules for Materials and Welding
(R4)	American Welding Society, D1.1 Structural Welding Code – Steel (AWS D1.1)
(R5)	ABS Guide for Nondestructive Inspection
(R6)	International Association of Classification Societies No. 47, Shipbuilding and Repair Quality Standard (IACS No. 47)
(R7)	Passenger Vessels Architectural and Transportation Barriers Compliance Board, 36 CFR Part 1196, (Proposed) Passenger Vessels Accessibility Guidelines
(R8)	USCG NVIC 09-97 CH 1, Guide to Structural Fire Protection
(R9)	46 CFR Part 69, Measurement of Vessels
(R10)	USCG MTN 01-99 CH-10, Tonnage Technical Policy
(R11)	IEEE Standard No. 45, Recommended Practice for Electrical Installations on Shipboard
(R12)	U.S. Public Health Service, Handbook on Sanitation of Vessel Construction
(R13)	Federal Communications Commission (FCC)
(R14)	SNAME T&R Bulletin No. 3-39, Guide for Shop and Installation Tests
(R15)	SNAME T&R Bulletin No. 3-47, Guide for Sea Trials
(R16)	SNAME T&R Bulletin No. 4-16, Recommended Practices for Ship Heating, Ventilation & Air Conditioning Design Calculations
(R17)	USCG NVIC 01-89, Underwater Survey Guidance
(R18)	ABS Guidance Notes on Ergonomic Design of Navigation Bridges
(R19)	ABS Guidance Notes for the Application of Ergonomics to Marine Systems
(R20)	ASTM F1166, Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities
(R21)	SNAME T&R Bulletin No. 3-51, Practices and Procedures for the Alignment of Marine Main Propulsion Shafting Systems
(R22)	USCG NVIC 17-91, Guidelines for Conducting Stability Tests
(R23)	ASTM F1321, Standard Guide for Conducting a Stability Test (Lightweight Survey and Inclining Experiment) to Determine the Lightweight Displacement and Centers of Gravity of a Vessel



The completed Vessel shall be certificated by the USCG, as prescribed in Reference (R1). The Owner will submit an application for Certificate of Documentation (COD) with Great Lakes and Registry endorsements. The Contractor shall provide a Builder's Certificate and deliver the vessel with a temporary Certificate of Inspection (COI) for Subchapter K, with only crew familiarity testing outstanding for issuance of the final COI.

The Vessel shall admeasure less than 100 Gross Regulatory Tons (GRT). A Certificate of Admeasurement for Regulatory Tonnage shall be provided. See Section 835 of this Specification for specific requirements.

The Vessel shall participate in the Underwater Inspection In Lieu of Drydocking (UWILD) Survey Program. Preliminary hull surveys, hull markings, and modifications which are required to gain acceptance into the program, as described in 46 CFR115.615, Reference (R17), and as directed by the USCG shall be arranged. See Section 603.4 for additional details.

It is essential that the intent and specifics of the accessibility guidelines in Reference (R7) are met throughout the public spaces of the completed Vessel. Contract Drawings and Contract Guidance Drawings have endeavored to address these requirements; however, there may be specific instances where details have been inadvertently omitted. It is the Contractor's obligation to bring any omissions to the attention of the Owner and to deliver a Vessel to the Owner that complies with Reference (R7). Specific passenger vessel accessibility concerns include:

1. Passenger Deck and Upper Deck access.
2. Elevator installation and access including size, turning radius, ramp slopes, and controls.
3. Signage and emergency signals.
4. Sanitary space access, turning radius, fixtures, grab bars, etc.
5. Weather deck door sills, ramps, slopes, and flats.
6. Hardware.
7. Wheelchair clearances – interior and exterior.
8. Door opening force.

073 Vibration and Noise

The Contractor shall hire an experienced consultant to perform noise and vibration predictions using a detailed analysis approach in order to meet the vessel's noise and vibration limits provided in Table 6 and Table 7. Local exceptions may be permitted with express approval of the Owner.

Table 6: Noise Limits

Space	dB(A)
Interior Passenger Areas	65
Pilot House and Crew Spaces Above Vehicle Deck	65
Passenger Stairways	70
Vehicle Deck	75
Exterior Passenger Areas:	75



Table 7: Vibration Limits

Space	Vibration Velocity Limits (mm/s)
Passenger Deck Passenger / Crew Areas	3.5
Upper Deck Passenger / Crew Areas	3.5
Bridge Deck Crew Areas	3.5
Pilot House	3.5

A noise and vibration prediction report shall be created and shall identify baseline noise and vibration levels that result from pertinent excitations, as well as any potential excesses. Based on the results, appropriate noise and vibration mitigation shall be determined and implemented to meet the noise and vibration criteria with the approval of the Owner's Representative at no additional cost to the Owner.

The noise and vibration consultant shall perform inspections of critical noise control features at one or more points during vessel construction to ensure pertinent noise and vibration control features are properly installed.

During sea trials, noise and vibration surveys shall be conducted in all spaces listed in Table 6 and Table 7. All equipment, including applicable portions of the heating, ventilation, and air conditioning (HVAC) systems, shall be operating normally during trials, and the survey shall be conducted underway while at a transit speed of 13.5 knots and at maximum vessel speed. Vibration survey shall be conducted in accordance with ISO 20238-5:2016. The noise survey shall be conducted in accordance with IMO Resolution MSC.337(91) "Code on Noise Levels on Board Ships". The Contractor shall provide the services of a reputable company experienced in conducting analysis of ship noise and vibration. A report shall be provided to the Owner.

Final vibration and noise reading locations and testing conditions shall be subject to approval and acceptance by the Owner prior to Vessel Acceptance.

The Vessel, and components thereof, shall be free from excessive vibration. Vibration is excessive when it exceeds the explicit limits given in Table 7, results in damage or clear potential damage to the vessel structure, machinery, equipment, or systems, or interferes with the proper operation of the Vessel or its components. Dangerous resonances at normal and emergent operating conditions will not be acceptable. The design speed of machinery shall not be reduced to avoid resonances. Barred speed ranges within the normal operating and emergent operating conditions of the propulsion system are unacceptable.

The vibration limits in Table 7 apply specifically to the decks of passenger and crew working spaces. Vibration criteria are an overall, frequency weighted root mean square (RMS) value that is summed between 1 and 80 Hz, in accordance with ISO 20238-5:2016.

The Vessel's local structure outside of the spaces listed in Table 7 shall be tested to ensure they have a single frequency peak response component, structural vibration velocity limit of 30 mm/s for structural response frequencies at 5 Hz and above. The Owner may, at their discretion, approve vibration velocities in excess of 30 mm/s if the Contractor can satisfactorily demonstrate that vibration velocities in excess of this limit will not result in fatigue cracking or other structural damage.

The Contractor shall be responsible for locating and correcting unsatisfactory vibration or noise conditions arising during tests or trials, or subsequently during the guarantee period, which can be attributed to design or construction of those elements by the Contractor.

074 Welding

Welding shall meet the standards of Reference (R3) and Reference (R4), as well as all applicable requirements set forth in the Contract Documents.

Prior to the start of construction, the Weld Schedule, Welding Procedure Specifications (WPS), and Procedure Qualification Records (PQR) shall be submitted to the Owner and Regulatory Bodies for approval. No deviation from the approved weld joint designs or procedures will be permitted without the Owner review prior to fabrication.

All welding shall be performed by welders holding current certifications for the approved procedures in accordance with Reference (R3). Prior to the start of construction, a roster of all qualified welders and electronic copies of their welding certifications shall be submitted to the Owner. Certificates shall be maintained during the Contract performance period.

All welds shall be visually inspected. Cyclically loaded structure shall be visually inspected to the standards of Reference (R4). Visual and other non-destructive testing (NDT) of welds by the frequency, location, and methods specified by Reference (R5) and to the Owner and Regulatory Bodies' satisfaction.

All defects discovered by visual or other NDT examination shall be corrected at no additional cost to the Owner. The Contractor shall be solely responsible for ensuring that all defective weld metal is carefully cut out and properly replaced to the complete satisfaction of the Owner and appropriate Regulatory Body representatives. Defective welds that do not meet the satisfaction of the Owner or Regulatory Bodies shall be removed and rewelded or repaired in accordance with Reference (R4).

A NDT plan shall be prepared, which must be approved by the Owner and Regulatory Bodies no more than 60 calendar days after Contract Execution, prior to commencement of welding, and before performing NDT on the Vessel. The Contractor is responsible for developing a NDT plan for the Vessel in accordance with USCG regulations. The Contractor shall hire subcontractors to perform specialized NDT procedures as necessary and provide acceptable documentation to USCG for review and approval.

The welding sequence shall be designed to minimize distortion and locked-in stresses. Structural welding shall be carried out in such sequence as to compensate for creeping and shrinkage as the work progresses. The distortion shall remain within the fairness standards of Reference (R6), unless a more stringent requirement for fairness is specified elsewhere in this Specification.

Intermittent welding is not permitted in the foundations for the propulsion engines, reduction gears, propulsion shaft bearings, generators, steering gear, bow thrusters, and hull structure immediately in way of these foundations, and areas exposed to weather. Continuous welding is required in tanks, toilet/shower spaces, exterior welds on superstructure, Engine Room bilges, and similar spaces where intermittent welding would result in corrosion to the welded ends, edges, or faying surfaces of attached members.

Fillet welds shall be wrapped around the ends of members, in weld relief locations, and around brackets to eliminate stress risers and corrosion points, and in accordance with Reference (R3). Errant arc strikes



outside the area of permanent welds shall be avoided. The Contractor shall grind smooth any blemishes caused by errant arc strikes and repair any defects per Reference (R6). Peening or caulking of weld material will not be allowed. Surfaces to be welded shall be free from mill scale, excessive rust, moisture, grease, or other contaminants that would prevent proper welding

075 Guarantee

The hull, coatings, outfit, and machinery, including work of subcontractors, shall be guaranteed against defects resulting from faulty material or poor workmanship that may become apparent within 12 months from the date of Vessel Acceptance.

The Contractor shall correct such defects at no cost to the Owner in accordance with the terms of the Contract.

A transferable manufacturer's warranty shall be provided for a minimum period of one year of operation for all equipment installed on the Vessel. Any warranties provided for equipment longer than one year shall be transferred to the Owner in their entirety. All warranties shall transfer to the Owner, and the warranty period shall start upon Vessel Acceptance.

076 Materials and Workmanship

Unless otherwise stated in this Specification, the Contractor shall supply the necessary labor, materials, services, equipment, etc., required to complete the construction and testing of the Vessel. All equipment and materials shall be new, suitable for marine use, and of current manufacture unless specific written approval to the contrary is obtained from the Owner using the process described in Section 040.4 above. Equipment shall operate under conditions of temperature, humidity, vibration, roll, and pitch commensurate with service in Lake Michigan.

Materials and equipment used, and the workmanship thereon shall be of the best description and quality throughout and of adequate sizes to accomplish the purpose intended. The work, in every respect, shall be to the complete satisfaction of the Owner and Regulatory Bodies.

The Contractor shall receive, inspect, store, segregate from other projects, and protect all materials from inclement weather, dirt, water, and other damage.

Quality of work and materials shall be in conformance with Reference (R6) for workmanship and repair procedures unless otherwise specified in the Contract Documents. Defects appearing at any stage of the work shall be cause for rejection even though the piece in question may have been previously been passed as satisfactory.

Pipe materials and fittings shall be appropriate for the service type and as noted on the Contract Guidance Drawings.

Structural steel shall be ABS Grade A, except Main Deck plating in way of vehicle traffic, which shall be higher strength steel, ASTM A-572, ABS AH-36 or DH-36. ASTM A36 may be used where permitted by ABS rules. All materials (including plates, shapes, welding electrodes, etc.) shall be in accordance with Regulatory Body requirements.

Where aluminum structure is specified, all material shall be suitable for marine construction. All plate shall be ASTM B928 5083-H321 alloy and all extrusions shall be ASTM B308 6061-T6 alloy.



The Contractor shall provide mill certification or ABS certification to the Owner prior to installation of the material. Certification shall include origin, heat number, size of member, and quantity.

Brasses and bronzes shall be mixtures of virgin material of proper proportion for the purpose intended and shall be clean, smooth castings, uniform in texture and finish.

Galvanizing shall be done by the hot-dip process after hot work has been completed. Electro-galvanizing will not be accepted except for pre-manufactured items and as approved by the Owner. Where galvanizing is damaged during construction, the Contractor shall repair the galvanizing using hot stick or zinc-spray metalizing methods in accordance with ASTM A780. Zinc repairs shall be lead free.

Where fasteners, pipe, tube, sheet metal, or plates and shapes are described as being stainless steel, marine grade 300 series stainless steel shall be used in all cases. Fasteners, fluid piping, and hose fittings shall be 316 stainless steel, unless otherwise specified. Piping and materials used for exterior handrails and ladders shall be 316L stainless steel, unless otherwise specified. Where stainless steel is used and wire-brushed, only non-ferrous wire brush materials shall be used.

Asbestos or asbestos containing materials shall not be used.

All correspondence, documents, drawings, nameplates and labels, manuals, and other written forms of communication, including those provided by subcontractors shall be in the English language.

077 Environmental Conditions

All Vessel systems, structures, machinery, and outfit shall be capable of sustained operation while subjected to the pertinent static and dynamic design angles of inclination prescribed in Reference (R3).

The worst case ambient air and sea water temperatures to be considered for HVAC system detail design are given in Section 510.

083 Spare Parts and Special Tools

The Contractor shall submit to the Owner a list of manufacturer's recommended spare parts and special tools as each new item of equipment is ordered. The list shall include the unit price of each spare part and the manufacturer's part number and shall include diagrams or drawings as necessary. Each list shall include the minimum required consumables, spare parts, and special tools, for each piece of equipment provided, necessary to support five years of continuous operation of the Vessel. The Owner reserves the right to procure any items from the lists provided at the unit price submitted by change order.

Operationally required parts and special tools needed during Vessel delivery shall be securely stored on board the Vessel. All other parts shall be delivered to the Owner prior to Vessel acceptance.

087 Temporary Services

A field office for the Owner's Representative shall be provided as set forth in Section 838.

Contractor shall be responsible for the provision of all necessary services throughout the entire period that the Vessel is at the Contractor's facility, including during trials completed at the Contractor's facility. Services may include, but are not limited to, potable water, shore power, compressed air, waste removal, access, craneage, security, etc.



The Contractor shall provide and maintain sanitary facilities at or near the Vessel in quantities and locations commensurate with the work underway. The Vessel's sanitary facilities shall not be used by Contractor's personnel, subcontractors, vendors, or guests.

The Contractor shall indicate in its bid submission the price per day for the provision of the temporary services set forth in this Section for any/all Owner-responsible extensions of the project.

087.1 Equipment Storage

Equipment purchased by the Contractor for use in the construction of the Vessel shall be received, inspected, securely warehoused, segregated from equipment from other projects, and protected from damage. The equipment shall be kept in a covered, clean, dry environment and relatively constant temperature (± 30 degrees from 70 degrees ambient). Equipment requiring special handling by its manufacturer shall be stored in accordance with the manufacturer's requirements.

The Owner shall be provided with access to stored equipment at any time upon two hours advance written notice.

Equipment shall be protected from overspray of solvents, paints, impact damage, and weld or cutting materials contact while in storage and onboard. Temporary fire-resistant covers or enclosures shall be placed over all equipment where overhead or adjacent hot work is being performed. Scaffolding or work platforms shall be placed over equipment to stand on or walk across for access. The Contractor and subcontractors shall not stand on equipment, piping, or other furnishings to work overhead.

The Contractor shall immediately comply with all directives from the Owner to protect or improve protection of equipment and components from physical damage.

087.2 Care of Vessel During Construction

The Contractor is solely responsible for the care of the Vessel, equipment, construction materials, and safety of all personnel until Vessel Acceptance. The Contractor shall maintain the Vessel and surrounding worksite in a manner suitable for safe, efficient construction in accordance with modern shipbuilding practice and applicable regulations. All necessary measures shall be taken to minimize and prevent wear or deterioration due to installation, testing, weather, sunlight, water, dust, or moisture during construction.

Frequent cleaning of the Vessel shall be undertaken during construction to remove excess debris and components, and interim cleanups are to be performed to maintain a housekeeping standard to the approval of the Owner.

All joinery and finished surfaces, including equipment components and machinery, installed before Vessel Acceptance shall be protected from scuffs, damage, dirt or debris intrusion, and paint overspray or drips by appropriate covers and shields to the approval of the Owner. Protective coverings include the use of fire blankets during welding and cutting operations, covering walkways and interior floor finishes, and covering equipment, decks, and finished surfaces with adequate protection prior to any painting in the space. The protective covers and shields shall be maintained in satisfactory order during the remainder of construction and refreshed as needed. Any damaged or inadvertently coated finished surfaces or equipment finishes shall be restored to a like-new condition prior to Vessel Acceptance. The Contractor shall remove any adhesive residue left after final removal of the protective covers or shields.



The Contractor shall submit a foul weather plan describing the Contractor's plan of action to protect the Vessel in the event of severe weather such as a named storm. The plan foul weather plan shall address the following:

1. Weather monitoring and thresholds for activating the plan
2. Communication protocol including roles and responsibilities
3. Mooring of the Vessel while afloat
4. Securing equipment and materials
5. Post-storm recovery and inspection

087.3 Fire Protection

During construction, flammable material shall not be stored on board the Vessel in such a manner as to create a fire hazard. Special care shall be exercised to prevent the possible outbreak of fire and perform periodic cleaning to minimize fire hazards. One or more pressurized fire hoses capable of reaching all portions of the Vessel shall be maintained at the Vessel's construction site at all times.

Hot work shall comply with applicable regulations or orders of OSHA, the USCG, and the local fire department. Experienced supervisors shall be present during all hot work.

Where hot work (torch cutting, welding, grinding) is being carried out in the vicinity of combustible material, a fire watch whose sole purpose shall be to watch for fires and keep firefighting equipment on hand, shall be on duty. Fire watch personnel shall remain on duty in the same space where hot work was performed for a period of at least 30 minutes after cessation of hot work.

Spent or partially spent portable fire extinguishers shall be immediately replaced with fully charged extinguishers. There shall be no open fires permitted on or within 50 feet of the Vessel at any time while in custody of the Contractor.

087.4 Hull Protection

The Contractor shall maintain rigid control of welding and grounding for the protection of the hull, its systems, and appendages during the entire time the Vessel is in the custody of the Contractor in order to prevent potential internal arcing and the resultant destruction of internal machinery surfaces, specifically, rotating machinery, including but not limited to all bearings and gears, as well as electrical components.

The Contractor is solely and completely responsible to comply with this standard of workmanlike practice to ensure the protection of all shipboard equipment. The Contractor shall bear total immediate and long-term responsibility for repair or replacement of all associated damage incurred to equipment. Any and all necessary repair work shall be accomplished for Contractor's account by an Owner-approved equipment technical representative to the full satisfaction of the Owner and as deemed necessary by an OEM for the damaged equipment.

091 Ship Inspections and Quality Assurance

The Contractor shall develop and implement a comprehensive testing and quality assurance plan. The purpose of this plan is to ensure that all workmanship is satisfactory, all equipment has been correctly installed, all systems are functioning properly, all work performed by subcontractors is acceptable, and regulatory requirements have been met. The testing and quality assurance plan will encompass all



aspects of the Vessel's construction, including hull fabrication, machinery systems, piping systems, electrical systems, outfitting, and painting. The testing and quality assurance plan shall be submitted to the Owner for approval within 45 calendar days after the Contract Award.

During construction, and at any time prior to Vessel Acceptance, the Owner and Regulatory Bodies, and equipment/material manufacturer's technical representatives shall be given free access to the Contractor's facility for the purpose of inspecting work and materials. These persons shall be granted access to the Vessel at any time prior to the Vessel Acceptance and will have the authority to reject any material or workmanship that does not conform to the requirements as set forth in the Contract Documents.

Provision shall be made for the Owner to witness all Regulatory Body inspections. The Contractor shall schedule all required USCG or other regulatory tests and inspections and notify the Owner of same in writing at least 10 business days in advance, unless another time period is specified herein.

For surfaces prepared for coating application, the Contractor shall give written notice of an upcoming inspection at least one business day in advance.

See additional testing and trials requirements in Section 900.

096 Weight Control Program

The Contractor shall be responsible for preparing a Builder's Weight Estimate. This estimate shall be submitted to the Owner within 45 calendar days after the Contract Award. The estimate shall be done in Ship Work Breakdown Structure (SWBS) format, to facilitate comparison with the Contract Design Weight Estimate, Reference (W). Disparities between the two estimates shall be identified by the Contractor and reconciled through discussion between the Owner and the Contractor to establish an Approved Maximum Vessel Lightship Weight.

Minimizing weight growth during construction is important. Throughout the functional and detail design and construction of the Vessel the actual weight of equipment and materials against the weight estimate shall be monitored. The Contractor's weight estimate shall be updated to include actual weights and updated centers of gravity. These updates shall be resubmitted monthly for review by the Owner. Notable changes in weight and in centers of gravity shall be brought to the attention of the Owner as they are discovered.

The Contractor is cautioned to pay close attention to the longitudinal and transverse centers of gravity of the Vessel, and it shall be responsible for the installation of Owner-approved permanent ballast to correct list and trim as described in Section 191. The Contractor shall be responsible for delivering the Vessel within the limit of the Approved Maximum Vessel Lightship Weight described above.

The Owner and the Contractor shall jointly conduct a deadweight survey at the time of launching to compare observed displacement with estimated launching weight.

Refer to Section 843 for stability Requirements.

099 Digital Images

The Contractor shall submit a set of at least 36 digital images in JPEG format every two weeks during the construction period, illustrating work progress. Images shall have a minimum size of 12 megapixels



(MPs). The Contractor shall include a digital image file index describing the date, subject, and location corresponding to each file name. The Contractor shall provide the file index and digital images to the Owner through a secure online file share service.



Group 100 – Hull Structure

100 General

The Vessel is generally to be constructed on a transverse system of framing and shall be of all welded construction. The frame spacing in the hull shall be 30 inches on centers, except from frames 24 to 31 where the frame spacing shall be 45 inches on centers. Frame spacing of the Car Deck stiffeners shall be 15 inches on centers.

The structural arrangement and scantlings reflected on the Contract Guidance Drawings have been developed in accordance with the American Bureau of Shipping Marine Vessel Rules. All scantlings shall meet or exceed the American Bureau of Shipping (ABS) requirements and the USCG technical notes. Where scantlings on the plans exceed ABS requirements, the increased scantlings shall be used.

The Contractor shall be responsible for adding brackets, chocks, and clips as required to develop the full strength of the members shown on the Contract Guidance Drawings. Scantlings not specified by the plans, ABS Rules, or USCG shall comply with the yard's practice.

Longitudinal strength shall be maintained by ensuring continuity of main fore and aft members including the Main Deck, bottom and deck girders, and the shell plating. Where the strength of a main structural member is impaired by cuts or interruptions in continuity, efficient means of compensation shall be fitted.

Local reinforcements, for special loads and vulnerable areas subject to high wear, also compensation for penetration, doors, stairway openings, etc., shall be provided generally in accordance with ABS rules.

In general, doublers shall not be used. Reinforcements shall be insert plates of increased thickness.

Limber and vent holes, 1-1/2" radius minimum, shall be cut as necessary to ensure proper venting and drainage of tanks, compartments, pockets, and voids. Tanks shall have limber holes and vent holes of adequate size for full capacity flow to suction and vent lines.

Plating for bulkheads, shell plating, and decks shall meet the fairness standards of Reference (R6)

Except at the Main Deck, wherever there is a difference in adjacent plate thickness, the stiffener side shall be kept flush. At the Main Deck, the weather surface shall be kept flush.

Particular care shall be taken on all visible surfaces (i.e., outside shell, deckhouse, etc.) to maintain a good appearance by means of suitable chamfers. Outside corners of steel material which passengers may contact shall be 1" minimum radius.

During construction, access shall be provided to all compartments and spaces for cleaning, painting, and inspection.

Temporary access openings may be provided through shell, bulkheads, decks, etc., for convenience of workers and are to be reclosed in place by welding. All such openings shall have large radius corners and shall be positioned to utilize existing design butt welds and seams wherever possible.



No rough edges shall remain where steelwork is cut. Penetrations shall be pre-cut by machine or neatly burned. Sharp and ragged edges or corners of structure that could cause injury to personnel, or which are unsightly, shall be removed, ground smooth, or sniped.

All steel material shall be shot blasted to coating manufacturer's recommendations but at least to SSPC SP 10 standard, and immediately thereafter coated with a suitable primer. The primer shall be of weldable type and fully compatible with ultimate coating system.

Design of steel structures shall allow clear heights as specified after allowing for passage of ducts, pipes, etc.

110 Shell and Support Structure

Frames and girders shall be bracketed on both sides of oil-tight and watertight bulkheads or slotted through watertight bulkheads and collared. Special attention shall be paid to the alignment of girders under the engines and reduction gears, and at the struts and rudders.

The hull shall have ice reinforcement in the bow forward Frame 15 and stern aft of Frame 37 as described in References (E) and (F).

111 Shell Plating

Shell plating shall be constructed in accordance with References (E) and (F). The boundaries of differing plate thickness shall be maintained as shown. Seams and butts shall be located to suit the Contractor's standard practice, subject to approval of the Owner's Representative. Four-way joint intersections shall be avoided to the extent possible. Shell openings shall be compensated for with insert plates with radiused corners.

Attention shall be paid to finish of exposed steel on outside shell and superstructure; welding shall be ground smooth where unsightly. It is not the intention to grind smooth all hand-made welding on the side shell plating.

Each overboard discharge through the shell plating shall be rigidly stiffened vertically and horizontally to the nearest structural members.

115 Stanchions

Provide stanchions to support longitudinal and transverse deck girders in accordance with References (E) and (F). Minimize the number of stanchions in public areas.

As far as possible, supports for the various decks are to be arranged vertically above each other to form as stiff a construction as possible. The structure shall be designed to eliminate vibration to the greatest extent possible.

Heavy stanchions and girders shall be fitted as needed to minimize vibration and meet the noise and vibration requirements in Section 073. Care is to be taken in the design of accommodation areas to ensure continuity of pillars, girders, bulkheads, and webs so as to minimize vibration.

Location of stanchions throughout, but especially in passenger areas, shall be arranged as far as possible to suit the arrangement, function, and decoration of the spaces concerned.



116 Skegs

The skegs shall be tapered, hollow construction with widths (half breadths) as shown on Reference (A). The skegs shall be fitted with suitable transverse framing and made watertight.

Stainless steel half couplings shall be installed in bottom plating at each skeg void and shall be fitted with 2" bronze flush plugs. After testing and welding in adjacent areas has been completed, the skegs shall be filled with an environmentally benign rust preventative, Esgard Bio-Float or equal, and drained.

117 Framing

Framing shall be in accordance with ABS except where the plans specify heavier framing.

120 Hull Structure Bulkheads

Transverse and longitudinal bulkheads shall be located and constructed as shown on the Contract Guidance Drawings. Bulkhead scantlings shall be generally as shown. Special treatment must be given to bulkheads in way of loads imposed by girders. The Contractor shall provide stiffeners, brackets, and chocks as required to complete the installation.

Bulkhead stiffeners shall be arranged to line up with girders or other stiffeners.

All openings shall have rounded corners to Owner's approval.

130 Hull Decks

The Vehicle Deck shall be fabricated generally as shown on Reference (E).

Wheel loads shall be taken as 22,400 lb in way of truck lanes, and 10,000 lb for passenger vehicles elsewhere on the vehicle deck. See Reference (S).

Insert plates with radiused corners shall be installed under bitts, cleats, pad eyes, and similar fittings. Vehicle Deck insert plates shall be installed flush on the top side with surrounding plates.

Deck beams shall be either slotted through bulkheads and girders or bracketed each side. In way of tight bulkheads, slotted beams shall be collared.

Decks shall be reinforced in way of corners of large openings, breaks, etc., where required by regulatory bodies. Such reinforcement shall be by insert plates of increased thickness – doublers are not to be used – and by installation of heavy girders.

136 Upper Decks

The Passenger Deck and decks above shall be fabricated as shown on Reference (E).

150 Deck House Structure

Superstructure bulkheads and frames shall be fabricated in accordance with References (E) and (F) except that the Contractor shall verify and provide scantling sizes, connections, and details in accordance with USCG Marine Safety Center Technical Note MTN 05-94 for racking requirements.



Superstructure exterior bulkheads shall be flat and curved plate construction with welded stiffeners on the inside. Care shall be taken to ensure fairness and minimize distortion of deckhouse bulkheads and house fronts. All deckhouse corners are to be well radiused.

Edges of the cutouts in the curtain plates shall be ground smooth to ensure good coating adhesion. Alternately, Contractor may install 3/8" round bars around the cutout perimeters, continuously welded both sides.

All structure above the Upper Deck shall be fabricated of aluminum plates and shapes. A bimetallic, explosion bonded strip shall be used for the steel to aluminum joint. The bimetallic strip shall extend outboard of the side shell only to the extent necessary, not more than 1 inch.

151 Bulwarks

The Contractor shall detail and construct Fore Deck bulwarks as indicated on References (B) and (F). Grind all welding on the bulwark caps smooth to present a smooth finish and avoid potential injury to crew and passengers. Close and fair the bulwark cap at each terminus. Bracket the bulwark to the deck with flanged plates that align with underdeck stiffening structure.

161 Deck Fittings

Mooring bitts and cast steel chocks shall be provided on the Main Deck and Fore Deck as shown on Reference (B). Corners and weld bead shall be ground smooth to prevent chafing of mooring lines.

Chafing protection, round bar or pipe, shall be provided on bulwark stiffeners where lines may lead from keels or chocks.

Insert plates and local under-deck stiffening shall be provided to accommodate the mooring bitt installation. Doubler plates are not acceptable.

163 Sea Chests

The Vessel shall have one sea chest built of 16 inch IPS Schedule 40 pipe, ASTM A-106, and shall be installed in the Engine Room generally where shown on Reference (G).

The sea chest assembly shall be installed in the shell with insert plates. All piping connecting to the sea chest shall be fitted with a gate or globe valves located as close to the sea chest as is practicable.

Piping between the sea chest body and sea chest isolation valves shall be Schedule 80.

The sea chest strainer plate shall be fabricated from ½" thick UHMW-PE sheet, or other material that can be considered neutrally buoyant when submerged to facilitate underwater removal by divers. The strainer plate shall be fastened with stainless steel studs and bronze Nylock® nuts. Slots shall be nominally 4" by 1/2" and provide at least 50% clear area. The strainer plate shall be hinged with stainless steel hinge pins that allow the plates to hang freely open and shall be flush with hull when bolted closed.

The sea chest shall be fitted with a vent which terminates on the Vehicle Deck outside of the curtain plate. The vent line shall have a gate valve at the sea chest penetration for isolation purposes. The sea chest vent shall have a quick disconnect fitting and ball valve installed above the deepest waterline for compressed air blow-down of sea chest strainer plates and evacuating water from sea chests for layup.



The interior of the sea chest shall be painted as described in Section 631. The sea chest shall have additional corrosion protection via 15 lb. magnesium anodes installed in accordance with Section 633.

170 Masts

A navigation light mast and a flag staff shall be provided and located as shown on Reference (B). Both shall be constructed of aluminum. The mast shall be properly braced with pipe and guy wires to prevent vibration of the mast. The mast shall be equipped with ladder rungs and safety rails as required for maintenance of the equipment.

Electrical cables on the navigation light mast shall be provided with watertight receptacles at each light fixture and adjacent to the mast base.

Flagstaffs shall be fitted with sheaves and brass cleats for halyards. Provide brass pulleys for each arm and gaff, three (3) complete with flag halyard of 1/4" nylon line with brass snap hooks secured to each end of halyard. Halyards shall be endless loop type, suitable for service intended.

180 Foundations

180.1 General

The Contractor shall design, fabricate, and install all necessary foundations and supporting structure. Foundations shall ensure rigidity, freedom from vibration in normal operation, and secure containment of the equipment in rough seas and crash stops (accelerations of at least 1.0 g in any direction).

Foundations shall extend a sufficient distance to distribute the load and to avoid excessive weight concentrations. Insert plates, girders, headers, and stanchions shall be fitted and under deck framing shall be otherwise reinforced to provide adequate support of the equipment. Top members of foundation girders shall be machined as necessary and drilled to suit the equipment base structure.

Foundations shall be designed such that they cannot trap water or oil.

Chocks and/or liners shall be fitted, machined as necessary to produce and maintain correct alignment and to permit adjustment of alignment.

Flat bars shall be welded around the edges of top plates where they are necessary to retain possible leakage of oil or water with drain plugs shall be provided to permit release of all drainage.

180.2 Propulsion Plant Foundations

Foundations for the propulsion machinery shall be fitted as an integral part of the Vessel's primary structure. Abrupt discontinuities shall be avoided by gradual tapers at the extremities of foundation structure.

The propulsion machinery foundations shall be of a height to suit the engine and reduction gear mounts with minimum one inch allowance for resin chocks. The reduction gear foundations shall be a continuation of the main engine foundations. Brackets shall be installed at every frame, except where such brackets interfere with the engine bolting arrangements. Welding of engine and reduction gear foundations shall be continuous.



180.3 Generator Foundations

Generator sets shall be furnished skid mounted. The generator skids shall be secured to the foundations using vibration isolating mounts supplied by the generator set manufacturer. Hull structure shall be locally reinforced to support the generator sets.

180.4 Auxiliary Equipment Foundations

Appropriate foundations and support structure (brackets, etc.) shall be provided for all equipment, such as electrical panels and instrumentation, regardless of weight. Containment coamings shall be incorporated into the foundation around all equipment where oil leakage may occur.

Design of foundations shall permit equipment access as required, and access for maintenance of foundations and adjacent hull structure. Foundations shall incorporate suitable supports so as to prevent excessive or unusual vibration under the normal range of Vessel operating conditions.

Auxiliary foundations shall consist generally of angles and plate, adequately secured to frames and with top bars of suitable size for connection of the machine. Where drip pans are needed, such may be formed of flanged plates with welded corners and acting as part of the foundations. All foundations shall be braced to reduce vibration. Floor plates shall not be extended to form part of the foundations.

Care shall be taken to avoid sharp corners or projecting members that might be hazardous to personnel. Due consideration is to be given in the design of foundations to provide for ready access to the equipment and adjacent structure and fittings.

Foundations for davits, kevels, chocks, and the like shall be designed to withstand the breaking strength of the cable or mooring lines attached.

191 Ballast

The Contractor shall conduct a deadweight survey after the Vessel launches for the purpose of establishing the as-built weight, longitudinal center of gravity, and transverse center of gravity prior to installing fixed ballast to offset any Vessel list and trim. The Contractor shall submit their findings to the Owner Prior to installation and shall prepare a fixed ballast plan for submittal to the Owner and the USCG for review and approval.

The Contractor shall provide up to 25 LT of lead ballast bars, located to reduce static list less than 0.25 degrees, and static trim to within 0.3 to 0.6 degrees aft in a loading condition with mid-level major operating tanks and no cargo deadweight. This fixed ballast may be required to be in multiple locations to properly correct trim and list. Quantity and locations are subject to final stability calculations. Tanks shall be approximately loaded as follows:

- 50% to 80% loading for fuel oil tanks, non-potable water.
- Ancillary tanks such as lube oil and hydraulic oil storage may be 80% full.
- Sewage, waste oil, and oily water tanks may have a nominal amount of tankage.

The lead ballast bars shall be vinyl or plastic coated or stowed in steel boxes sealed with gaskets or caulking once the bars are installed and secured. The contractor shall design and fabricate steel racks with retaining straps or steel boxes to secure the ballast in place.



The contractor may propose alternatives to lead ballast for consideration by the Owner. Any such alternative must be securely stowed to prevent shifting, easily removable from the vessel, and allow for inspection of the hull in way of the ballast.

The fixed ballast shall be installed prior to the final stability test required by USCG as established by NVIC 5-82 for Fixed Ballast.

Group 200 – Propulsion Machinery

200 General

This Section describes requirements for the Vessel's main propulsion system and supporting auxiliary systems. Supporting auxiliary systems for other fuel oil consumers including generators are also described herein as are general machinery arrangement requirements.

Refer to Sections 500 through 505 for general piping requirements.

200.1 Introduction

A main propulsion system, including auxiliary systems, as described in the Contract Documents shall be installed. The propulsion system is for a single-ended design, with two fixed-pitch propellers at the stern, and a transverse thruster at the bow. The propulsion machinery installation will consist of two non-reversing, 4-stroke, turbo-charged diesel engines, each connected through reversing reduction gears to a propeller and a single diesel engine driving the transverse thruster.

All provided machinery, equipment, and installation thereof shall meet all applicable Contract Documents and Regulatory Body requirements. Refer to Section 180 for machinery foundation requirements. Each piece of equipment shall be installed, aligned, and fastened within the tolerances prescribed by the manufacturer.

Insofar as practicable, similar items of machinery and equipment such as electric motors, starters, controllers, and distribution panels shall be supplied by a single manufacturer for spare parts interchangeability.

200.2 Machinery Vibration and Noise Control

Machinery and equipment selections, mounting details, and acoustic treatments have been selected to minimize vibration in the equipment and the Vessel. The entire machinery installation shall be free of excessive vibration while operating. Machinery vibration levels shall not exceed manufacturers' requirements and shall comply with the requirements of Section 073.

Resilient mounts shall be provided for vibration-inducing and vibration-sensitive equipment. The main engines shall be resiliently mounted, and ship service generators shall be resiliently mounted on manufacturer-provided skids. Exhaust shall be resiliently mounted as discussed in Section 259. Where necessary to achieve the noise and vibration requirements of Section 073, other machinery shall be isolated from the hull with vibration isolating mounts. Resiliently mounted equipment shall incorporate the appropriate flexible connections, which may include piping, electrical cables, grounding straps, ducting, and exhaust.



Where the Contractor is responsible for equipment or machinery selection, foundation design, or equipment mounting, the Contractor shall ensure that the design and installation minimizes structure-borne and airborne noise, such that the limits of Section 073 are not exceeded.

200.3 Machinery Arrangement

Machinery shall be arranged as generally shown in Reference (G). The Contractor is responsible for detailing the final machinery arrangements and systems based on final equipment selections, final arrangements and systems shall be approved in writing by the Owner prior to installation.

THE ARRANGEMENT OF MACHINERY AND DEVELOPMENT OF SYSTEMS REFLECTED ON THE CONTRACT GUIDANCE DRAWINGS IS BASED ON PARTIAL AND PRELIMINARY DATA. THE CONTRACTOR IS RESPONSIBLE FOR RE-ENGINEERING THE MACHINERY ARRANGEMENT AND SYSTEMS TO SUIT THE INSTALLED ENGINES AND REDUCTION GEARS.

Machinery and equipment installations shall be in accordance with Section 071.

Provisions shall be made for handling all major components of the main and auxiliary machinery including main engines, reduction gear, generators, compressors, pumps, and motors. Pad eyes for equipment removal and maintenance shall be arranged and installed. The pad eyes shall be sized and located so that all items of equipment too heavy to lift by hand for maintenance can be tended by two or more pad eyes. Pad eyes shall be mounted to primary structure. The capacity of each pad eye shall be permanently and prominently labeled. Where pad eyes are located on structure covered with structural fire insulation, they shall extend below the insulation and be provided with a removable muff to maintain the fire boundary.

In addition, trolley beams shall be installed for engine and generator maintenance in the Engine Room. Beam and trolley are to be sized and arranged to suit installed equipment.

233 Main Engines

The main propulsion engines shall be Caterpillar (CAT) 3512E, A Rated, 1341 HP at 1,600 RPM and arranged for keel cooling. The engines shall be provided with certification and technical files for compliance with EPA Tier 4 emissions requirements.

The Contractor shall supply the main engines and all necessary auxiliary equipment and systems to support the installation and commissioning of the propulsion engines. The Contractor shall install the engines in accordance with all manufacturer and regulatory requirements, and provide foundations as described in Section 180.

Each engine shall be resiliently mounted to reduce vibration and noise transmission to the ship structure. All cables, pipes, exhaust, and hoses connected to the engines shall be suitably flexible to withstand normal vibration and movement without damage or transmission of excessive vibration to surrounding structure. Hoses shall be routed with bends to prevent tethering.

Each engine shall have alarm, monitoring, and safety shutdown functions as required by the Regulatory Bodies. Each engine shall have high coolant temperature and high lube oil temperature alarms, and automatic shutdown upon overspeed, low lubricating oil pressure, high jacket water temperature, or upon release of the Engine Room fixed firefighting system.



Each engine shall be provided with manufacturer specified air filters, fuel filters, oil filters, lubricating oil, coolant, belts, and other consumables necessary to provide an operational installation. Each engine shall also be fitted with a fuel oil cooler.

Each engine shall be fitted with a 9 kW pump circulated jacket water heater. The heater shall be thermostatically controlled and interlocked such that it is not energized when the engine is running.

The Contractor shall provide the services of a CAT authorized technician to oversee commissioning, initial startup, and testing of main engines. CAT test reports of initial startup shall be provided to the Owner.

The main engines shall not be started for the first time without the prior approval and on-scene presence of the Owner's and manufacturer's technical representatives. Refer to Section 982 for test and trial requirements.

Each engine shall be provided with an electronic monitoring system, with a display panel located at each control station. Local engine monitoring and control shall also be provided at each engine. Propulsion controls are described in Section 252.

241 Reduction Gears

Two marine reduction gears, ZF Model W8300 shall be installed. The reduction gear ratio shall be between 3.538:1 and 4.174 (inclusive) subject to final propeller selection per Section 245. Each gear shall have a flanged input for remote mounting, flanged output, mating flange, and integrated shaft brake. The Contractor shall provide and install the reduction gears and all necessary ancillary materials and equipment required by the manufacturer for a complete operational system. The port and starboard reduction gears shall be arranged for opposite port/starboard propulsion shaft rotation when driven by standard rotation engines.

The reduction gears shall be remote mounted from the main engines in and coupled to the main engine via a torsional coupling / high speed shaft assembly described in 243.2. Each gear shall be rigidly mounted to its foundation resin chocking compound, Chockfast Orange or equivalent.

243 Propulsion Shafting

243.1 General

Two complete propulsion shaft systems shall be provided as described herein. The propulsion shafting system shall comply with applicable USCG requirements including all regulatory documentation, failure modes analyses, and testing and verification procedures. The shafting arrangement shall be modified as necessary to eliminate serious torsional, flexural, and longitudinal vibrations within the normal and emergent operating conditions of the propulsion system.

Calculations

Calculations shall be performed as required to finalize design of the propulsion shafting. A propulsion system vibration analysis, including torsional and lateral (whirling) vibration of the complete finalized drivetrain, including the propulsion engines, reduction gear, couplings, bearings, shafting, and propeller, shall be provided. The analysis and findings shall be submitted to the Owner and each drivetrain component supplier for approval prior to finalizing the system arrangement and start of component



fabrication. Approval from each drivetrain component supplier shall include confirmation of the mass elastic data used in the analysis, and confirmation that the findings are within acceptable limits.

Installation and Alignment

The main propulsion machinery shall be installed and aligned within the tolerances prescribed by the manufacturers and in accordance with Reference (R21) and Regulatory Body requirements.

An alignment procedure shall be submitted to the Owner for approval at least 30 days prior to the start of shafting system installation. A description of the intended setup procedures, alignment offsets, alignment equipment to be used, component maximum tolerances, maximum expected engine movements, inspection hold points, and hot and cold loads shall be included in the procedure.

Each stern tube, bulkhead seal, and bearing assembly shall be initially aligned using laser alignment tools in accordance with the approved procedure. Final alignment shall utilize the strain gauge method. Prior to final alignment, all major machinery shall be installed, all welding of Vessel's primary structure and superstructure completed, and the Vessel shall be afloat with no list or trim at light operating draft. Alignment shall be witnessed by the Owner and shall be subject to Owner approval.

Alignment results, including bearing reactions and influence numbers, shall be submitted to the Owner's and manufacturers' representatives for approval prior to pouring chocking compound or installing alignment dowels. A final alignment check after all chocking is complete shall be completed. A report setting forth the final readings and approvals with comments shall be submitted for Owner's approval prior to commencement of Dock Trials.

243.2 High Speed Shaft / Torsional Coupling Assembly

The reduction gear shall be coupled to the main engines with an input shaft and torsional coupling, Vulkan Model VKF 5710-4100/21 or equal, subject to verification during detail design of the propulsion system. Final selection of the input shaft and torsional coupling assembly to be selected based on the results of a torsional vibration analysis and a 6-DOF analysis of the engine resilient mounting system. Final coupling selection is subject to engine and gear manufacturer approval as described in Section 243.1.

243.3 Line and Tail Shafts

The line and tail shafts shall be solid Aquamet 17, Aqualoy 17, or equivalent straightened, turned, and polished with the following minimum physical characteristics:

Tensile Strength	135,000 PSI
Yield Strength	70,000 PSI
Elongation in 2 in.	16%
Reduction in Area	50%

The tail shafts shall be 5-1/2" diameter. The forward end of the tail shaft shall be machined to suit the stern tube seal and line shaft coupling. The propeller end shaft taper, threads, and propeller nut shall be machine to SAE J-755 standard dimensions.

The line shafts shall be 5" diameter. The aft end of the line shaft shall be machined to suit the line shaft coupling and the forward end shall be machined to suit the reduction gear companion flange.



243.4 Couplings

Couplings joining the line shafts to the tail shaft shall be hydraulic shrink-fit couplings, SKF "OKC" series or equal. The couplings shall be installed according to manufacturer's instructions. The couplings and polished shaft surfaces to each side of the couplings shall be protected against corrosion using plastic shrink wrap.

One hydraulic pump and associated equipment required to install or remove the SKF couplings shall be provided for delivery with the Vessel.

The line shafts shall be coupled to the reduction gear output flanges using the gear manufacturer provided counter flanges. The contractor shall machine forward end of the line shaft and counter flange to suit.

243.5 Shaft Ground Assemblies

Each propeller shall be fitted with a shaft grounding assembly with clamp on silver band, spring compression carbon brush, and brush arm and holder. The shaft ground assembly shall be installed as close to the stern tube seal as possible while still allowing adequate working room for seal maintenance. A copper grounding strap shall be fastened to nearby primary structure.

243.6 Line Shaft Bearings

One Craft split roller bearings Type S1 BCH 500 FL, or equal, shall support each line shaft. The bearings shall be aligned on their foundations, using Chockfast Orange resin. The line shaft bearings shall be factory drilled for installation of RTD temperature detectors.

243.7 Line Shaft Bulkhead Seals

The Contractor shall provide and install mechanical bulkhead seals where the line shafts penetrate the Engine Room aft bulkhead. Bulkhead seals shall be EagleBurgmann Espey WDK-BHS, Wartsila Manesafe Type ND, or equal.

243.8 Stern Tube

The stern tube shall be constructed of 12" OD by 8.5" ID steel mechanical tubing. The stern tube assembly shall have holes drilled and tapped to accommodate 1/2" Allen head alignment screws for fore and aft stern tube bearing alignment. Fill and vent holes shall also be bored in the stern tube to allow the casting of the poured resin chocks.

243.9 Stern Tube Bearings

Each stern tube assembly shall have water lubricated forward and aft stern tube bearings, Johnson Cutless. Cooling water injection for the stern tubes shall be provided as described in Section 256.1. Each bearing shall be aligned using Chockfast Orange resin, or equal. Bearings shall be liberally coated with resin release prior to pouring.

243.10 Forward Stern Tube Seals

The forward stern tube seals shall be Duramax Drymax, Simplex Simplan, or equal. Cooling water for the stern tube seals shall be provided as described in Section 256.1. A sump and pump with float switch shall be installed under each stern tube seal as described in Section 256.1.



243.11 Shaft Guards

The Contractor shall provide and install shaft protective guards constructed of 2" x 2" x 1/4" angle frames and 1/4" aluminum diamond plate. Guards shall be attached to framing with 3/8" diameter flat socket head countersunk stainless steel machine screws. Angle frames shall be drilled and tapped.

Rubber isolation material 1/8" thick shall be installed between angle and aluminum plating.

Hinged covers shall be installed in way of bearings and other equipment requiring periodic maintenance. Hinges shall be stainless steel.

243.13 Shaft Tachometers

Each propeller shaft shall have an independent tachometer system (PMC 8502, or Owner-approved equal). Each tachometer system shall consist of a magnetic pickup, signal processor, and two bi-directional analog tachometer displays at each operating station.

The Contractor shall rigidly mount the magnetic pickups such that they are aligned with vendor-supplied magnetic tape installed on each line shaft. All components of the shaft tachometer systems, or their enclosures, shall meet NEMA 250 type 4 or 4X requirements.

The tachometers shall be flush mounted and display bi-directional shaft RPM between 0-550, in 10 RPM increments with each 50 RPM emphasized and each 100 RPM labeled. Tachometers shall be self-illuminated (with dimmer). The systems shall be powered from 24Vdc.

245 Propellers

Provide and install two fixed-pitch propellers fabricated, machined, and balanced in compliance with ISO 484/2 Class 1 standard. Design propellers to accommodate rope guards and lifting/pulling bolts. Propellers shall be thoroughly stress relieved prior to machining and finishing. Propellers shall be dynamically balanced and the trailing edges of blades shall be properly ground to prevent "singing." Propellers shall be secured to the tail shafts with propeller nuts, which upon final fitting and tightening shall be locked to the propeller with a locking tab or similar.

Each propeller shall be five-bladed, Ni-Al Bronze, and 66 inch diameter. The hub and blades shall be capable of absorbing the full rated output of the main propulsion engine at maximum pitch and RPM. The propeller geometry shall be selected to obtain the best possible combination of efficient propulsion and minimum vibration of the propulsion machinery and ship's hull. The design of the propeller and determination of the propeller characteristics shall be based on the results of a propeller selecting study, which may be provided by the propeller vendor. The analysis shall include assessment of cavitation extent, efficiency, and predicted alternating thrust, and provide a cost/benefit analysis comparing stock propeller performance with a skewed and/or wake adapted design considering capital cost, repair cost, and fuel savings.

The reduction gear ratio and pitch ratio may be modified if necessary to align with final propeller selection. Gear Ratio based on specified ZF 8300 can be 3.538, 3.760, 3.958 or 4.174 to reduce propeller RPM. Propeller selection shall be coordinated with reduction gear purchase to accommodate lead time.



Propeller direction of rotation shall be inboard. The starboard side propeller shall be left-handed (counterclockwise turning when viewed from aft), and the port side propeller right-handed (clockwise turning when viewed from aft).

252 Propulsion Controls

The vessel shall have an electronic propulsion control system, ZF TotalCommand or equal, supplied by the reduction gear supplier. The propulsion control systems shall be installed and adjusted under the supervision of the manufacturer's authorized representative.

Control of each propulsion drive train shall be achieved through the use of combined speed/direction control levers.

Remote controls for the port and starboard main engines and the bow thruster shall be installed in the Pilot House, Bridge Wings, and Aft Control Station. The port and starboard engines shall be controlled from a single, dual lever control head. The bow thruster shall be controlled from a separate control head, mounted so the handle moves athwartship.

Additionally, local throttle and clutch controls shall be provided in the Engine Room. The Engine Room control station shall have a single speed/direction lever on for each engine. The local propulsion system control heads shall be mounted in the Engine Room adjacent to main engines, within sight of both the shafting and the engine mounted gauges.

Each control station shall have an LED that illuminates to indicate when the station is in control. The Engine Room control station shall be considered the "master" control station and shall have a two-position control transfer switch to toggle between "local" and "remote" control. When the switch is turned to "local," control shall be retained at the Engine Room station. When the switch is set to remote, control may be transferred to one of the two remote stations.

Each remote station shall have a control push button that will allow an operator to take control when the button is depressed, and the Engine Room control station is in "remote" control. Control transfer between stations will not occur unless the throttles at both stations are set to the idle position.

Starting for the main engines shall be provided from the Engine Room, Pilot House, and Aft Steering Station. Shutdown of the engines shall be actuated by 24 VDC shutdown switches located in the Engine Room, Pilot House, and Aft Steering Station. The switches shall be the guarded type to prevent accidental shutdown.

Each propeller shaft shall have an independent tachometer system as described in section 243.13.

256 Cooling Systems

256.1 Stern Tube Seal and Bearing Cooling System

The Contractor shall design and install a shaft seal and bearing cooling system for the vessel.

The Contractor shall provide two cooling pumps arranged in parallel so that either pump can provide a minimum of 12 gallons per minute to each stern tube, 24 gallons per minute total. Automatic balancing valves, Hays Mesurflo 2323 or equal, shall be installed in each seal branch to regulate flow. The water for



stern tube lubrication shall be injected at the forward stern tube seal via a connection port mounted on the seal. Stern tube cooling piping shall be galvanized steel.

A flow switch shall be provided in the supply branch to each seal, and a low flow alarm for each configured in the ship's alarm and monitoring system.

Arrange the system so that it can be completely drained for winter layup using compressed air to fully remove water from the stern tube cooling system.

Valves shall be provided to permit isolation of each pump and each shaft seal. A simplex strainer, bronze body with stainless steel basket, shall be provided on the suction side of each pump.

The Contractor shall provide a 1/4 HP centrifugal discharge pump in the sump below each shaft seal. Pumps shall be float-switch activated and shall discharge overboard just below the guard strake. The ship's alarm and monitoring system shall have a separate "pump running" alarm for each shaft seal pump, see Section 436.2.

Contractor shall provide and install all necessary ancillary materials and equipment, including but not limited to all foundations, fasteners, fittings, packing, lubricants, hoses, etc. for a complete and operational system.

256.2 Engine Cooling

The Contractor shall install cooling systems for each main engine, reduction gear, bow thruster engine, and ship's service generator on the vessel, generally as shown in Reference (H). Each cooling circuit shall be equipped with engine-driven close-coupled coolant pumps provided with the engine.

Cooling piping shall include USCG-approved flexible connections to accommodate engine motions and thermal expansion, valves to minimize coolant loss when servicing the heat exchangers and instrumentation as required for monitoring and diagnosis. Any high points in the cooling systems shall have valved vents. Provide engine manufacturer-approved corrosion inhibiting antifreeze for all engines in sufficient concentration to protect against freezing. Each cooling circuit shall be fitted with two 1" valved fill/drain connections located near each coolant supply and return pipe near the keel cooler connections.

Cooling system alarms for each cooling system shall be installed in accordance with USCG requirements and Section 436.

Propulsion Engine Cooling

Each main engine shall be equipped with two cooling water circuits as shown in Reference (H). The main engine aftercooler circuit shall also provide cooling for that engine's reduction gear. Each cooling water circuit shall have an independent packaged keel cooler, Fernstrum or equal. The keel coolers shall be sized for 100% engine load in 75° F ambient water temperature at a vessel speed of 3 knots, and a 50% ethylene glycol mix.

Generator Engine Cooling

Each generator engine shall be equipped with two cooling water circuits as shown in Reference (H). Each cooling water circuit shall have an independent packaged keel cooler, Fernstrum or equal. The keel



coolers shall be sized for 100% engine load in 75° F ambient water temperature at a vessel speed of 0 knots, and a 50% ethylene glycol mix.

Bow Thruster Engine Cooling

The bow thruster engine shall be equipped with two cooling water circuits as shown in Reference (H). Each cooling water circuit shall have an independent packaged keel cooler, Fernstrum or equal. The bow thruster engine aftercooler circuit shall also provide cooling for bow thruster reduction gear. The keel coolers shall be sized for 100% engine load in 75° F ambient water temperature at a vessel speed of 0 knots, and a 50% ethylene glycol mix.

259 Engine Exhaust Piping

The Contractor shall provide and install a complete exhaust system for each diesel engines.

The Contractor shall verify that the main engine and generator engine back pressure does not exceed the manufacturers' requirements. Weight transmitted to the engine connection is not to exceed the manufacturers' recommendations in hot and cold conditions.

Each diesel engine shall exhaust through a separate pipe and silencer. The main and auxiliary diesel engine piping shall be grouped within the engine casings and lead up individually to the weather as shown by References (B) and (G). The bow thruster engine exhaust shall be routed from the Bow Thruster Room through the overhead of the car deck and engine casing to weather, generally as shown by References (B) and (G).

259.1 Materials and Installation

Each main engine exhaust pipe shall not be less than 14" diameter between the engine outlet and exhaust silencer, and not less than 12" diameter from silencer to outlet. The generator and bow thruster exhaust pipes shall not be less than 6" diameter.

Exhaust pipe spools, expansion joints, and silencers shall be DeAngelo Marine Exhaust or Owner approved equal.

Exhaust pipes shall be fabricated from 14 Gauge 316L stainless steel.

Stainless steel rain hoods or similar arrangements shall be provided at the funnel diaphragm plate to prevent ingress of water.

Exhaust take down joints shall be lightweight 316L plate flanges drilled to ANSI B16.5 standard. Flange material shall be ASTM A182 GR316L.

The main engine, generator, and bow thruster exhaust silencers shall be spark arresting. Silencers shall be selected such that noise levels on the vessel will meet the requirements of Section 073. Silencers shall be fabricated from carbon steel. Flanged connections shall be provided to all silencers.

A flexible bellows shall be provided at each engine exhaust outlet to allow for vibration and thermal deflection. The flexible bellows shall be multi-ply convoluted stainless steel tube (single ply bellows are not acceptable), with fine pattern convolutions and flanged ends. Flow direction shall be permanently marked on the exterior. One flanged end of each flexible connection shall be a "Van Stone" type.



Additional flexible bellows shall be installed as needed to provide for thermal expansion. These assemblies shall be similar to those provided at the engine exhausts outlets, except that they need not be multi-ply.

A system of resilient mounts shall be installed to support exhaust system. The mounts shall be designed to allow adequate thermal movement without straining the piping, machinery, or ship structure and to minimize heat and vibration transfer. Heat stops shall be fitted to insulate the piping and silencers from the structure. The mounting system shall utilize a combination of captive rubber mounts, bonded tube rubber hangers, and combination steel and rubber vibration isolators. Acceptable manufacturers include Christie & Grey and Rubber Design.

All exhaust pipes shall be fitted with drains at the bottom end of vertical piping runs. Drains shall consist of threaded steel half-couplings welded to the pipe. Schedule 40 pipe shall be threaded into the half couplings and capped with 1/2" inch ball valves.

Watertight, flanged heat reducing flexible penetrations, Rubber Design or equal, shall be used where exhaust piping penetrates watertight bulkheads or decks. The bulkhead penetrations shall incorporate heat stops between the pipe and structure, shall be bolted in place for ease of maintenance, and shall maintain the watertightness and fire rating of the boundary penetrated.

259.2 Engine Exhaust Insulation

Engine exhaust systems shall be insulated from the connection at the engine up to the funnel diaphragm.

Exhaust piping, SCRs, and silencers shall be insulated with removable exhaust blankets fabricated from needled glass mat with a stainless steel mesh interior liner and silicone impregnated glass cloth covers. Thickness of the exhaust blankets for all piping in crew accessible areas shall ensure that the surface temperature of insulated pipe or components does not exceed 125°F. Blankets shall be fastened using stainless steel hooks and lacing. Blankets in the Engine Room shall be fabricated in sections no longer than six feet to permit removal for maintenance.

259.3 AUS Dosing System

An AUS (aqueous urea solution) dosing system shall be installed for each main engine in accordance with the engine manufacturer and Regulatory Body requirements. The system shall be complete with all components necessary for satisfactory operation. The finalized system shall be approved by the Owner prior to installation of system components.

All materials in contact with AUS shall be compatible with AUS32 and UAS40. Materials shall be selected Refer to ISO 22241 and ISO 18611 for material selections.

Provide and install one urea tank with 1,300 gallons capacity. The urea tank shall be an independent stainless steel tank of material suitable for AUS storage and have all the features listed below:

- One 1 1/2-inch fill, with a Camlock fitting
- One 2-inch vent to main deck
- One sight gauge, Gems Suresite or equal
- One tank level indicator (TLI), refer to Section 437
- One temperature transducer



- One thermometer
- One 1-inch drain at bottom of tank, with ball valve and threaded plug
- One bolted inspection and access hatch, on or near top of tank
- Supply, Return, and Overflow connections as required for AUS Dosing System

The urea tank shall be located in the engine room to prevent freezing during layup, and the area surrounding the tanks shall be ventilated as described in Section

The AUS dosing system for each engine consists of one AUS dosing cabinet and one SCR. Urea is supplied to the dosing cabinets by a CAT supplied transfer pump. Each dosing unit subsequently meters urea to one main engine SCR from an internal buffer tank.

All tubing connecting the urea tank, transfer pump, dosing cabinets, and SCRs shall be 316L stainless steel tubing with stainless steel tube fittings. Utilize tube bends to minimize the number of fittings in each line. The stainless steel tubing shall be connected to the dosing cabinets and SCRs with short flexible hoses having SAE J2044 end fittings.

Full port stainless steel isolation ball valves shall be installed at the tank suction and at the inlets and outlets of each piece of dosing equipment to facilitate operation and maintenance.

All components shall be selected, sized, and arranged in strict accordance with the engine manufacturer's requirements.

261 Fuel Service System

Provide and install a complete fuel oil piping system to all diesel engines in accordance with Reference (I), 46 CFR 119.455, and other applicable CFR sections.

Fuel shall be supplied from an integral fuel oil tank. The tank shall have a capacity of 9,525 gallon capacity and shall be fitted with the following.

- One 3 inch fill line led from the shore fill station mooring station on the vehicle deck.
- One 4 inch goose neck vent fitted with a stainless steel flame screen
- One 1 inch drain fitting with valve and threaded plug located near the bottom of the tank.
- One sounding tube
- Two inspection and access manholes
- One magnetic flag style level indicator, Gems Suresite or equal, located in engine room.

See Section 437 for tank level indication requirements.

The tank fill and vent shall be routed to the Vehicle Deck fueling station, where shown on Reference (B).

The fuel supply connection from the tank shall be fitted with a shut off valves located as close to the tank as practicable. The fuel tank shut-off valves shall be arranged to provide fuel oil shutoff from the Main Deck with a stainless steel flush deck box and remote reach rod.



Group 300 – Electrical Systems

300.1 General

A complete electrical system, including wiring and equipment, as described in the Contract Documents shall be installed. The shipboard electrical system shall derive power from either the ship's service diesel generators, or from the shore power connection. Power shall be distributed via the main switchboard and associated power distribution panels. See Section 324 for switchboard operations.

The generated voltage for this vessel is 208Y/120 VAC, 60 HZ, 3-phase/4-wire, grounded neutral. Auxiliary machinery control voltages shall be 120 volts or less, provided by internal and suitably sized control power transformers, when the control circuit extends outside the control enclosure. This includes such circuits as thermostats, motor control, remote shutdowns, lighting, general outlets and indicator and operator controls. Power for the control and alarm system shall be 24 VDC. Any deviations from the assigned voltages shall be subject to Owner's approval.

All equipment, materials and workmanship shall fully comply with the requirements of 46 CFR Part 120.

The installation of electrical equipment and wiring required by items specified in other sections of this Specification shall be provided and installed whether or not specifically called for in this Section. Cable and circuit breaker sizing shown in the Contract Guidance Drawings are for guidance only. The Contractor shall be responsible for final design sizing in accordance with the applicable Regulatory Body requirements and final equipment selections.

A continuous record of changes in electrical load conditions due to design development during construction and from final selection of equipment shall be maintained. Electrical load changes shall be reported to the Owner as an electrical loads analysis on a monthly basis as part of the progress meetings set forth in Section 040.1.

A laminated copy of the final as-built electrical one-line shall be provided and mounted in the vicinity of the respective switchboard as identified in Section 324 of this Specification.

Circuit design schematics shall be mounted on the inside cover of motor controllers along with other pertinent system data such as overload heater and fuse sizes.

300.2 Arrangement of Equipment

The arrangement and installation of the electrical equipment shall be generally as shown on the Contract Guidance drawings. Electrical equipment and components shall be located in a manner that facilitates efficient operation and allows for ease of maintenance. The final electrical equipment arrangements and systems details, including equipment not shown on Reference (J), based upon final equipment selections, shall be approved by the Owner prior to installation. Electrical equipment arrangements shall allow for minimum maintenance clearances as detailed in References (R1) and (R11).



300.3 Equipment and Materials

Equipment, materials, and workmanship shall be as set forth in Section 076.

Equipment requiring external wiring shall have suitable terminal boards or blocks with solderless terminals to which the Contractor shall make the connections.

The maximum allowable temperature rating for any equipment or wiring shall be in accordance with the applicable Regulatory Body and vendor requirements.

Waterproof metal enclosed equipment, NEMA Type 4X, and impervious sheathed wiring shall be used in locations subject to condensation, on all weather decks, and areas subject to wash down by hose such as the Vehicle Deck and Engine Room.

Drip-proof enclosures shall be used for all other equipment. NEMA Type 12 enclosures with oil resistant synthetic gaskets will be acceptable as drip-proof. Rotating machinery shall be protected with drip-proof enclosures.

Connection boxes, outlet boxes, junction boxes, light fixtures, and similar wiring fittings and fixtures installed in locations exposed to weather, condensation, or excessive dampness shall be watertight. They shall be brass, bronze, copper free aluminum, or other approved non-corrosive material.

Electrical equipment, wiring, and spare parts shall be suitably protected against corrosion, moisture, mold, or other destructive agents to which the Vessel may be exposed during normal operation. In general, the equipment shall be finished to suit the space in which it is installed. For painting requirements see Section 631.

300.4 Equipment Nameplates and Markings

See Section 602.5

300.5 Electrical Bonding

All conductive electrical enclosures or equipment shall be electrically bonded to the Vessel's structure. Provide and install bonding/equipment grounding systems in accordance with 46 CFR §120, and Applicable Regulatory Body Requirements.

Bonding shall be ensured by mounting equipment directly to ship structure or by using flexible copper cable or straps sized per the National Electrical Code (NEC). Either method shall form a positive ground connection from the enclosure to Vessel's structure. Ground metal frames of portable lamps, tools and other similar cord and plug apparatuses supplied as ship equipment through a suitable conductor in the power supply cable at the ground pole of all receptacles.

302 Motors and Controllers

302.1 Electric Motors

General

Motors shall meet the design, performance, application, and installation requirements defined herein, while meeting the applicable requirements of the USCG. To the extent possible, all motors shall be



provided by a single manufacturer. Exceptions are special electronic equipment and small fractional horsepower units.

Motors shall comply with Reference (R11) where identified as such in the Contract Documents (where so identified, standard equipment motors shall be replaced if not in compliance with Reference (R11)).

Rating

Unless otherwise defined in these Specifications or the Contract Guidance Drawings, when describing specific equipment motors, 1/2 horsepower and larger shall be 3-phase, 208 VAC, 60 Hz squirrel cage induction types, sized for continuous duty. Motors less than 1/2 horsepower may be single phase, 120 VAC, 60 HZ.

Motors in the Engine Room, Bow Thruster Room, and Steering Gear Room shall be rated for 50° C ambient temperature.

Motors, unless otherwise defined, shall be NEMA Design "B" torque characteristics.

Electric motor continuous duty service factors shall be a minimum of 1.15 with Class F or better insulation.

Motors shall meet or exceed NEMA Premium Efficiency ratings unless otherwise specified or Approved by the Owner.

Electrical Characteristics

All motors shall be suitable for full voltage across the line starting. Locked rotor and breakdown torques, and locked rotor currents shall be as specified in the NEMA standards for the design application. Motors 1/2 HP and less shall be equipped with line current interrupting, automatic reset, and thermal protection.

Mechanical Characteristics

Motors shall be totally enclosed, fan-cooled (TEFC) unless otherwise noted. Motors in direct drive axial fans may be totally enclosed, air over (TEAO). Motors shall have marine grade corrosion resistant coating. Motors shall be inverter duty rated when controlled by variable frequency drives.

Nameplate Data

Each motor shall be fitted with a nameplate as described in Section 602.5, and include the following minimum information:

- Manufacturer's type and frame designation
- Rated horsepower
- Rating classification
- Design ambient temperature
- Temperature rise at rated load
- RPM at rated load
- Voltage
- Amperes at rated load
- Number of phases



- Frequency
- Service Factor if above 1.0
- Code for locked rotor KVA on motors 1/2 hp and larger in accordance with NEMA standards

A motor data booklet shall be submitted to the Owner prior to Vessel Acceptance. The booklet shall list all electric motors throughout the Vessel. The booklet shall contain the following information for each motor

- Complete nameplate data
- Location of each motor on the Vessel
- Motor service and circuit number
- Manufacturer's name, address, local representative

302.2 Variable Frequency Drives

All variable frequency drives (VFDs) shall be of a commercial off the shelf design, suitable for a marine environment. The system design shall ensure that the total harmonic distortion in the power system and the VFD's effect on the power distribution system is within Class Regulatory limits under all operating conditions. Any necessary special cabling or installation requirements shall be included as part of the scope of supply. Motors and cabling connected to the output of VFDs shall be rated to handle the associated conditions.

Each VFD shall be sized for the motor it is powering at its maximum current requirements at peak torque demand.

302.3 Motor Controllers

General Requirements

Motor controllers shall be marine type, complying with the requirements of the Underwriters Laboratories, Inc. Standard for Industrial Control Equipment and USCG 46 CFR Subchapter K. Controllers shall be supplied by one manufacturer, Square D or equal, to the maximum extent possible.

208 VAC motor controllers shall be connected to the ship's electrical system with 4 conductor cable, such that 120 VAC power for control and indication functions can be derived without the usage of transformers.

Illuminated pushbuttons shall be provided for "Motor Running" indication and speed and direction where applicable. Run indicator lights shall be green for single speed motors; amber for low speed and green for high speed in the case of two speed motors. Automatic controllers shall have blue indicator lights for automatic control, and green for motor running on "hand-off-auto" or "off-auto" controllers.

Operating controls shall be mounted in the front panel of the enclosure and push-to-test motor running pilot lights shall be provided.

Controllers shall be located near the motor served.

Reduced voltage type controllers are required for larger motors to limit current inrush to acceptable limits for the generator and minimize voltage dip. The Contractor shall prepare voltage dip calculations to verify proper selection of controllers for the service intended.



Drawings and technical information of the motor controllers shall be submitted to the Owner for approval prior to issuing a purchase order.

Combination Starters

Combination type controllers shall be provided for all motors 1/2 horsepower and larger. Motors less than 1/2 horsepower shall be provided with LVRE motor switches.

All controllers shall incorporate a circuit breaker that opens all phase conductors, either within the controller or in the supplying panel. An external disconnect suitable for lockout shall be provided on each motor controller. An overload or fault on any conductors shall open all phase conductors. Each conductor shall be provided with both short term (instantaneous magnetic) and long term (thermal) trip protection (except for the Steering Gear, which shall be provided with instantaneous-only trip). Each motor controller shall be labeled with the load description and circuit number.

Variable Frequency Drives

Where variable frequency drives (VFD) are specified, they shall be programmed for system operation under each mode of operation. Local and remote control stations shall be provided with illuminated push buttons that select/indicate the mode of operation as indicated in the Contract Documents.

Label each VFD with the load description and circuit number.

Nameplate and Wiring Diagram

Controllers shall be labeled as described in Section 602.5 and include the following minimum information on a corrosion resistant nameplate:

- Service
- Manufacturer, type, and serial numbers
- Voltages and phases
- Current or horsepower
- Operating instructions if any
- Circuit designation

A laminated copy of the wiring diagram for each controller as installed shall be permanently mounted inside the cover. Terminals shall be clearly identified.

Spares

The Contractor shall provide the following spares for controllers:

- One set of contacts
- One operating coil
- One overload relay heater for each phase, or solid state overload relay, as applicable
- One pilot light lens and lamp for each 10 identical parts, or fraction thereof.

303 Fire/Ventilation Shutdown Circuit

Machinery space ventilation requirements are set forth in Section 513.



Ventilation fans, fuel consuming machinery, and fuel oil pumps shall be provided with separately fused, remotely tripped motor controllers or under-voltage trip circuit breakers that will shut down upon interruption of the shutdown circuit. The Vessel shall be equipped with separate Engine Room and Bow Thruster Room fire and ventilation shutdown circuits. The Engine Room shutdown circuit shall be controlled from the Pilot House and Engine Room access. The Bow Thruster Room shutdown circuit shall be controlled from the EOS and the Bow Thruster Room access. Each shutdown station shall be equipped with ventilation shutdown and reset buttons. The buttons shall be labeled, accompanied with instructions, and guarded to prevent inadvertent operation. The ventilation shutdown circuits shall also be activated upon release of the fixed gas suppression system in the space served.

310 Generators Sets

The Contractor shall install two ship service generators powered by diesel engines, Caterpillar C9.3 or equal, with a continuous rating of 300 kW at 1800 rpm, 208 volts, 3-phase, 4 wire, 0.80 power factor, 60 hertz. **The Contractor may propose alternative, optimized generator sets of reduced capacity, such as Caterpillar C7.1, subject to the approval of the Owner. The Contractor shall provide supporting documentation demonstrating the proposed system meets all vessel operational and mission load requirements and maintains the required redundancy and single-failure tolerance.**

The engines shall be four-cycle turbocharged/ aftercooled engines meeting EPA Tier 3 emissions standards. The engines shall be provided with all necessary documentation to demonstrate compliance with EPA emissions requirements.

Each shall be keel cooled with dry exhaust, engine driven jacket water and SCAC pumps, and 24 VDC electric starting. Each generator shall have an automatic voltage regulator. In addition, each generator shall have a voltage regulator cutout switch and manual voltage regulator, both located on the front panel of each generator control section of the switchboard

Each generator shall be provided with an electric heater to prevent condensation in the windings. The heaters shall automatically switch, ON when the generator is not running, OFF when the generator is running. Each diesel engine shall be provided with an electric, thermostatically controlled jacket water heater. Each generator shall be fitted with a fuel oil cooler.

Each generator set shall be resiliently mounted to reduce vibration and noise transmission to the ship structure. All cables, pipes, exhaust, and hoses connected to the generator sets shall be suitably flexible to withstand normal generator vibration without damage.

Each generator shall be complete with manual and automatic voltage regulation control modules and shall include local and remote monitoring and control. Power the governors, voltage regulators, and other control power consumers from battery banks or uninterruptible power sources. Jacket water pump, jacket water heater, water cooled exhaust manifold, flywheel with housing, and simplex fuel filter shall be provided and mounted to each generator set. Hoses shall be fire resistant. Cooling water expansion tanks shall be provided.

Each generator set shall have alarm, monitoring, and safety shutdown functions as required by regulation. Each generator set shall have high jacket water temperature and high lube oil temperature alarms, and automatic shutdown upon overspeed, low lubricating oil pressure, or high jacket water temperature.



The generator sets shall automatically shut down upon release of the fixed firefighting system in the Engine Room.

320 Power Distribution Systems

320.1 General

The distribution of ship service electrical power shall be as generally shown in Reference (J). The finalized system shall be approved by the Owner prior to installation of system components. See Section 030 for additional details regarding system drawings.

The ship service 208/120V distribution system shall have its neutral point grounded at the switchboard.

Single-phase loads shall be balanced between the three phases of the ship service distribution system. Each phase of the system shall operate within 15% of average current when the Vessel is operating under cruise condition.

All protective and control devices, and wiring shall meet the requirements of USCG.

320.2 Power Distribution

Power distribution to auxiliary machinery and to power and lighting branch circuit panel boards shall be individual circuits from the ship service switchboard. Engine Room and other auxiliaries shall be powered and controlled from individual motor controllers or VFDs.

Electrical equipment that is not specifically required to be portable shall be permanently connected to the ship's wiring. Where the use of flexible cord is unavoidable, the frame of the equipment shall be grounded by an additional conductor in the cord.

320.3 Convenience Receptacles

Electrical receptacles shall be provided on all decks and in all crew and passenger areas. The number of outlets shall take into consideration the number of passengers and crew in each space, providing sufficient receptacles to provide convenient access throughout Vessel. In Passenger Lounges, all booth or row seating areas shall be provided with a receptacle.

Receptacles shall be 120 VAC duplex receptacles, 2-pole, 3-wire (grounded), rated for 20A, and shall use side mounted screw terminals. Receptacles shall be grounded locally and through a grounding conductor extended to the panel supplying the circuit. Receptacles in the Pilot House, Crew Day Room, and all passenger spaces shall have integrated USB and USB-C charging ports.

Unless noted otherwise, receptacles shall generally be located approximately 18 inches above the finished floor or deck surface; however, receptacles on Main Deck shall be located at least 24 inches above deck. Where receptacles are located at tables, counters, consoles, seating, or workbenches they shall be placed above that surface.

All receptacles installed in machinery spaces or in exterior areas shall be watertight.

Receptacles shall be provided with GFCI protection in machinery spaces, in the crew space, cleaning gear lockers, heads, Main Deck, exterior areas, and at workbenches. GFCI protection may be provided via the branch circuit breaker, or with individual GFCI receptacles.



As a minimum, convenience receptacles shall be provided in the following locations and quantities. Those listed here shall remain available for vessel operations and shall be in addition to any utilized for installed equipment. Receptacle locations shall be spread evenly around a specified space; placement shall be subject to approval by the Owner:

Interior duplex-type receptacles:

- Pilot House – 2
- Electronics/Security Room – 4
- Crew Day Room – 2 with USB ports
- HVAC Fan Room – 2
- Aft Passenger Lounge – 12 with USB ports
- Aft Control Station – 1
- Observation Lounge – 15 with USB ports
- Washrooms, CG Locker, Em Gear Locker – 1 Each
- Stair Tower – 2

GFCI-protected duplex-type watertight receptacles:

- Deck House Top – 6
- Solarium/Upper Deck exterior – 8
- Bow Thruster Room – 1
- Car Deck – 6
- Engine Room/Machinery Spaces – 4

Receptacles mounted in lining panels or non-structural bulkheads shall be mounted with cover plates flush with the surface of the lining panel or non-structural bulkhead wherever possible. Use corrosion resistant fasteners to attach the wiring device enclosure to the plate.

320.4 Cableways and Wireways

Cables shall be routed in wireways wherever possible. Main wireways shall be provided between the Engine Room and Steering Gear Room, Engine Room, and Bow Thruster Compartment, and between the Engine Room and the Pilot House, HVAC Fan Room, crew spaces, washrooms, passenger spaces, and Aft Control Station.

Cableways shall be fitted with Regulatory Body approved marine cable transits wherever they transit through watertight or A-class decks or bulkheads. The transits shall be suitable for both unarmored and armored cable. Cables transiting through watertight or A-class boundaries shall be fitted or insulated, as appropriate, to maintain the integrity of the boundary. Signal and power cables shall be separated utilizing separate transits. Penetrations that must be watertight shall be STI Marine MPACT firestop system, or equal. Where firestops are not required to be watertight, STI Marine EZ-Path Series transits or equal shall be used to minimize future maintenance.

Penetrations for individual cables shall use stuffing tube or cable gland fittings to provide a watertight seal, which shall be compatible with armored or unarmored cable, as applicable.

Cables not routed in cableways shall be supported by galvanized steel or stainless steel hangers not more than 24 inches wide and spaced not more than 14 inches in a horizontal run, or 18 inches in a vertical



run. Hangers shall be strong enough to withstand short circuit conditions. Cable trays shall be installed to maintain sufficient clearance for painting vessel structure throughout the life of the vessel.

Cable banding shall be stainless steel.

Cableways and MCTs shall be sized to provide 30% capacity unused and available for future installations. Additional MCTs shall be installed in the Pilot House Deck under each console and at the perimeter of the Casing.

320.5 Electrical Cable

Electric wire and cable shall comply with Regulatory Body requirements, including 46 CFR. Power distribution cable shall meet the requirements of IEEE-1580. Cables shall use type LSX or LES insulation and type L or TPO jacketing. Unless required by Regulatory Body requirements, cable shall be unarmored and unshielded. Cable shall be TriCab type BV for unarmored applications, Type DV for armored applications, or equal. Cable shall be TriCab type DF for VFD applications, or equal.

All cables shall be concealed from weather to the maximum extent possible. Special cables may be used for electronic equipment as recommended by the equipment manufacturer.

No cable smaller than 4100 circular mils (14 AWG) in size shall be used for general power and lighting service.

Portable cables shall be heavy-duty rubber covered. Portable cables shall contain a conductor for equipment grounding.

Wire sizes indicated in the Contract Plans are for guidance only. The Contractor shall be responsible for calculating circuit voltage drops and determining the final wire size to comply with requirements of Reference (R11), based upon actual cable lengths.

320.6 Cable Installation

Cables shall be run as directly as possible, consistent with practical wireway grouping and similar factors, and in accordance with Section 320.4. Cables shall be run in continuous lengths without splices or junctions. Cables should not be double banked, but if unavoidable, the requirements of Reference (R11) shall apply. Cables that are subjected to mechanical damage shall be protected by metal guards. Likewise, cables subjected to potential moisture dripping shall be provided with sheet metal drip shields. Cables shall not be installed in bilges or other places where liquids may accumulate, unless being run to equipment located in those spaces. Wireways shall be installed in a manner that will minimize rat harborage.

Cables shall be identified and labeled in accordance with Section 602.5.

Cables shall be concealed in spaces that require lining.

Openings for passage of cables through non-tight bulkheads shall be collared with round bar or flat bar to prevent chafing. Cables not part of a cableway and passing through watertight bulkheads and decks shall be provided with stuffing tubes, or bulkhead transit fittings. Cables passing through decks shall be provided with kick pipes or trunks at least 10 inches high on the main and weather decks and 6 inches elsewhere.



Openings for passage of cables through non-tight bulkheads shall be edged with metal strips to prevent chafing. Cables passing through decks shall be provided with kick pipes or trunks at least 10" high in the weather, and 6" elsewhere.

Cable connections shall be made within equipment enclosures or standard approved appliances with terminal blocks. Terminal blocks shall be non-combustible moisture proof phenolic or plastic with barriers between terminals. Terminals shall be of the solderless type with conductor ends ferruled before attaching. The lugs shall be a type that will prevent turning.

All cables shall be secured adequately to prevent motion caused by vibration. Where wiring terminations are made within enclosures, junction boxes, or equipment, sufficient slack shall be included in the wiring to prevent tension or mechanical load on the wire connections. Wiring terminations may be made with screw-type terminal boards or ring lugs. Spade, pin, or fork type wire terminations are not acceptable.

320.7 Shore Power Connection

Shore power available at the ferry facilities is 208 VAC, 3-phase/4-wire, with ground. One 208 VAC, 3-phase/3-wire, with ground, 200A shore power receptacle shall be provided. The Contractor shall provide a complete plug/receptacle package, to be located on the Vehicle Deck, which ensures functionality with the existing available shore power supply.

The shore power connection shall supply an isolation transformer, which shall supply the ship service switchboard.

320.8 Electrical Distribution Panels

Power distribution panels shall be Square D Company, or equal, provided with automatic short circuit and overload protective devices matching the approved panels as described in Section 320.9.

Distribution panels shall be UL listed, bearing the UL label. The panelboard and protective devices shall be assembled into a single interior unit mounted in a steel enclosure, consisting of a box and front designed to be mounted on a bulkhead. The panels shall be of the dead-front type, designed for connection to a 208/120 V, 3-phase/4-wire AC source.

Panel enclosures shall be classed NEMA 12 in machinery spaces, NEMA 4X in exterior locations, and NEMA 1 in the Pilot House and dry accommodation spaces, and in accordance with Regulatory Body Requirements. Any panel that may be accessible to passengers is to include a latch and cylinder type lock with all locks keyed alike. Three keys shall be supplied to the Owner prior to Vessel Acceptance.

Each panel shall be identified in accordance with Section 602.5.

Circuit directory frames and cards, fitted with a clear plastic covering, shall be provided on the inside of each panel door as required by Regulatory Body requirements, including 46 CFR 111.40.

Within each panel, one spare circuit breaker and space for an additional circuit breaker shall be provided for every ten active circuits, or fraction thereof. Spare circuit breakers shall be of representative sizes of the circuits used in the panel.

320.9 Protective Devices

Branch circuit breakers shall be molded-case, Square D Type QO or equal, with thermal-magnetic trips. Circuit breakers shall be the quick-make, quick-break type and shall trip free upon overload or short



circuit. Tripping mechanisms capable of safely opening the circuit they protect while subjected to the maximum fault current. Individual breakers shall be factory sealed. Multi-pole circuit breakers shall have all poles shall be opened simultaneously by a common trip mechanism. Breakers shall be interchangeable and shall be capable of operating in any position. Panel feeder circuits shall use adjustable LSI trip circuit breakers as necessary to provide selective coordination.

Circuit breakers used for switching shall be switch duty rated. One spare circuit breaker and space for an additional circuit breaker shall be provided for every ten active circuits, or fraction thereof. Spare circuit breakers shall be of representative sizes of the circuits used in the panel.

Each feeder circuit breaker shall have an interruption rating not less than the maximum fault current available at the point at which the device is installed.

The use of fuses shall be avoided to the maximum extent possible. If used, fuses shall be of the cartridge nonrenewable type conforming to the standards of UL. Two spares of each type used shall be provided to the Owner prior to Vessel Acceptance.

320.10 Spare Parts, Tools, and Test Equipment

The following spare parts shall be provided:

- Fuses: 50% of each type and size installed, with a minimum of five each
- Switches: 10% of each type and size installed, with a minimum of one each
- Circuit Breakers: As specified for distribution panels and switchboards (see Sections 320.9 and 324.3)

The Contractor shall provide any special tools required to operate, maintain, or service any electrical equipment.

The following test equipment shall be provided:

- One digital multi-meter, Fluke 110 series or equal, capable of reading AC and DC volts, amps, and ohms
- One digital insulation resistance tester, Fluke 1520 meg-ohm-meter, or equal

324 Ship Service Switchboard

The switchboard shall provide for the control and protection of the ship's service generators, connection to shore power, and distribution of 3-phase, 208/120 VAC electrical power as shown on Reference (J). The switchboard shall provide for operation of either generator or shore power. The switchboard, located in the Engine Room, shall be mounted on an engineered foundation and sway braced to the surrounding structure. The height of the foundation shall provide sufficient clearance for cabling such that no cable is installed in the bilge.

The switchboard shall be constructed by a UL-891 certified facility which has been so certified for at least three years prior to the start of construction of the switchboard for this vessel. Verification of certification shall be provided to Owner's Representative.



The switchboard shall be installed in accordance with USCG 46 CFR 120.330. The Contractor shall prepare and submit a switchboard arrangement plan to the Owner prior to placement of the purchase order. The arrangement plan shall be detailed, complete with features and technical data on all devices.

The switchboard manufacturer shall provide wiring diagrams and shop drawings of the switchboard to the Contractor, and the Contractor shall provide same to the Owner for approval prior to fabrication. The drawings shall clearly show design, construction material, finish installation, front layout, point to point wiring diagrams, material list, mounting details, and label plate list including floaters for terminal blocks. The manufacturer shall provide three complete sets of as-built drawings of the switchboard and cut sheets of the components to the Contractor.

Switchboard components listed in this specification and all others required for a complete system shall be provided. The switchboard shall be furnished as specified herein and shown on Reference (J), and shall be installed and fully connected into the ferry electrical system by the Contractor.

The switchboard shall be demonstrated during onsite tests to fully provide operating logic that accomplishes the functionality and operation specified below.

Rubber mats with the required dielectric resistance shall be provided by the Contractor in front of the switchboard.

324.1 Switchboard Construction

Enclosure

The switchboard shall be drip proof enclosed, of dead front, all welded steel construction. All operating controls and indicators shall be front mounted and fully accessible by hinged panels. All other components shall be accessible by removable front, side, and rear panels. The switchboard front shall be adequately illuminated by normal lighting. Construction shall allow for adequate cable entry.

The switchboard frame shall be constructed of 12 gauge cold rolled formed steel and/or structural steel angles welded together into a rigid framework. The bottom shall be completely open for possible cable entrance. All front instrument panels shall be formed approximately 1 inch on all sides and hinged. Front panels covering molded case distribution circuit breakers shall be formed and bolted. Side and rear panels shall be flat sheets, bolted on. All formed and bolted panels shall be fastened with center seeking knurled head captive screws and floating nut block assemblies. All formed and hinged front panels shall be fastened with open and turn flush clamps. All hinged panels shall be equipped with door positioners for holding the panel in the open position during access to internally mounted components. Non-conducting grab rails shall be provided across the entire front of the switchboard.

Bus Bars

Bus bars shall be made of commercially pure copper and sized in accordance with Reference (R11). All bus bars shall be silver plated over their entire length. Bolts, washers, and nuts used to maintain bus contact shall be of corrosion resisting material or appropriately plated. All bolts in bus connections shall be tightened to an appropriate uniform torque value for each size bolt. After final tightening, each bus bolt, nut, and washer shall be marked with a line going across them to an adjacent area of the bus with a permanent black "marks-a-lot." The mechanical strength, bracing, and supports of the bus shall be designed to suit maximum available short circuit current.



Components

All electrical components shall be selected to operate satisfactorily in a 50° C ambient temperature and shall be as described below.

Circuit Breakers

Circuit breakers shall be quick-make, quick-break, trip free. All circuit breakers shall be UL 489 listed and shall have an interrupting rating adequate for the maximum fault current available at their respective location. All ungrounded poles shall be opened simultaneously by a common trip mechanism. Trip elements or sensors shall be calibrated or ambient compensated for operation in a 50° C ambient temperature, or properly de-rated in accordance with the circuit breaker manufacturer's instructions for use in ambient temperatures above 40° C. Breaker frame size, nominal trip setting, and de-rated trip setting shall be shown on the drawings and on the engraved breaker ID plate attached to the front of the switchboard.

All circuit breakers shall be mounted in such a manner that the breakers may be removed from the front without disconnecting line or load bus or power cable terminations through use of heavy duty plug-in bases for molded case circuit breakers. The plug-in base is to provide a mechanical safety interlock to prevent circuit breaker removal under load or in the "ON" position.

Generator circuit breakers shall be 100% rated with LS/I solid state trip units. Each generator breaker will be equipped with a stored energy operator, under-voltage release, and auxiliary contacts as required.

Molded case distribution circuit breakers shall be manually operated with frame and trip ratings as shown on Reference (J).

Instruments

All instrumentation shall be provided by a generator multifunction digital meter. Instruments shall be constructed to minimize damage from dust or moisture.

The system shall include relays as necessary to interface with the Integrated Alarm System (see section 436) to display all alarms, provide load shed capabilities, and indicate generator status/mode of operation.

All rotary type instrument, control and circuit breaker switches shall be oil-tight and clearly labeled for function.

All under-voltage trip (UV) devices shall be 24VDC, to prevent tripping during power transfer operations.

Fuses

Instrument fuses shall be of the non-renewable cartridge type. They shall be accessible from the front of the switchboard through the hinged panels containing the instruments and controls they protect.

Indicating Lights

Indicating lights shall be long-life LED type.



Wiring

Instrument and control wire shall be a minimum of #14 SIS, 41 strand (except for electronic component connection which can be #18), flame retarding, flexible switchboard wire. Each wire end shall be fitted with a permanent sleeve type wire number and terminated with vinyl insulated compression lugs applied with a ratchet tool where component terminations permit. Switchboard wiring shall be neatly run and properly supported. Grommets shall be provided to protect wiring where it passes thorough metal panels. Components required to be interconnected with external equipment shall be wired to barrier type terminal boards that are readily accessible and clearly marked. The secondary of all current transformers is to be wired to shorting type terminal blocks. Wiring support devices and materials on the back pans, side pans, or the rear of doors shall meet UL 94V-0 flame retardant for nylon or polyethylene. Wiring duct, cable tie mounting devices, clamps or clips shall be permanently fastened. Any adhesives used shall be epoxy. Foam tape is specifically unacceptable.

Nameplates and Labels

Components mounted on the front of the switchboard shall be provided with nameplates that clearly indicate their use. Nameplates for circuit breakers shall give the circuit designation, breaker frame size, trip setting, and load served. All instruments, switches, and front mounted components shall have nameplates, appropriately engraved. Internally, easily readable, use identification shall be provided for all fuses and any other components. Main buses shall be marked with their phase designation. All terminal blocks shall be numbered and keyed to circuit designations on wiring diagrams. Engraved nameplates shall be black letters engraved on white background.

Switchboard Components

The following description of components required within various compartments is for guidance only and does not relieve the manufacturer of responsibility for the final design and arrangement. It is the manufacturer's responsibility to furnish all components required for a complete and workable system. Switchboard manufacturer shall provide sufficient detailed descriptive information about the switchboard including all drawings, parts lists, operating description, and other documentation to obtain regulatory and Owner approvals.

Minimum control components for each generator control compartment:

- One set of potential transformers with primary and secondary fuses, as required
- Three current transformers, as required
- One control power transformer
- One generator "heater on" indicator light
- One generator multifunction meter, SATEC PM130 Plus Power Meter or equal
- One circuit breaker control switch, two position (open and close)
- One Circuit Breaker Closed indicator light
- One mounting and connecting of an automatic voltage regulator, supplied with the engine generator set
- One mounting and connecting of a manual voltage control, supplied with the engine generator set
- One voltage control switch, raise-off-lower, spring return to off, or a voltage adjusting potentiometer depending on the type of voltage regulator furnished with the generator sets



- One speed control switch or potentiometer depending on the governor interface provisions furnished with the generator sets
- One engine control switch, (ECS)
- One circuit breaker control switch (BCS)
- One voltage / frequency source (VFS)
- One under voltage relay, (27)
- One under frequency relay, (27)
- One phase sequence / balance monitor (PSBM)
- One power available light

Master control minimum components:

- One ground detection panel
- One programmable logic controller, (PLC)
- One PLC fail light
- One generator load shed warning light
- One load shed activated light

Minimum components for all generator protection and distribution feeder circuit breaker sections as shown on Reference (J).

324.2 Switchboard Operations

General Description

This switchboard shall control two Generator sets and one Shore Power connection. The switchboard may be arranged for non-parallel operation of either generator or shore power. It shall be mechanically or electrically interlocked to provide OPEN TRANSITION transfers only between Shore Power and Generator and from one non-parallel Generator to the other.

The Contractor may propose an alternative, optimized switchboard arrangement, including reduced-capacity generator sets and automatic paralleling and/or split-bus capability, subject to the approval of the Owner. The proposed system shall meet all vessel operational and mission load requirements, maintain required redundancy and single-failure tolerance, and include automatic load shedding of non-essential loads as necessary to support continued operation following the loss of one generator. The Contractor shall provide a supporting electrical loads analysis and system documentation demonstrating compliance with these requirements.

Indication lights in the Pilot House will show the current status of each generator as "running," "standby," or "shut down."

324.3 Spares

Spare parts for the switchboard installation shall be provided as follows:

- Two spare fuses for each fuse installed
- One molded case thermal type circuit breaker for each group of 10, or fraction thereof, identical breakers installed, where non-interchangeable units are used
- One complete induction type protective relay for each type installed
- One control relay/module of each type installed



330 Lighting System

330.1 General

Efficient lighting systems shall be provided in accordance with the applicable requirements of Reference (R1). The finalized system shall be approved in writing by the Owner prior to installation of system components. Lighting design for the Vessel shall follow the ABS Guide for Crew Habitability and Regulatory Body requirements. Provide an illumination study that shows the locations of proposed fixtures and calculated light intensity in lux of footcandles on deck plans of the vessel.

Lighting systems are classified as "Normal" if they are supplied from the ship service switchboard and "Emergency" if they are supplied by battery backups. These supplies may be direct or indirect via transformers and distribution panels.

Prior to installing fixtures, the Contractor shall develop a lighting arrangement plan to reflect the light locations, circuits assigned, and the wiring architecture, including junction boxes and switches, for the Owner's approval.

Light fixtures shall feature IP ratings appropriate for their installation location as required by USCG. Equipment exposed to the weather or dampness shall be watertight.

Fixtures exposed to weather and in mechanical spaces and voids shall have unused cable entry holes plugged with drip-proof plugs. Sealing entry holes with caulking **does not** satisfy this requirement. Fixtures exposed to moisture shall be mounted with stainless steel fasteners, grade 316. All general illumination shall be 120 VAC, 60 Hz using marine-type LED light sources, unless noted otherwise. Secondary lighting shall be 120 VAC, 60 Hz marine-type LED fixtures with emergency battery backups or 24V DC marine-type LED fixtures fed from a central battery bank.

Light fixtures operating at 120VAC or greater shall comply with UL 1598A, and fixtures operating at less than 50V shall be durable commercial marine grade, suitable for use in the intended application.

330.2 General/Emergency Lighting

Lighting fixtures should generally be provided in the following quantities, but fixture quantity shall be adjusted as necessary to provide light intensity levels as specified in Section 330.1:

Qty	Item	
3	Pilot House	Phoenix LRMC-4-PER-DF-AC-50K(-RED), Note (1)
10	Crew Passage (2), Forward Observation Lounge (8)	Phoenix LRMC-4-PER-DF-AC-50K
13	Pilot House (2), Crew Passage (2), Aft Control Station (1), Forward Observation Lounge (8), Emergency Lights	Phoenix LRMC-2-PER-DF-AC-50K-EMB, Note (2)



20	Deck House Top (6), Upper Deck (6), Passenger Deck (8) Weather decks	Phoenix VB-W-17LED-CW-GHA
48	Interior Lights: Crew Spaces, passenger accommodations, stairwells, heads; except Fwd Observation Lounge	Phoenix LRMC-4-PER-DF-AC-50K-EMB
8	HVAC Fan Room (4), Solarium (4)	Phoenix ReadLED RLED-2-DF-50K
21	Car Deck	Phoenix ReadLED RLED-2-DF-50K
21	Car Deck, Emergency Lights	Phoenix ReadLED RLED-2-DF-50K-EMB2
24	Engine Room (15), Bow Thruster Room (3), Aft Void (2), Steering Gear Room (4)	Phoenix ReadLED RLED-2-DF-50K
15	Engine Room (8), Bow Thruster Room (1), Aft Void (4), Steering Gear Room (2), Emergency Lights	Phoenix ReadLED RLED-2-DF-50K-EMB2

Note 1: One fixture to have red filter and separate switch.

Note 2: Emergency fixtures in the Pilot House shall be switched.

Any fixture substitutions from the table above shall be approved by the Owner.

General lighting shall be fed from 120 VAC power distribution panels as shown on Reference (J). Control of the general lighting shall be from single pole light switches located at a central control location in the Pilot House.

The emergency lights for a given space shall draw primary power from the same circuit that provides power to the general lighting in that space. The single pole switches, which control the general lighting fixtures, shall be connected to the circuits such that the emergency lights remain energized when the switches are turned off. This configuration will allow the vessel's general lighting to be turned off without depleting the emergency lighting batteries.

Emergency lighting fixtures shall be placed to illuminate public spaces to enable crew and passengers to navigate evacuation routes.

All emergency battery backups shall have adequate capacity to provide lighting for a period of at least 30 minutes upon loss of main power.

Each of the emergency lighting fixtures shall be identified with an engraved laminated phenolic label having a 1 inch white letter "E" on a red background.

330.2 Flood Lighting

The vessel shall be equipped with the following exterior floodlighting fixtures:



Qty	Item	
4	Docking Lights	120 VAC, Phoenix EcoMod EM3-LO-MF-120-277-50K
4	Security Lights	120 VAC, Phoenix EcoMod EM3-LO-MF-120-277-50K
2	Davit Lights	120 VAC, Phoenix SturdiLED STL-HI-45-UNIV

One docking light is to be mounted above and outboard of the stern loading ramp on each side of the vessel and directed at the water aft of the vessel. The remaining docking lights shall illuminate the water adjacent the port side of the vessel, per Owner's direction.

Security Lights are to be mounted on the outboard edge of the Bridge Deck as directed by Owner.

Docking and security floodlights are to be switched (in pairs) inside the Pilot House. Davit lights are to be locally switched.

330.4 Navigation Lights

See Section 422

330.5 Pilot House Lighting

Each third of the Pilot House console is to be provided with two dimmable gooseneck LED light fixtures, with integrated red lens (6 fixtures in total).

Provide dimmable red filters or lamps on all instrument lighting, which would interfere with the night vision of Pilot House personnel.

Arrange indicator lights on the Pilot House consoles and aft Pilot House bulkheads, so they create minimum reflection on Pilot House windows during night operations.

330.6 Searchlights

One 10 inch diameter, LED searchlight system shall be provided at the Pilot House. The searchlight system shall consist of a Carlisle & Finch model 10LN-DE-ANCH1 searchlight with a C2-14 remote electric controller. The searchlight shall be located on the Pilot House top elevated to clear the Pilot House visor and provide clear illumination of the fore end of the vessel. Controllers for the searchlight shall be provided in each respective bridge console.

330.7 Portable Lights

Four portable, battery-operated lights shall be installed on the vessel. Each light shall be stowed on bulkhead-mounted brackets furnished and installed by the Contractor. One shall be located in the Pilot House in a location designated by the Owner. Two lights shall be located on the Car Deck level inside the entrances to the Engine Room. One shall be located at the top of the sprinkler equipment space access trunk.

330.8 Spares

Spares for the lighting system shall be provided consisting of 10% of the amount installed of each type of item listed below but not less than two each:



- Lamps
- Diffusers
- Globes (exterior deck lights)
- Fuses

340 Storage Batteries

340.1 General

Batteries provided for the various systems described herein shall be Absorbed Glass Mat (AGM) construction, sealed valve regulated lead acid, 12-volt, sized and wired in series/parallel as required. Engine starting batteries shall be sized per engine vendor recommendation. Each battery shall include a manufacturer's label showing its make and model number, electrical capacities and specifications, weights, and date of manufacture. Battery connections shall be pressure type lugs.

Each battery bank shall be located in vented battery boxes securely mounted on a foundation. Battery and battery bank installations shall include all ancillary materials and equipment including, but not limited to, all foundations, vented battery boxes, cables of sufficient size to supply the required amperage to all starters, solder type battery lugs, fuses and circuit breakers of proper size and type, wiring, hangers, etc., for a complete and operational system. Battery boxes shall be USCG-approved and constructed from polyethylene or similar.

340.2 Battery Chargers

Battery chargers shall meet the requirements of 46 CFR 112.55 and shall be fitted with drip shields. The Contractor shall supply a Newmar Phase Three series or Owner-approved equal battery charger for each bank of batteries fitted. The chargers shall be sized to fully charge the associated batteries from fully discharged to fully charged in not more than eight hours. The chargers shall be fully automatic and when the battery reaches full charge, the charger shall reduce its charging rate to a trickle current for battery maintenance. The charger shall also include rate of charge indicator.

340.3 24V DC Circuits

Two 24 VDC battery banks and distribution systems for electronics and control power shall be provided as shown on the Contract Guidance Drawings. The battery chargers for these banks shall be rated for 95A output.

Each ship service generator and the bow thruster engine shall have a dedicated 24 VDC starting battery bank, consisting of two Group 31 batteries. Starting batteries shall be located as close as practicable to their respective engine. One single-bank charger, rated at 20A output, shall be furnished to charge each generator starting battery banks.

Connection of the batteries to the charger shall not interfere with the availability of the batteries for service. The batteries shall be provided in non-metallic vented battery boxes with a mounting rack.

340.4 12V DC Circuits

The 12 VDC loads shall be supplied via a 24-12 VDC converter, Newmar 32-12-50 or Owner-approved equal, via a distribution panel located in the Pilot House.



Group 400 – Command and Surveillance/ Electronics

400 General

The electronics equipment described herein shall be installed in strict accordance with the requirements and recommendations of the Regulatory Bodies, Contract Documents, and the manufacturer. In cases where these requirements contradict, see Section 030, which specifies the order of precedence.

All cabling, wiring, connectors, controls, and all other equipment, materials, and labor necessary for the complete installation and commissioning of the command and surveillance and electronics systems described within this Specification shall be the responsibility of the Contractor.

The Contractor is responsible for detailing the final command and surveillance and electronics equipment arrangements and systems based upon final equipment selections. Arrangements and systems shall be approved by the Owner prior to installation.

All navigation electronics shall be the latest model available at the time of bid submission. Prior to purchase and installation, the Contractor shall submit the make and model of all electronics equipment covered in this Section for Owner approval.

In general, the routing and installation requirements for electrical supply/distribution cables found in Section 320 shall apply to network and signal cables installed under this Section unless specified otherwise in this Section, including, but not limited to, all requirements for installing, supporting, labeling, terminating, deck and bulkhead penetrations, and other cable installation. Additionally, all network and signal cables shall be shielded or inherently immune to electromagnetic interference (EMI) and plenum rated, low smoke zero halogen, flame retardant PVC jacketed cable. The cables shall be run in continuous lengths without splices or junctions and shall be routed and bundled separately from AC and DC power supply/distribution cables. Cables shall be identified and labeled in accordance with Section 602.5. Both ends of each cable shall be labeled. After cable installation and termination, the Contractor shall neatly bundle the cables in the network cabinet and secure them to the cabinet structure. Excess cabling shall be neatly looped and secured.

All network cables shall be tested and certified according to TIA/EIA T568B CAT6A standards after they are pulled into place and terminated. Test in accordance with ANSI/TIA/EIA-568-B.2 and provide a testing report to the Owner that includes the date, technician performing the test, equipment used, cable length, wire map, and test results for each individual pair within the cable, indicating whether the tested cable meets the performance standard. Cables that fail the tests shall be repaired and retested until satisfactory results are achieved.

The services of manufacturers' representatives and electronic specialists shall be retained as necessary to ensure a fully functional installation. Precautions shall be taken to prevent electromagnetic interference. The Contractor shall be responsible for demonstrating that all equipment defined in this Section operates without such interference.



420 Control Consoles

Controls and instruments shall be mounted in each console as described in this Specification and as required by Regulatory Body requirements and for safe operation of the Vessel.

The consoles described in Sections 420.1 through 420.3 shall have a durable finish epoxy or powder coat finish. Console tops shall be modular with matte black laminate covered aluminum working surfaces to facilitate instrument and control mounting. The Contractor shall submit finish sample and color to the Owner for approval.

Adequate ventilation shall be provided in consoles to maintain the required environmental conditions for operation of equipment housed in the consoles. Fit the front and one side with hinged doors to permit convenient access to all internal components. Sufficient fixed LED lighting and electrical outlets shall be provided under console for maintenance and electrical equipment. Lights inside console shall be switched, with the light switches mounted just inside the access doors.

Prior to construction, a full-scale plywood or foam core mockup of each console and its enclosure shall be created for Owner approval prior to final console fabrication. The mockup shall include paper or foam images of, or the actual instruments and controls, to be positioned on the console. Of particular importance are the propulsion controls and steering controls.

All illuminated components and devices mounted in the consoles shall be dimmable. Any indicators that are not dimmable shall be mounted in an alternate location on the vertical face of the console, as directed by the Owner, so as not to inhibit night visibility.

420.1 Pilot House Console

Pilot House Console Components

1. Steering Controls
 - Non follow-up steering jog
 - Full follow-up steering lever
 - Rudder angle indicator
 - Steering control engage lighted pushbutton
 - Steering not in control indicator light
 - Steering pump run indicator light, No. 1
 - Steering pump run indicator light, No. 2
 - Steering pump run switch, No. 1 or 2
 - Autopilot control panel
2. Propulsion Controls
 - Main Engine No. 1 propulsion speed/clutch direction control head
 - Main Engine No. 2 propulsion speed/clutch direction control head
 - Bow Thruster Engine speed/direction control head
 - Console control engage lighted pushbutton
3. Integrated Alarm System
4. MAIN ENGINE NO. 1 PANEL
 - Engine Electronic Display Module
5. MAIN ENGINE NO. 2 PANEL



- Engine Electronic Display Module
- 6. SHAFT NO. 1
 - Shaft RPM/direction meter
- 7. SHAFT NO. 2
 - Shaft RPM/direction meter
- 8. WHISTLE PUSHBUTTON
- 9. SHIP'S GENERAL ALARM/PUBLIC ADDRESS
- 10. RADAR MONITOR (Primary)
- 11. RADAR MONITOR (Repeater)
- 12. SPEED LOG
- 13. AIS
- 14. MISCELLANEOUS SWITCHES
 - Docking light switch
 - Window wiper switches
 - Defroster switches
 - Ventilation Shutdown/Fire damper "close" switch
 - Security light switch
 - General lighting control
- 15. FIRE PUMP
 - Fire pump start switch
 - Fire pump pressure gauge
- 16. AUTOMATIC FOG HORN CONTROL
- 17. AUXILIARY GENERATOR NO. 1 PANEL (display)
- 18. AUXILIARY GENERATOR NO. 2 PANEL (display)
- 19. CCTV MONITOR
- 20. COMPASS

420.2 Aft Control Station

Detailed console layout shall be carefully developed in conjunction with the Owner, with final console fabrication occurring after Owner approval as set forth in Section 420.

Aft Control Station Components

- 1. Steering Controls
 - Non follow-up steering jog
 - Rudder angle indicator
 - Steering control engage lighted pushbutton
 - Steering not in control indicator light
 - Steering pump run indicator light, No. 1
 - Steering pump run indicator light, No. 2
 - Steering pump run switch, No. 1 or 2
- 2. Propulsion Controls
 - Main Engine No. 1 propulsion speed/clutch direction control head
 - Main Engine No. 2 propulsion speed/clutch direction control head



Bow Thruster Engine speed/direction control head
Console control engage lighted pushbutton

3. WHISTLE PUSHBUTTON

420.3 Bridge Wing Control Stations

Two bridge wing control stations shall be installed in the pilot house, generally where shown in Reference (B).

Bridge Wing Control Components (each side)

1. Steering Controls
 - Non follow-up steering jog
 - Rudder angle indicator
 - Steering control engage lighted pushbutton
 - Steering not in control indicator light
 - Steering pump run indicator light, No. 1
 - Steering pump run indicator light, No. 2
 - Steering pump run switch, No. 1 or 2
2. Propulsion Controls
 - Main Engine No. 1 propulsion speed/clutch direction control head
 - Main Engine No. 2 propulsion speed/clutch direction control head
 - Bow Thruster Engine speed/direction control head
 - Console control engage lighted pushbutton
3. WHISTLE PUSHBUTTON

421 Non-Electric Navigation Aids

421.1 Barometer

One 6-inch brass surface-mounted aneroid barometer, Chelsea or equal, shall be mounted on an interior Pilot House bulkhead. Final location shall be proposed by Contractor and approved by Owner prior to installation.

421.2 Thermometer

One interior and exterior reading thermometer shall be installed in the Pilot House. Final location shall be proposed by Contractor and approved by Owner prior to installation.

421.3 Clinometers

One bubble-type clinometer, Moeller model 458 or equal, having dual graduated scales of ± 15 degrees of heel and ± 45 degrees of heel mounted in the Pilot House on the Vessel's centerline. Final location shall be proposed by Contractor and approved by Owner prior to installation.



421.4 Clock

One 12.75-inch surface mounted 12/24-hour battery operated quartz marine clock, Chicago Lighthouse Industries or equal, shall be installed in the Pilot House. Location to be proposed by Contractor and approved by Owner prior to installation.

421.5 Ship's Horn

One air horn shall be installed above the Pilot House top, Kahlenberg Model D-2 or equal. The air horn shall be activated from a whistle control panel, Kahlenberg Model M-512 or equal, in the Pilot House console. A solenoid valve with 24 VDC coil shall be preceded by a wye strainer and an isolating ball valve. In addition, the whistle shall be fitted with manual actuation via a spring loaded valve and lanyard to a lever located in the Pilot House overhead.

Horn location to be proposed by Contractor and approved by Owner prior to installation.

The signal controller shall be installed in the Pilot House console.

421.6 Fog Bell

One cast bronze fog bell, 12-inch flare diameter, Perko Figure 0150 or equal, with bracket, clapper, and spliced bell rope shall be mounted at an exterior Pilot House location. Final location shall be proposed by Contractor and approved by Owner prior to installation.

421.7 Magnetic Compass

One binnacle-mounted magnetic compass, Ritchie Globemaster B-463 or equal, shall be mounted on the main Pilot House console at centerline. Compass shall have an integral anti-shock mount, compensating balls, and 24 VDC lighting. The Contractor shall perform the usual compass swing maneuvers as part of trials and provide the Owner with the deviation card.

422 Navigation Lights

Provide a Navigation Light Panel and all lighting per the COLREGS and generally as shown on Reference (B). Light fixtures shall be AquaSignal Series 34 LED (<50m, black), or Owner-approved equal. All navigation lights and control panels shall be in full compliance with all applicable USCG regulations.

The navigation lights shall be connected via marine waterproof plug and receptacle assemblies located at each navigation light location.

The lights shall be controlled by a navigation light control panel installed in the Pilot House. The panel shall provide visual/audible alarm in the event of a navigation light failure and shall comply with Regulatory Body requirements.

426 Electrical Navigation Aids

426.1 General

The electronic navigation systems shall be in accordance with the applicable Regulatory Body requirements, including FCC, Part 83, and USCG regulations. The installation and testing of equipment shall be supervised by the equipment manufacturer's representative. All antennas shall be installed to avoid interference with each other and provide maximum clear reception.



The Contractor is wholly responsible for ensuring that the design and installation of the navigation system equipment is complete and adequate for the service intended and that they comply with Regulatory Body Requirements.

The Contractor shall be responsible for accomplishing inspection and obtaining certification. The system shall be considered complete only when the FCC inspection and certification has been accomplished.

All electronic navigation aids shall be Furuno or equal. Final arrangement of navigation equipment shall be included and approved as part of the console mockups described in Section 420.

All Pilot House instruments shall be on a common dimmer circuit.

426.2 Radar/GPS System

The vessel shall be equipped with an integrated radar/AIS/GPS/compass/chart plotter system including the following:

- Two 16" LCD color multi-function displays, (Furuno NavNet TZtouchXL model TZT16X, or equal)
- Two (2) radar sensors (Furuno Radar Sensor, model DRS6DNXT Class, or equal)
- Two (2) GPS receivers (Furuno GPS/WASS Sensor, model GP340, or equal)
- One (1) class A AIS transponder system, including class A AIS transponder, 4.3-inch color display, GPS/VHF combined antenna and distributor unit GPS antenna (Furuno Automatic Identification System, model FA170, or equal) with a second display
- One (1) satellite compass antenna (Furuno SCX20 or equal).

The components shall be connected across NMEA 2000 and Ethernet protocol networks as necessary to create an integrated navigation system. The system shall permit the display of radar, navigational charts, vessel position and heading, and AIS contacts on the TZtouchXL multifunction displays. The Contractor shall supply and install all interconnecting cabling, interface units, junction boxes, antennas, antenna mounts, and support brackets for a complete, functional system. The Contractor shall supply and install supporting NMEA 2000 network with up to 10 equipment drops, NMEA data conversion and expansion, power supply, and cabling. The displays and controls shall be mounted in the pilot house.

The installation shall include all required chart software for operation on Lake Michigan.

426.3 Depth Sounder and Speed Log

The Contractor shall provide and install one bronze through-hull 600W depth sounder transducers with speed temperature (Furuno model 525STID-MSD7 or equal) The transducers shall be integrated into the multi-function displays described in Section 426.2. The Contractor shall propose transducer installation location in consultation with the manufacturer's representative and submit for Owner approval.

426.4 Autopilot

The Contractor shall provide and install one autopilot system, Furuno NAVpilot-1000 or owner approved equal.

430 Interior Communications

Public Address/General Alarm System Internal shipboard communications and general alarms shall be provided by telephone, public address, and general alarm systems as described in Sections 423 and 433.



The systems shall meet all applicable requirements for internal communications and emergency alarm systems as set forth in Subchapter K of 46 CFR. An integrated communications system may be utilized with Owner's approval.

432 Telephone Systems

432.1 Sound Powered Phone System

The Contractor shall provide and install a common talk, selective ring, sound powered phone system. There shall be a total twelve sound powered telephone stations on the vessel installed in the following locations:

- One phone on the bridge
- One phone in the electronics/security room
- One phone in the aft control station
- One plug-in jack in the aft passenger lounge
- One plug-in jack in the passenger observation lounge
- One plug-in jack near the elevator on the Passenger Deck
- One phone by the Engine Room Access door
- One plug-in jack near the elevator on the Vehicle Deck
- One phone plus one plug-in jack near the shore connections station
- One plug-in jack in Steering Gear compartment
- One phone in the Engine Room, plus one plug-in jack
- One phone in the Bow Thruster Room, plus one plug-in jack

The Contractor shall provide and install talk back stations at the fueling station, the stern loading ramp, the port side passenger loading door, the rescue boat station, at each mooring station, at the aft Control Station and on the Pilot House.

432.2 Standard Telephone System

There shall be a total of eleven (11) standard telephone stations on the vessel installed in the following locations:

- One phone on the Pilot House
- One phone in the electronics/security room
- One phone in the aft control station
- One phone in the crew dayroom
- One phone in the aft passenger lounge
- One phone in the passenger observation lounge
- One phone near the elevator on the Passenger Deck
- One phone by the Engine Room Access door
- One phone in the elevator
- One phone in the Engine Room
- One phone in the Bow Thruster Room

Phone stations shall be drip-proof. The phones located in the Engine Room and bow thruster acoustic booths shall be outfitted with a jack and portable headset that will allow hands-free communication for



Engine Room personnel. The portable headset cord shall be of sufficient length to allow the operator to reach each side of each reduction gear and the fire pumps. A rotating beacon with flashing blue light and an electronic horn with a distinctive tone shall be provided and installed in the Engine Room, to alert Engine Room personnel to incoming calls. The horn shall be audible when the engines are operating at cruising RPM.

Upon system completion and commissioning, the Contractor shall provide a system wiring diagram with all devices and cabling annotated.

433 Announcing Systems

433.1 Public Address/General Alarm System

A combined PA/GA system shall be installed for announcements and alarms over the vessel's loudspeakers from the Pilot House console.

The Contractor shall work with the system provider to determine necessary loudspeaker locations and system components to ensure compliance with all Regulatory Body requirements. The Owner shall approve the final system design and loudspeaker locations. Loudspeakers shall be installed in the following locations at minimum:

- Top deck passenger area
- Crew Day Room
- Electronics/Security Room
- HVAC Fan Room
- Aft Passenger Lounge
- Aft Stair Tower
- Solarium
- Observation Lounge
- Passenger Deck passageway
- Car Deck
- Engine Room
- Shaft Alley

The general alarm function shall be integrated with the PA system. The audible alarm shall be transmitted over the vessel's loudspeakers. In the Engine Room, the audible alarm shall be supplemented by a rotating beacon with flashing red light.

The system shall be tested and balanced by the Technical Representative.

Nameplates and markings shall be provided in accordance with USCG regulations.

Upon system completion and commissioning, the Contractor shall provide a system wiring diagram with all devices and cabling annotated.

433.2 ADA Visual System

An ADA visual messaging system shall be provided with the following capabilities:



- Visible notification appliances (strobes) complying with section 18.5 of NFPA 72 shall be provided throughout passenger accessible spaces. Visual notification appliances shall be activated upon activation of the passenger general emergency alarm.
- Visual messaging on 32" TV screens in passenger spaces, two in each passenger space. The final arrangement shall be proposed by Contractor and approved by Owner prior to installation.
- Visual messages shall be synchronized with the pre-recorded audio messages broadcast via the PA/GA System, see Section 433.1 Above or manually selected from a control panel in the Pilothouse. The system shall be easy to use, with push buttons that play the pre-recorded messages and display the pre-loaded visual messages.
- Pre-loaded messages shall include:
 - Welcome Message
 - Departure Message
 - Abandon Ship Message
 - Medical Emergency Message
 - Fire Message
- When not displaying messages or upon pressing stop, the messaging monitors shall display a preloaded wayfinding image showing an exploded view of the Vessel with locations of stairways, food service areas, restrooms, etc. shall be displayed.
- The pre-loaded visual messages and the wayfinding image shall be user configurable.

The visual messaging monitors shall generally be mounted on a bulkhead near the finished ceiling, several feet from windows and light fixtures, and away from interferences such as door swings and removable ceiling panels. The exact location shall be Owner approved prior to installation. Each visual messaging monitor shall be provided with signal cable as well as a duplex receptacle 120VAC power supply. Monitors shall be robustly mounted to withstand shipborne vibrations and sea motions.

434 Ship's Network

The Vessel shall be equipped with two cellular Wi-Fi networks for internet access. One shall provide internet access to the public, and the second shall be dedicated for crew access. The wireless network will be provided by a series of access points installed in the passenger and crew spaces, with cellular connection to the internet via stack mounted antennas on the pilot house top.

The access points and cellular antennas will be provided and installed on the Vessel by the Owner after Vessel Acceptance. The Contractor is responsible for installing CAT6A network drops, 120v outlets, and mounting provisions for each wireless access point and antenna.

435 Network Cabling

The Contractor shall provide and install the necessary CAT6A cables for the ship's network and CCTV systems. The Contractor shall propose the final location of all network drop locations described below and obtain Owner's approval of same prior to installation.

A 48U standard 19" network server rack shall be installed in the Electronics Room. It shall be secured to the deck with weld studs and sway braced to the nearest bulkhead. The rack layout shall be proposed by Contractor and approved by the Owner prior to installation. Front and rear access shall be provided if feasible, and racks shall be installed to allow free air circulation on all sides.



The Contractor shall leave a three-meter service loop on all network cables measured from the entry point at the top of the network rack enclosure to the end of the termination. The Contractor shall terminate cables at the network rack with high-quality keystone compatible CAT6A jack modules, Panduit or equal.

The Contractor shall provide and install CAT-6 cable runs from each equipment, access point, and camera to the server rack in the Electronics Room. The Contractor shall terminate new cables at the drop location in a junction box with a high-quality keystone compatible CAT6A jack modules, Panduit or equal. All jacks shall have gold-plated contacts. Final locations shall be proposed by the Contractor and approved by the Owner prior to installation.

Cable service shall be differentiated with colored outer jackets as follows:

- Cameras: Yellow
- Data: Blue
- Wireless Access Points: Green

In addition, the Contractor shall provide two two-inch conduit or cable tray runs, with suitable fire stops and weather seals, from the Electronics Room to the top of the Pilothouse to service coaxial and CAT6 runs for cellular data. Final locations on the house top shall be proposed by Contractor and approved by Owner.

436 Alarm and Monitoring Systems

436.1 Machinery Alarm and Monitoring System

The Contractor shall provide and install a PLC based modular monitoring and alarm system to provide remote centralized monitoring of the machinery plant and ship's auxiliary alarm, safety, and warning systems. The system shall collect and display information from switched or analog inputs, or from digital communications. The system shall monitor and display all regulatory required, propulsion related information, as well as incorporate specified control functions. The system shall also monitor and display generator status/mode of operation at the Pilot House display.

The monitoring and alarm system shall utilize touch screen HMI interface panels located in the Engine Room and in the Pilot House at each steering station. The Engine Room display shall be drip-proof NEMA 12

Alarm system logic shall be such that alarms are self-monitoring and fail safe. The system shall utilize open-architecture PLC programming, with all required software and hardware provided to the Owner for future system modifications (additions/deletions of monitoring/alarm points and/or modifications of set points and delays).

Alarms shall generate a visual display and audible alarm. Alarms shall have appropriate titles, which clearly indicate the parameter in alarm, and, where appropriate, whether it is high or low

Each panel shall include a horn and silencing button that also acknowledges an alarm. Acknowledging an alarm shall silence the audible signal. The visual indication shall remain in the alarm state until the alarm condition has been restored to normal. If additional alarm conditions occur after any alarm has been acknowledged but not yet cleared, an audible and visual alarm for the new alarm shall be initiated. The



system shall clearly identify the difference between an acknowledged alarm and an alarm that has not been acknowledged. With the exception of motor running indication, provisions shall be made for testing audible and visual alarms without rendering the associated circuits inoperative.

The audible alarms shall be of appropriate volume to allow the operator to hear above the ambient noise conditions of the space. In the Pilot House, the audible alarm shall not exceed 95 dBA. Audible alarms shall be unique in tone or signal to allow them to be distinguished from all other alarms: fire alarm, general alarm, telephone, etc. The horn circuit in the Engine Room panel shall be extended to a weatherproof horn mounted on the inboard side of the Deck House near the entrance to the Crew Day Room. The Engine Room panel shall have a selector switch with two positions: 1) "normal" operation and 2) "in-port" operation. The horn shall be activated when an alarm sounds while the selector switch is in the "in-port" position.

Standard and commercial parts, selected from established product lists, shall be incorporated in all component designs to the maximum extent possible. The system shall provide an effective means for monitoring temperatures, pressures, RPM, position/angle, DC voltage and amperage, AC voltage, amperage and kilowatts, liquid levels, on/off switching, and other variables which are essential for propulsion, machinery, and electric plant operation. Bidirectional shaft tachometers shall be provided.

The alarm system shall provide local signal conditioning units that possess excitation power, and sufficient data processing to convert raw data to engineering units.

The alarm and monitoring system shall be designed to minimize cabling requirements. Electronics shall be interchangeable, where possible, to minimize spares requirements but still allow rapid repair by module replacement. Care shall be taken to minimize the effects of ship's vibration on system components.

Power supply requirements unique to the alarm and monitoring system such as transducer excitation requirements, internal solid-state devices, such as CPU's, PLC's, PC's, system clock, etc., shall be provided in duplicate by the system vendor. Each power supply shall be capable of supplying the full load of all units powered by the system they serve.

Individual protective devices shall be provided in the input and output of each power conversion device.

Means for testing faulty circuits and check points for calibration purposes shall be provided and shall be readily accessible.

The system shall permit operator adjustment of time delays, set points, scale ranges, and alarm limits. Each analog and discrete measurement shall have an alarm time delay, chosen from a global set of time values. Alarm time delays shall not reset prior to alarm annunciation unless the input returns to a value within limits for a period of time equal to the time delay.

Each analog input shall have up to four possible alarm limits or set points: two lower and two upper. All or none of these limits may be utilized on an input-by-input basis. Alarm limits shall be either fixed or interactive in nature. Interactive alarm limits shall have the ability to dynamically change based on the value of an independent input to the system. The alarm and monitoring system shall prevent false alarms due to momentary transient conditions or when equipment is starting or stopping.

Meters and gauges, required for use by regulatory agencies, shall be minimum 2" diameter, 1% accuracy, panel mounted. Dial faces shall be white with black graduations, figures, and letters. Pointers shall be black. Graduations shall cover an arc of over 250° when possible. The scale range shall be selected so that the normal operating point is near mid-scale. Indicators shall be marked and in U.S. customary units: temperature in °F, pressure in psi, and vacuum in inches of mercury. Meters and associated sensors shall be calibrated as a system in accordance with instrumentation industry standards.

Equipment vendors or the Contractor, as applicable, shall supply the system sensors, transducers, switches, and other inputs. It shall be the Contractor's responsibility to define the scope of supply and to provide a system that meets the applicable USCG regulations.

Unless otherwise specified, audible devices, sensors, transducers, and switches shall comply with the applicable requirements in UL Standards for Safety for the specific equipment and shall be UL listed.

System components shall be marked, in a permanent manner, with the following:

1. Item name
2. Item part number
3. Revision level (part of item number)
4. Serial number

Meters, gauges, and indicators shall be identified with nameplates permanently mounted below the instrument. Nameplates shall be either machine engraved brass with black enamel filled inscriptions or machine engraved black phenolic plastic with white inscriptions. Abbreviations shall be avoided as much as possible but where necessary shall comply with Mil-Std 12D or generally accepted marine standards.

Switches installed for transfer or control functions shall be rotary or push-button type, equipped with clearly marked label plates to indicate their function and position. All switches shall be provided with detents to securely hold the switch in the selected position and shall have handles or operators suitable for the intended service. Guards shall be provided for all emergency shutdown devices.

Configure the system to monitor and alarm all machinery and system alarms required by regulatory bodies, equipment manufacturers, and this Specification. Panels shall incorporate the following minimum requirements

The Engine Room alarm system shall receive 24V DC power.

436.2 Fire Detection and Alarm System

The Contractor shall install a USCG approved addressable Fire Alarm System installed in accordance with 46 CFR part 76. The system shall have an alarm panel located in the Pilot House, which is interfaced with the detectors and manual call stations on the vessel.

The accommodation spaces and Steering Gear Room shall be fitted with ionization type smoke detectors. The Engine Room and Bow Thruster Room overhead shall be fitted with rate compensated temperature detectors. The Vehicle Deck shall be fitted with heat and smoke detectors. Both styles of detectors shall be spaced in compliance with their UL or other testing laboratory listing and regulatory requirements.

The Vehicle shall be fitted with manual pull stations, located as follows:



Qty	Deck	Location
4	Vehicle	Adjacent each stairway leaving the Vehicle Deck
3	Passenger	Inside stair tower, adjacent elevator, transverse passageway.
4	Upper	Inside stair tower, Pilot House, aft end of Crew Passageway, Aft Passenger Lounge adjacent stairway

436.3 Steering Gear Alarm System

Each steering gear shall have an independent alarm system as described in Section 561.

436.4 List of System Alarms

The following table represents, as a minimum, the machinery and system alarms that shall be integrated into the alarm system panels described above. It shall be the Contractor's responsibility to define the full scope of supply and to provide a system that meets the applicable USCG regulations.

Abbreviations Used:

LAH	High level alarm
TAH	High temperature alarm
PAL	Low pressure alarm
PAH	High pressure alarm (motor overloaded)
LAL	Low level alarm
FAL	Loss of flow
EAL	Electrical power failure
UA	Multi-parameter alarm
MA	Manual activation
POS	Position

Monitoring Point	Alarm
ENGINE ROOM ALARMS	
A. Bilge Alarms	
Steering Gear Room	LAH
Aft Void	LAH
Engine Room	LAH
No. 1 Stern Seal Well Pump Long Run	UA
No. 2 Stern Seal Well Pump Long Run	UA
Tank room	LAH
Bow Thruster Room	LAH
B. Compressed Air	
Starting air pressure	PAL
C. No. 1 Main Propulsion	
Engine LO pressure	PAL
Engine FO filter differential pressure	PAH
Engine JW temperature	TAH
Engine JW expansion tank	LAL



	Engine after cooler (AC) temperature	TAH
	Engine AC exp tank	LAL
	Engine exhaust temperature	TAH
	Engine automatic shutdown	UA
	Engine LO sump level	LAL
	Red gear LO pressure	PAL
	Red gear LO temperature	TAH
	Red gear clutch pressure	PAL
	Red gear sump level	LAL
	Shaft seal cooling water	FAL
	Line shaft bearing temperature	UA
D.	No.2 Main Propulsion	
	Engine LO pressure	PAL
	Engine FO filter differential pressure	PAH
	Engine JW temperature	TAH
	Engine JW expansion tank	LAL
	Engine AC temperature	TAH
	Engine AC expansion tank	LAL
	Engine exhaust temperature	TAH
	Engine automatic shutdown	UA
	Engine LO sump level	LAL
	Red gear LO pressure	PAL
	Red gear LO temperature	TAH
	Red gear clutch pressure	PAL
	Red gear sump level	LAL
	Shaft seal cooling water	FAL
	Line shaft bearing temperature	UA
E.	No.1 Diesel Generator	
	Engine LO pressure	PAL
	Engine LO temperature	TAH
	Engine FO filter differential pressure	PAH
	Engine JW temperature	TAH
	Engine JW expansion tank	LAL
	Engine AC temperature	TAH
	Engine AC expansion tank	LAL
	Engine Exhaust Temperature	TAH
F.	No.2 Diesel Generator	
	Engine LO pressure	PAL
	Engine LO temperature	TAH
	Engine FO filter differential pressure	PAH
	Engine JW temperature	TAH
	Engine JW expansion tank	LAL
	Engine AC temperature	TAH
	Engine AC expansion tank	LAL



	Engine Exhaust Temperature	TAH
G.	Bow Thruster Engine and Bow Thruster	
	Engine LO pressure	PAL
	Engine LO temperature	TAH
	Engine FO filter differential pressure	PAH
	Engine JW temperature	TAH
	Engine JW expansion tank	LAL
	Engine AC temperature	TAH
	Engine AC expansion tank	LAL
	Engine Exhaust Temperature	TAH
H.	Tanks	
	Fuel Oil Tank	LAL
	Fuel Oil Tank	LAH
	Oily Water Tank	LAH
	Waste Oil Tank	LAH
	Urea Tank	LAH
	Urea Tank	LAL
	Potable Water Tank	LAH
	Potable Water Tank	LAL
	Sewage Tank	LAL
I.	Miscellaneous	
	FLOURO-K pull box cover open	MA
	Heat tape summary alarm	UA
	Accommodations HVAC Summary Alarm	UA
J.	SWITCHBOARD Alarms	
	85% Electrical Load	
	95% Electrical Load	
	105% Load Shedding	
K.	STEERING GEAR ALARMS	
	No. 1 Motor	PAH
	No. 1 Hydraulic Tank	LAL
	No. 1 3 Phase Power	EAL
	No. 1 Control Power	EAL
	No. 2 Motor	PAH
	No. 2 Hydraulic Tank	LAL
	No. 2 3 Phase Power	EAL
	No. 2 Control Power	EAL
L.	Fire Detection System	
	Fire Detection System Fault	
	Fire Detection System Fire Alarm	
	Fire Detection System Power Failure	
M.	Sprinkler System	
	Fwd Supply Valve Position	POS
	Aft Supply Valve Position	POS



Dry Pipe Valve, High Pressure	PA
Dry Pipe Valve, Low Pressure	PAL
System Flow Alarm	PAH
Sprinkler Tank Valve Position	POS
Sprinkler Pump Discharge Valve	POS
Sea Chest Isolation	POS
Firemain cross-connect	
Sprinkler Tank Low Pressure	PAL
Sprinkler Tank Temperature	
Sprinkler Tank High Level	LAH
Sprinkler Tank Low Level	LAL

437 Tank Level Indication

Unless otherwise indicated, all level transmitters shall interface with the Machinery Alarm and Monitoring system (MAMS) for remote tank level indication (TLI), alarms, and pump control when required.

The fuel oil tank shall have a pressure transmitter interfaced with the MAMS and configured to provide continuous level indication.

The engine lube oil and potable water tanks shall each have a Gems SureSite level indicator and a level transmitter interface with the MAMS. Remote TLI shall be provided at the pump controls and at the fill/pump-out station for each liquid.

A float-type level switch, GEMS LS-800 series or equal, shall be installed at the top of the waste oil and oily water tanks for high level alarm.

The sewage tank shall have an ultrasonic non-contact type tank level transmitter (Gems UCL-200 or equal) with input to the MAMS.

440 VHF Radio System

The Contractor shall install three VHF radio sets: two in the Pilot House, and one at the aft control station. The VHF radios in the Pilot House shall be located to allow convenient access by an operator stationed at the propulsion control console. The Contractor shall furnish and install each complete systems consisting of a VHF radio (Icom M424G), with a 4 ft antenna, and Icom SP-37 external loudhailer speaker mounted on top of the Pilot House or aft control station. Contractor shall supply and install all interconnecting cabling and support brackets for a complete functional system.

439 CCTV Systems

The contractor shall install a closed circuit television system for video surveillance purposes. The system shall consist of multiple cameras, master control and data storage units, and a remote control and display unit. The system shall capture video images at 30 frames per second with date and time stamping. The cameras shall be waterproof, high definition (minimum 2 mega pixel resolution), located as follows:



Location	Quantity
Engine Room	2
Bow Thruster Room	1
Forward Vehicle Deck	2
Aft Vehicle Deck	2
Stairways from Vehicle Deck to Passenger Deck	2
Observation Lounge	2
Passenger Deck Corridors	2
Passenger Deck Exterior	2
Aft Passenger Lounge	2
Solarium/Aft Deck	2
Top Deck	2
Elevator Car	1
Exterior Vessel Side at Bridge Wings Looking Forward	2
Exterior Vessel Side at Bridge Wings Looking Aft	2
Stern, above vehicle ramp Looking Aft	1

In addition, provide and install two thermal imaging cameras with thermal hot spot detection and alert capabilities one forward, and one aft in the Vehicle Deck. Final locations to be determined by Owner.

The master control and data storage units shall be located in the electronics/security room. The remote control unit shall be located in the Pilot House and shall have a minimum 24" display monitor. The data storage unit shall have sufficient storage capacity to hold 30 days of video from each camera.

The Contractor shall provide and install the necessary CAT6A shielded network cables capable of Power over Ethernet (PoE) for the CCTV system as described in Section 435. Before installation, the Contractor shall verify camera locations with the Owner.



Group 500 – Auxiliary Systems

This Section describes the requirements for the Vessel's auxiliary systems. All systems described herein shall be installed in strict accordance with the requirements and recommendations of the Regulatory Bodies, Contract Documents, and equipment manufacturers. In cases where these requirements contradict, see Section 030, which specifies the order of precedence.

The Contractor is responsible for detailing the final arrangements and systems of each auxiliary system described herein based upon final equipment selections, which arrangements and systems shall be approved by the Owner prior to installation.

500.1 Piping Systems Design

The design, equipment, materials, and workmanship for all piping systems shall fully comply with the applicable Regulatory Body requirements, as well as the requirements set forth in the various sections of this Specification and as shown on the Contract Guidance Drawings.

Pipe, valves, and fitting materials shall conform to the material schedules set forth on the Contract Guidance Drawings. Piping sizes indicated on the Contract Guidance Drawings are given for reference purposes. Final selection of pipe sizes for fabrication and installation is the responsibility of the Contractor. Fluid velocity criteria given in Table 8 shall be used in piping system sizing.

Table 8: Fluid Design Velocities

Service	Nominal Velocity (ft/sec)	Maximum Velocity (ft/sec)
Fuel Oil Service Suction	1D ^{1/2}	4
Fuel Oil Service Discharge	1.5D ^{1/2}	6
Lube Oil Suction	1D ^{1/2}	4
Lube Oil Discharge	2D ^{1/2}	6
Raw Water Suction, Steel	3D ^{1/2}	12
Raw Water Suction, Galvanized Steel	3D ^{1/2}	9
Raw Water Discharge, Steel	5D ^{1/2}	15
Raw Water Discharge, Galvanized Steel	5D ^{1/2}	9
Cold Potable and Sanitary Water, Cu Tubing	--	8
Hot Potable Water	--	5
Fresh Water Suction	3D ^{1/2}	15
Fresh Water Discharge	5D ^{1/2}	20

Piping shall be led as directly as practicable with a minimum number of bends and fittings and with sufficient takedown joints to provide for isolation, removal, inspection, servicing, and replacement of piping, valves, fittings, and equipment. Piping shall be routed to avoid cutting ship's structure where possible. Pipe bends shall be used to the maximum extent possible in lieu of elbows.

Approved mechanical fitting systems, such as Viega ProPress or MegaPress, may be substituted for welded or brazed joints where indicated on Contract Guidance Drawings. Such fittings shall only be used where permitted by the USCG regulations and in accordance with their approvals. Alternate mechanical fitting systems may be considered. The Contractor shall submit details and regulatory approvals for proposed alternatives to the Owner for approval prior to detailed design of the system.



Contractor shall exercise care in developing the system arrangements and installation of piping aboard the Vessel to ensure the following:

- Unobstructed passage along walkways and ladders
- Access to perform maintenance
- Unobstructed access to all doors, hatches, and openings
- Ready removal of the Vessel's equipment and system components

Piping systems, regardless of size or material, shall be laid out for machine bending of pipe to a radius of five times the nominal diameter of the pipe where practicable, but with a minimum radius of three times the nominal diameter, if necessary.

Isolation capability is required so that individual components may be secured while the Vessel is in service. In order to meet the operational requirements and to facilitate on-board maintenance, isolation valves shall be incorporated for individual and sectional subdivision, to include all branch lines, mains, and equipment.

500.2 Marking, Nameplates, and Labels

See Section 602.5.

503 Pumps

Pumps complying with the performance requirements and construction features described herein and elsewhere in this Specification shall be installed as required. Pumps shall be of commercial-marine type built in accordance with the standards of the Hydraulic Institute and ASTM F-998 as applicable.

Pumps shall be installed with ensured suctions either through submergence, foot valves, or priming systems so that pump operation is immediate and positive. The installed pumps shall be verified to have sufficient Net Positive Suction Head (NPSH) for the selected service and system. Raw water pumps shall be placed as low in the Vessel as possible, well below the light waterline for ensured priming.

The performance requirements listed on the Contract Guidance Drawings are based upon preliminary equipment selection, pipe size, and estimated system routing. The Contractor shall supply pumps meeting the required flow and head requirements of the installed piping systems.

Where two or more pumps of the same size and type are specified, they shall be duplicates.

For horizontal units, except close-coupled pumps, the pump and its driver shall be mounted on a common base of rugged construction. Dowels or fitted bolts shall be fitted where necessary to ensure proper alignment.

Generally, each pump shall have a pressure gauge connected on the discharge side and a compound pressure gauge on the suction side, with ranges of each consummate with the expected operating ranges of same. Where pump connections are of a different size than the connected piping, a tapered transition piece of adequate length shall be used.

A valved vent tube shall be located at the top of the casing on all centrifugal pumps that require venting during start-up. Alternatively, where it is not possible to provide a vent line directly from the top of the casing, the vent line may be located at the discharge from the pump. Vents on raw water pumps shall be



fitted with a tube directed to the bilge. Valves shall be ball type, 1/4 inch to 1/2 inch with stainless steel body. Vent tubing shall be stainless steel or copper.

Mechanical seals shall be provided for all pumps. Where possible, pumps shall be balanced hydraulically. All pumps shall be equipped with suitable thrust bearings to absorb any primary residual thrust that may occur during operation, or when the pump loses suction. In general, pumps shall be equipped with sealed ball bearings contained in the housings and removable as a unit with the pump shaft.

Centrifugal pumps shall be selected to operate at, or near, the maximum efficiency point on the head-capacity curve. The pumps shall have non-overloading power characteristics, and the driver rated horsepower shall at least equal the maximum power requirement of the pump at rated speed without allowance for a service factor.

Pump details shall be submitted to the Owner for approval.

505 Piping

505.1 General

All piping materials and installation shall meet Regulatory Body requirements.

Unions shall not be installed in piping located behind linings, false ceilings, or in other inaccessible locations.

Except as noted elsewhere in this Specification or Contract Guidance Drawings, each bilge branch and fuel oil tank suction connection shall have a suction bell mouth with the inlet diameter not less than 1 1/2 times the pipe diameter. The bottom of the inlet shall be 1/2 the pipe diameter from the bottom of the tank, but not over 1 1/2 inches.

Piping systems that require drainage during start-up or relatively frequent manual drainage in service shall be provided with drain lines fitted with valves. Threaded plugs shall be installed at low points where drainage is required on an infrequent basis such as for periodic inspection, maintenance, or dry-docking. Flanged or bossed drainage fittings shall be installed where an unavoidable low point or pocket exists in a pipe run. Vent fittings shall be provided for removal of air in piping installed with unavoidable high points. The final quantity, location, and arrangement shall be subject to Owner approval.

Regulatory Body-approved flexible connections shall be provided where required to isolate vibration and to accommodate thermal growth. Flexible connections shall also be provided between piping assemblies and resiliently mounted equipment. All flexible connections shall be sufficiently flexible to avoid overstressing the equipment, connected piping, or the flex assembly itself.

In general, fluid piping systems shall use flexible hose assemblies with 37-degree flare swivel end connections on both ends for connections two inches and smaller, and Garlock Style 206 or equal flanged flexible connections for larger connections. Hose assemblies conveying fuel or lube oil shall be flame-resistant and USCG approved. In general, flexible hose assemblies shall not be less than nine inches length or more than 30 inches length. Flexible hose runs shall not substitute for pipe or tube.

Garlock EZ-Flo flexible couplings or equal, where used, shall be Regulatory Body-approved for the intended service with steel flange retaining rings, chlorobutyl carcass, Hypalon liner and Neoprene cover, or equal.



Flexible connections for use in the engine exhaust system and compressed air systems are addressed in Sections 259 and 551, respectively.

Piping systems and components shall be insulated in accordance with Section 508.

Valves, cleanouts, or other components requiring access for maintenance or operation that are installed behind joinery shall be minimized to the greatest extent possible. Suitable access panels shall be provided for valves, cleanouts, or other components requiring access for maintenance or operation.

Where piping penetrates a watertight bulkhead, a deck or tank top, an approved penetration fitting shall be used to ensure the tightness of the structure. Penetration details shall be developed as shown on the Contract Guidance Drawings or as approved by the USCG. In no case shall the plating form part of a joint or piping.

The Contractor shall ensure that any penetrations through tonnage frames do not violate tonnage rules for openings. Generally, penetrations through tonnage frames shall be made tight around the pipe or duct or shall be spaced such that the distance between the edges of two openings is equal to, or greater than, the largest dimension of the larger of the two openings.

To prevent damage to piping and joints at bulkheads and decks, expansion bends shall be provided, as necessary, to allow for sufficient piping movement due to the working of the ship's structure. Expansion joints shall not be used except in engine exhaust.

Ferrous pipe and fittings required to be galvanized shall be galvanized by the hot dip process after fabrication when welding is necessary. Where screwed fittings are called for, galvanized pipe and fittings shall be used. Where galvanizing is damaged during installation, a cold galvanized coating for repairs shall be applied.

Where joints of ferrous and non-ferrous materials cannot be avoided, the connection shall be made with a flanged take down joint in accordance with Section 505.4.

Pipe welding shall comply with Regulatory Body requirements, and the details of ASTM F722, Standard Specification for Welded Joints for Shipboard Piping Systems

Piping systems containing oils shall be installed at least 18" away from surfaces that have temperatures under the insulation of greater than 450°F. Flanges and similar take down joints in such systems shall be located remotely from exposed surfaces having a temperature of more than 450°F, and protective shielding shall be provided around flanged connections to prevent the possibility of spray onto exposed hot surfaces.

The routing of piping directly over or within two feet of electrical equipment shall be avoided, to the maximum extent possible, and in no case shall flanges or joints be located over electrical equipment.

Piping shall not be routed directly over engines, except for systems connected to the engine. Piping shall not obstruct manholes, hatches, or accesses.

Pipe segments may be painted after successful completion of hydrostatic testing and prior to installation onboard as set forth in Section 982.2. Untested segments shall be left unpainted and un-insulated until successful completion of all installation and operational testing procedures as set forth in Section 982.3.



505.2 Valves, Fittings, and Instrument Piping

Valves shall be accessible from the grating level whenever possible. Where valves must be located out of easy reach, the Contractor shall install reach rods, remote operators operable from the IAS, or some other Owner-approved means of access.

Hand wheels for sea valves shall be easily accessible as set forth in Reference (R20).

Manually operated valves shall be easily operable by one person, directly or through mechanical advantage type operators. Valves and valve handwheels shall be located so that the operator's hand may easily pass between the handwheel and any interference, with the handwheel open, closed or in between.

Except when mounted overhead and arranged for operation from below, manually operated valve stems shall be installed with the valve stem rotated above the valve body in the horizontal plane. Ball and butterfly valves shall be installed in such a manner that the valve opens and the handle lines up with the piping under normal operating conditions.

Valves shall be right hand closing and shall have either a rising stem, or an indicator to show whether the valve is open or closed.

Spindles, seats, and disks of valves shall be corrosion-resistant material. Bodies and disk materials shall be as noted in the materials schedule on the diagrams. Valve stems shall be stainless steel. Valve seats shall be Buna N, Viton, or metallic as required to suit the service.

Unless otherwise noted in this Specification or the Contract Guidance Drawings, valves that are 2 inches and larger, except butterfly valves, shall be flanged with bolted bonnets and packing glands. Valves that are 1 1/2 inches and smaller may have union ends and bonnets, socket weld ends (with sufficient take-down joints to facilitate valve removal and replacement), or threaded ends.

The use of threaded valves and fittings in systems containing fuel oil, lube oil or hydraulic oil shall be limited to equipment connections and small fittings such as gauge piping and drain plugs to minimize the potential for leakage.

Check valves shall be installed wherever flow reversal in a system would be detrimental to operational requirements.

Stop check valves shall be installed wherever flow reversals could flood a space.

Swing check valves shall be installed in a horizontal plane and in a fore and aft orientation where possible.

Relief valves shall be provided on the discharge side of all positive displacement pumps and air compressors which do not have built-in relief valves.

In general, gate or ball valves shall be used where shut off only is required. Globe or angle valves shall be used where throttling is required.

Butterfly valves may be used in pipe three inches and over if the seat material suits the maximum operating temperature of the system, subject to Owner approval. Butterfly valves shall not be



substituted for gate valves or globe valves shown on the Contract Guidance Drawings and shall not be used on sea chests and overboard shell connections. Butterfly valves shall use lugged bodies at shell connections, and at connections for equipment that must be disconnected for maintenance such as heat exchangers.

Where pressure reducing valves are installed, a bypass with a globe valve shall be provided around the reducing valves with a pressure gauge and relief valve on the low-pressure side.

Thermometers with dry wells, and pressure gauges with snubbers, shall be installed as required to check proper operation of piping and equipment. Pressure gauges shall be provided for all pumps, with a compound type at the suction side and a pressure type at the discharge side of all pumps. Differential pressure gauges shall be provided at all strainers and filters. The gauges shall be 2 1/2-inch diameter, liquid filled. Pressure gauges shall be provided with shut-off valves and snubbers. Gauge piping assemblies shall meet the requirements of ASTM F721.

Valve locking devices shall meet the requirements of ASTM F993, Type II.

505.3 Remote Valve Operating Gear

Provide valve remote operating gear for the Forepeak Void bilge suction line penetrating the collision bulkheads as generally shown on Reference (M), as well as elsewhere where required by Regulatory Bodies and generally indicated on the Contract Guidance Drawings.

Remote operating gear shall terminate at the Main Deck or outside the space as required by USCG. Operating gear shall be rigid shafting with universal joints or flexible shafting.

Deck boxes shall be commercially manufactured and constructed from stainless steel. Each shall be provided with a stainless steel or bronze flush cap, permanently stamped or engraved with its function on the cap and on the rim. The deck box shall indicate whether the valves served is open or closed. Deck boxes for the systems described herein and elsewhere in this Specification shall be of identical manufacture. Provide four identical T-wrenches which serve all deck boxes. Final T-wrench mounting locations shall be proposed by Contractor and approved by Owner prior to installation.

505.4 Takedown Joints

Unless otherwise noted in this Specification or Contract Guidance Drawings, flanged takedown joints shall be provided in piping 2 inches and over, and unions may be used in piping 1 1/2 inches and smaller. Takedown joints shall be provided to allow removal of all in line equipment, or to allow removal of equipment normally blocked by the piping.

Where joints of ferrous and nonferrous materials cannot be avoided, the connections shall be made with flanged takedown joints fully isolated with gasket, sleeved fasteners, and isolating washers under the fasteners. All metal-to-metal connections between the hull and the keel coolers are to be isolated with non-metallic gaskets, washers, and bolt hole inserts.

Flanges in piping shall conform to ANSI standards for the appropriate service.

Where a steel flange is used with a cast iron flange, CPVC, or bronze flange, flat face flanges, and full flange gaskets shall be used. Flange gaskets shall be asbestos free. Flange gaskets shall be compatible

with the piping material, fluid conveyed, design pressure and temperature of the systems in which they are installed and shall meet all USCG requirements. Unions in metal piping shall be ground joint type.

Takedown joints in soft copper tubing shall be SAE 45 degrees flare type, with long nuts.

505.5 Pipe Hangers

Piping shall be adequately supported by hangers suitable for the materials and service, and in compliance with Regulatory Body requirements.

Pipe hangers shall meet the requirements of ASTM F708. The Contractor shall adjust the design, spacing, and installation of pipe hangers, as necessary, to provide an installation suitable for carrying the weight of the pipe and its contents, including dynamic loading imposed by the operating conditions of the connected equipment and the Vessel, and to prevent damage from vibration and thermal expansion.

Hangers shall be attached to the pipe with bolted clamps and welded to basic ship structure. Care shall be exercised to place pipe hangers so that strain is avoided where piping is connected to machinery. Hangers shall not be attached by welding directly to pipes.

Hangers supporting copper stainless steel tubing shall use non-metal resilient materials between the tubing and steel portions of the hanger, poly-block style or similar.

Hangers supporting hot engine piping such as exhaust and jacket water, shall accommodate thermal growth along with flexible pipe connections to the engine.

506 Fills, Vents, Sounding Tubes, and Overflows

The Contractor shall layout and install tank fill pipes, vents, and sounding tubes to comply with Regulatory Body requirements and generally as shown on the system diagrams. Vents shall be provided for all tanks and inaccessible spaces below the Main Deck. Configure vents and sounding tubes so they do not obstruct access to machinery, interfere with crew operations, or present a tripping hazard.

Vents to the weather shall terminate at the Vehicle Deck level unless otherwise indicated. Vent heads shall be located at least 30" above the deck.

The Steering Gear Room, Voids, and Tank Room shall each be fitted with two 3 inch vents, located port and starboard. The steering Gear Room, Voids, and Tank Room vents shall be fitted with stainless steel vermin screens. Fuel oil, waste oil, oily water tank and sewage tank vents shall be fitted with stainless steel flame screens. Except for the sea chest vent, all vents lead to weather shall be fitted with float type non-return vent heads.

The fuel oil tank and aft void vents shall be located away from sources of ignition.

Fill, discharge, and vent pipes for tanks containing fuel oil or lube oil shall be surrounded by a containment coaming. Each containment coaming shall have a capacity of at least one-half barrel.



508 Pipe Insulation

The Contractor shall develop a piping insulation schedule and submit it to the Owner for approval. This schedule shall include, but not be limited to, the following:

- Insulate the exhaust piping, including silencers (see Section 259.2).
- Insulate hot potable water piping for energy conservation and safety.
- Insulate main, generator, and bow thruster engine cooling piping above the floor plates, and where necessary to prevent injury to personnel and equipment.
- Insulate various systems where necessary to prevent freezing. Some systems may not require insulation if installed with proper drainage to prevent freezing.
- All hot and cold water piping and air conditioning piping and tubing, including valves, shall be insulated as necessary to prevent heat transfer, sweating, and/or freezing.
- Where, in BITA's opinion, insulation is subject to damage, it shall be covered with removable aluminum sheet metal guards.

All insulation material and installation details shall be in accordance with ASTM F683-10, except as modified by this Specification and in order to meet all applicable Regulatory Body requirements.

Piping insulation and lagging in accommodation, service, and control spaces shall be USCG approved incombustible materials. Elastomeric foam plastic insulation shall not be used in these spaces except as allowed by Reference (R1) and Reference (R8).

Refrigerant piping, valves, and fittings shall be insulated with Regulatory Body-approved closed cell foam. Insulation shall be noncombustible or low flame spread and tested in accordance with 46 CFR 164.012 or Annex 1 Part 5 of the FTP code. Insulation materials, thickness, and method of application shall be in accordance with Regulatory Body requirements.

Insulation installed on piping exposed to weather shall be covered with stainless steel jacketing.

Prior to the installation of any insulation and/or lagging, the piping system must have all installation tests and inspections completed and approved. Refer to Section 982 for installation testing requirements.

All water piping and drains exposed to weather or in unheated spaces shall be insulated and heat taped prior to insulation. Heat tape shall be self-regulating. Provide heat trace controllers for control and monitoring of heat tapes with alarm outputs. Connect alarm outputs to the ship's alarm and monitoring system.

Label heat taped piping over insulation to indicate location of heat taping. Locations of heat taped piping shall also be indicated on the As-built piping drawings.

510 Heating, Ventilation, and Air Conditioning

510.1 General Requirements

The Contractor shall install Heating, Ventilation, and Air Conditioning (HVAC) systems as described in this Specification. Perform HVAC calculations in accordance with Reference (R16) and arrange the systems to meet USCG requirements, including all applicable Navigation Vessel Inspection Circulars. Install all HVAC components necessary to deliver heat, ventilation, and air conditioning as indicated in this specification.



The Contractor shall be responsible for sizing fans, air-conditioning units, heaters, and ducts and providing calculations to Owner to confirm compliance with the above requirements. In no case shall fans or total space heating be less than shown by Reference (V).

510.2 Design Conditions

The HVAC equipment installed shall be capable of maintaining indoor design conditions while operating at the outdoor design conditions noted in Table 9.

Table 9: HVAC Design Conditions

	Winter	Summer
Outside Air Design Temperature Crew and Accommodation Spaces	-0.4 °F	84.6 °F DB, 70.3 °F WB
Outside Air Design Temperature Machinery Spaces	-0.4 °F	90 °F DB
Water Temperature	32 °F	75 °F
Crew and Accommodations Spaces	70 °F	75 °F, 55% RH
Engine Room and Bow Thruster Room	45 °F	113 °F

Winter heating requirements assume spaces are empty of people, and no credit shall be taken for heat from adjacent spaces, lighting, or equipment as part of those requirements.

510.3 Noise

The installed HVAC systems shall meet the noise limits described in Section 073. The HVAC noise level must be low enough to not cause excess noise when combined with machinery system noise. The noise limits for accommodation heating and ventilating systems should be designed to be at a minimum 5dB less than the noise limit for each compartment as specified in Section 073. HVAC noise is considered to include the contribution of noise from the fan, ducts, turns, branches, and diffusers. The Contractor shall prepare noise calculations for the finalized system in noise critical areas and shall select and install insulation and HVAC acoustic treatments as needed to meet the noise and vibration requirements of this Section and Section 073. Selection of such treatments shall be subject to the details of fan selection and duct routing.

510.4 Ducting

Ductwork shall be fabricated from galvanized steel sheet metal in accordance with the standards of the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and Regulatory Body requirements. Break large panels to prevent panting. Ducts shall be smooth inside with no protruding edges. All ducts shall be airtight.

Duct joints shall utilize flanged or Regulatory approved clamp or sleeve joints with an approved adhesive tape and duct sealer as suitable for the size, shape, and tightness requirements of the duct. Ducts passing over electrical equipment shall be made watertight, insulated and shielded to prevent condensation from dripping upon electrical equipment.

Machinery space ventilation ducts shall be fabricated from 16-gauge G90 galvanized sheet steel. Ducting shall be installed as close to the overhead as possible. All joints shall be flanged, riveted, or welded; slip joints shall not be used.



Where required by USCG for fire protection, ducts shall be a minimum of 11-gauge (3mm) steel. 11-gauge minimum steel shall be used for sleeves between fire dampers and the adjacent fire boundary, and for ducts passing completely through a space without serving that space.

Ductwork shall be sized such that air velocity in any part of the ducting system does not exceed 3,000 feet per minute for machinery and hold spaces. Ducting velocities in accommodations spaces shall be limited to 2,000 feet per minute, however where space conditions necessitate, local velocities may be as high as 2,500 feet per minute, subject to Owner approval prior to installation.

Where practicable, bends and elbows shall be fabricated with a throat radius of at least one times the width or diameter of the duct. Where a smaller throat radius is required, splitters or turning vanes shall be used. Round 90° elbows shall be made of at least five parts or vaned turns, which may be used at the Contractor's choice. Reductions in duct size shall be accomplished by long transitions with maximum included angle of 30°.

To the extent practicable, ducting leading into or out of fans shall be straight for at least three duct diameters in order to reduce noise.

Supply and exhaust ducts shall be fitted with removable access panels at regular intervals of no more than 30 feet. Additional access panels shall be provided in the following locations:

- Immediately upstream and downstream of fans and coils or fan coil units. These may be omitted if the ducting in such areas is flexible and/or removable and easily reinstalled.
- Immediately upstream of dampers.
- In way of duct and trunk low-point drains.
- Bottom of vertical trunks and non-removable ducts.

All duct access panels shall meet the following requirements:

- The minimum thickness for access doors shall be consistent with the minimum thickness required for the adjacent ductwork.
- Fasteners used to secure the duct access doors, such as bolts, weld studs, latches, or wing nuts, shall be carbon steel or stainless steel and shall not penetrate duct walls.
- Access doors shall seal airtight. Where ducts serve more than one space or penetrate fire boundaries, access doors shall have a gasket or sealant that is rated for at least 1,500°F.

Duct access panels shall be located in readily accessible locations clear of interferences.

The number of ducts penetrating decks, structural bulkheads, girders, or other strength members shall be minimized to the greatest extent possible. Where penetrations are required, provide suitable strength compensation such as sleeves or doublers.

Where avoidable, ducts shall not penetrate watertight or fire zone boundaries. Penetrations shall maintain the integrity of the boundary and must be approved by USCG. No ventilation ducts shall penetrate transverse watertight bulkheads below the Main Deck.

Passenger and crew space diffusers shall be the round or square ceiling type, with balancing dampers and shall have noise damping plenums. Diffusers and registers shall have robust, tamper proof construction, and shall be selected and located for proper air diffusion in the space served. Diffusers



shall be integrated with the ceiling system, painted to match the surrounding décor, and arranged to effectively ventilate the spaces served. Terminal and register velocities in the passenger spaces shall be selected and spaced for effective air distribution and to achieve the noise requirements of Section 510.3.

510.5 Weather Louvers and Mist Eliminators

Air inlets leading from the weather shall be fitted with mist eliminators or weather louvers. Inlet velocities through mist eliminators shall not exceed 1,300 feet per minute based on the face area of the mist eliminator. Inlet velocities through inlet louvers shall not exceed 500 ft per minute based on the gross inlet face area.

Exhausts to the weather shall be fitted with aluminum weather louvers. Weather louvers shall be removable and held in place with stainless steel screens. Velocities across exhaust louvers shall be generally limited to 750 feet per minute based on gross face area to the greatest extent possible under all operating conditions.

Weather louvers and mist eliminators shall be fitted with drains led to the nearest weather deck drain or to weather. Structure supporting louvers, mist eliminators, and attached plenums shall also be arranged for complete drainage to prevent corrosion. Drain lines running straight to weather shall run inside structure to within 6 inches of the deck.

Gooseneck or mushroom ventilators may also be used for intake and exhaust terminals where appropriate.

Fit all supply and exhaust ducts with stainless steel insect screens.

510.6 Ventilation Insulation and Lagging

Ducting (including equipment, access, flanges, and re-circulation ducts) for air-conditioned or ventilated spaces and ducting conveying ventilation air through more than one space shall be insulated and lagged. Ducting in machinery spaces and those carrying non-air conditioned air within a single space shall not be insulated.

Insulation shall be 1-inch-thick fibrous glass board with minimum density of 3 pounds per cubic foot for rectangular duct. Insulation on round or flat oval ducts and bends shall be 1-inch-thick flexible fibrous glass with a minimum density of 1.5 pounds per cubic foot. Vapor barriers shall be factory-applied aluminum foil, at least 0.002 inches thick. Joints in the vapor barrier shall be overlapped a minimum of 2 inches and coated with approved vapor sealing compound. All insulation shall be noncombustible and comply with Regulatory Body requirements.

Insulation shall be secured to the duct with a suitable adhesive. On rectangular ducts over 24 inches wide, equipment, and plenums, insulation shall be further secured with metal clips, pins, or studs. Adhesive shall be chemically compatible with the insulated surface. Any insulation applied to the inside of ducting shall be specifically designed for that purpose and shall be suitably installed to ensure adherence.

In areas where insulation may be subject to damage, protection such as galvanized steel or aluminum sheathing or guards shall be provided. The location and extent of such protective sheathing shall be to the satisfaction of the Owner.



Acoustic insulation shall be installed where required to limit sound levels in passenger areas, in accordance with Section 510.3.

510.7 Fire Dampers

Fire dampers, where required by Regulatory Body requirements, shall be installed in accordance with applicable USCG requirements, including the provisions of NVIC 09-97 CH-1, using stainless steel fasteners. Fire dampers shall be Halton type FDB2, Wozair MFD, or equal.

If a fire damper is not immediately adjacent to a removable louver, an access door shall be installed in the duct adjacent to the fire damper to allow inspection and cleaning of the fire damper blades.

Where fire dampers are concealed by joinery, provide access panels for inspection and operation of the damper. All fire dampers shall be capable of manual operation

Fire dampers for machinery spaces and the vehicle deck shall have automatic electric actuators, Belimo or equal, power to open/spring closed, and 165°F fusible links. Fire damper actuators shall be provided with power from the 120 VAC power distribution system and configured so that interruption of the power will initiate closing of dampers and shutdown of ventilation fans. Dampers and fan shutdowns for each system shall be independent.

510.8 Condensate Drains

Condensate drains for air conditioning units shall be piped to a nearby deck drain.

512 Accommodations HVAC

512.1 General

Crew and accommodations spaces shall be air conditioned and heated using ducted split heat pump systems. The systems shall utilize air cooled condensers. Heat pumps shall be suitable for marine service and shall be selected and configured for efficient operation in low ambient conditions. The heat pump systems shall be fitted with auxiliary electric duct heaters for operation in low ambient conditions.

In addition to the heat pumps, each space shall be fitted with local electric resistance heat sized to offset space loads in the design outdoor conditions, to provide supplemental heat during periods of extreme cold and when the central heat pump units are secured.

Each HVAC zone shall have independent controls and thermostats in the spaces served. Controls for each zone shall operate independently and shall be separately programmable to permit the set points to be varied throughout the day. The control systems shall be programmed for unattended operation and include self-diagnostics and summary alarms outputs integrated with the ship's alarm and monitoring system. Remote control and monitoring of passenger space HVAC systems shall be installed in the Pilot House. Remote shutdowns shall be provided in accordance with USCG requirements.

Thermostats mounted in passenger spaces shall be protected by locked tamper-proof covers.

512.2 Pilot House

The pilot house shall have an independent air conditioning unit. Ducting shall be installed in the Pilot House overhead, concealed above the drop ceiling to distribute air throughout the pilot house. The



outdoor condenser unit for the Pilot House HVAC unit shall be located behind the Pilot House, generally where shown on Reference (B).

Outdoor air supply for the shall be regulated via port and starboard sliding windows

Four fan forced wall mounted electric resistance heaters rated 3 kW minimum, Indeeco or equal, shall be installed throughout the Pilot House.

512.3 Upper Deck

Interior Crew and Passenger Spaces

Interior passenger and crew spaces on the upper deck shall be air conditioned and heated. A direct expansion air handler shall be installed in the HVAC fan room, with air ducted to the Aft Passenger Lounge and the Crew Day Room. The air conditioning system shall be variable air volume, modulating air in response to heating and cooling load demand in each space. The hallway and crew washroom between frames 20 and 13 will be cooled using transfer air from the crew day room via a door louver.

The outdoor condenser unit for the Upper Deck HVAC system unit shall be located on the Upper Deck near the HVAC Fan Room, generally where shown on Reference (B).

Supplemental heat shall be provided by fan-forced wall mounted electric resistance heaters, Indeeco or equal. The aft passenger lounge shall be fitted with four heaters with minimum rating of 3 kW. The Crew Washroom, Crew Dayroom, HVAC Fan Room, and Aft Control Station shall each be fitted with one heater rated 1.5 kW minimum.

The crew washroom shall be fitted with an exhaust fan that extracts 70 CFM from the space to weather. Make up air for the crew washroom shall be supplied via a door louver.

Return air from the aft passenger space and crew hallway shall be ducted back to the air handler.

Outside replenishment air shall be supplied via supply ducting to the air handler. The outside air shall be mixed with the return air upstream of each air handler. Exhaust air (equal in volume to the outside air) shall be extracted and discharged to atmosphere. Outdoor air shall be modulated in response to occupancy, varying between 120 and 580 cfm based on CO2 level in return air stream.

Electronics Security Room

The electronics security room shall be air conditioned using an independent mini split system heat pump sized for the space load. Install the outdoor unit for the electronics security room adjacent to the security electronics room below the port side exterior stairs to the pilot house. The electronics security room shall be fitted with one electric resistance heater rated 1.5 kW minimum.

The electronics security room shall be fitted with an exhaust fan that extracts 50 CFM from the space to weather. Make up air for the electronics security room shall be supplied via a door louver.

Aft Passenger Deck (Solarium)

The covered portion of the aft passenger deck shall be fitted with eight radiant heating panels, Indeeco or equal, each rated at 2 kW minimum.



512.4 Passenger Deck

The passenger spaces on the passenger deck shall be air conditioned and heated. A direct expansion air handler shall be installed in the Auxiliary Fan Room below the Pilot House, with air ducted to the Observation Lounge. The air conditioning system shall be variable air volume, modulating air in response to heating and cooling demand.

The outdoor condenser unit for the Upper Deck HVAC system unit shall be located behind the Pilot House, generally where shown on Reference (B).

Supplemental heat shall be provided by fan-forced wall mounted electric resistance heaters, Indeeco or equal. The observation lounge shall be fitted with four heaters with a minimum rating of 3 kW.

The five washrooms, cleaning gear locker, emergency gear locker, and PFD locker shall be air conditioned and heated using transfer air from the observation lounge. A exhaust fan installed in the HVAC fan room shall draw air from each of these spaces and discharge it to weather. Make-up air for each washroom and the cleaning gear locker shall be supplied via a door louver. Make-up air for the PFD locker and emergency gear locker shall be supplied via door undercuts.

Outside replenishment air shall be supplied via supply ducting to the air handler. The outside air shall be mixed with the return air upstream of each air handler. Exhaust air (equal in volume to the outside air) shall be extracted from each zone and discharged to atmosphere via the washroom exhaust fan, which shall be variable speed. Outdoor air shall be modulated in response to occupancy, varying between 430 and 580 cfm based on CO2 level in return air stream.

512.5 Stair Tower

The aft stair tower shall have a fully independent air conditioning, ventilation, and heating system serving only the stair tower. A direct expansion air handler shall be installed in the HVAC fan room with air ducted to the stair tower. A portion of the supply air shall be ducted to each level of the stair tower, port and starboard.

Exhaust air shall be extracted near the top of the stair tower utilizing an exhaust speed exhaust fan at a rate of 480 CFM. Outside replenishment air shall be supplied via supply ducting to the air handler. The outside air shall be mixed with the return air upstream of the air handler.

Supplemental heat shall provided by fan-forced wall mounted heaters, Indeeco or equal. The stair tower shall be fitted with seven heaters with a minimum rating of 3 kW each distributed throughout the stair tower.

512.6 Vehicle Deck Ventilation

The Vehicle Deck will be equipped with four 3025 cfm ventilation supply fans, each supplying air to the Vehicle Deck via demisting louvers. Two fans shall supply air to the forward portion of the vehicle parking area, and two shall supply air to the aft portion of the vehicle parking area. Air shall be exhausted at the aft of the Vehicle Deck via the mooring port openings and the opening at the top of the aft vehicle ramp.

The Vehicle Deck ventilation fans shall be variable speed, with manual speed control and start/stop controls provided from a control panel in the Pilot House.



An electrically actuated fire damper shall be installed at each inlet. The fire dampers shall close upon fan shutdown, or upon actuation of the Vehicle Deck fire

Duct silencers and fan insulation shall be provided as necessary to meet the noise limits of Section 073.

513 Machinery Space Ventilation System

The Engine Room and Bow Thruster Room shall be provided with mechanical ventilation sufficient to both offset the heat rejection of the equipment as well as provide the appropriate amount of engine combustion air in each space and as described herein.

513.1 Engine Room

Fresh air supply shall be taken through a demisting weather louver and intake trunk located on the starboard side of the vessel, between Frames 25 and 27 above the vehicle deck.

Two Engine Room Supply fans shall be installed in the intake plenum on the starboard side. Engine Room supply fans shall be mounted on vibration isolators. Flexible duct connectors, properly rat proofed, shall be provided at the fan inlet and discharge of each fan. The contractor shall size the fans to suit the installation, considering heat rejection combustion air requirements from major equipment including two main engines, and one generator operating simultaneously.

The Engine Room supply fans shall be variable speed, with airflow to the Engine Room varied based on the ambient space temperature. The engine room fans shall also have manual speed control and start/stop controls provided from a control panel in the Pilot House.

Duct silencers and fan insulation shall be provided as necessary to meet the noise limits of Section 073.

Ducts shall be installed to efficiently distribute air throughout the Engine Room. Sufficient air shall be ducted each main engines and generators, and to the forward and aft portion of the engine room. Sufficient supply air shall be directed between the Urea tank and the SCRs and other surrounding equipment to prevent overheating of the urea storage tank.

Ventilation air shall be exhausted from the Engine Room via the port and starboard exhaust stacks and weather louvers installed on the aft face of the stacks above the bridge deck. The weather louvers shall be sized so that maximum static pressure in the engineer room does not exceed 0.25 inH2O above ambient for easy opening of engine room doors.

The intake trunk and exhaust louvers shall be fitted with electrically actuated fire dampers. The fans and fire dampers shall have manual remote shutdown from the bridge and automatic shutdown upon actuation of the Flouro-K 1230 fire suppression system

The Engine Room shall have five fan forced electric unit heaters, Indeeco Triad or equal, rated 5 kW each.

513.2 Bow Thruster Room

Fresh air supply shall be taken through a demisting weather louver and intake trunk located on the starboard side of the vessel above the Fore Deck

The bow thruster compartment will be equipped with one supply fan that draws air from the intake trunk and discharges it via ducting to a terminal near the bow thruster engine.



Ventilation air shall be exhausted from the Bow Thruster Room via an exhaust trunk and weather louver installed on the port side of the vessel above the fore deck.

The intake trunk and exhaust trunk shall be fitted with electrically actuated fire dampers at the entrance to the Bow Thruster Room. The fan and fire dampers shall have manual remote shutdown from the bridge and automatic shutdown upon actuation of the Flouro-K 1230 fire suppression system

The Bow Thruster Room shall have two fan forced electric unit heaters, Indeeco Triad or equal, rated 5 kW each.

513.3 Tank Room Ventilation

The starboard tank room gooseneck vent shall be fitted with a flange mounted centrifugal supply fan, capable of supplying 300 cfm to the space.

521 Firemain System

521.1 Firemain

The Contractor shall layout and install firemain system as indicated on Reference (M). The system shall meet the requirements of the USCG, and the requirements described herein. General piping requirements are described in Section 500.

The firemain shall be served by a fire pump in the Engine Room. The fire pump shall be capable of remote starting from the Pilot House. A fire pump run light indication and pressure gauge shall be provided on the Pilot House.

A duplex strainer shall be installed between the sea chest and the fire pump.

The firemain system shall have fire stations located generally as shown on the Reference (B).

Each hydrant shall have a 1-1/2 inch angle globe hose valve, a 50 foot length of 1-1/2 inch approved fire hose (connected), a spanner wrench, a combination nozzle, and a fire hose rack fitted in an enclosure. Enclosures shall be stainless steel. The hydrant enclosures shall be approved by the Owner.

Fire hose shall meet the requirements of USCG 46 CFR 118.320. Fire stations shall be marked in accordance with USCG 46 CFR 78.47.

Firemain piping shall be Galvanized Schedule 40 Steel.

See Section 163 for sea chest requirements.

521.2 Shore Supply

The Contractor shall provide and install an accessible shore-water supply connection station to allow the vessel to charge the Firemain and Sprinkler Systems. The shore supply station shall be located near the port-aft mooring station on the Vehicle Deck. An international shore connection flange and fire station department shore connection adapter with hose threads matching those used in normally visited ports shall be provided.



A spray applicator attachment shall be provided, in accordance with USCG requirements, to be mounted in a location approved by the Owner's Representative.

522 Sprinkler System

The Contractor shall install automatic sprinkler systems, generally as shown on Reference (K). The system shall meet the requirements of USCG, NFPA-13, and the requirements listed below.

The sprinkler system shall be a dry pipe, automatic system serving the vehicle deck.

A shore supply connection shall be provided per Section 521.2.

Sprinkler piping shall be routed for complete drainage to the dry pipe valve. Where pockets are unavoidable, valved drains to completely empty the systems shall be installed.

The Contractor shall furnish and install a listed centrifugal sprinkler pump. Pump characteristics shall be in accordance with Reference (K). The sprinkler pump shall be a horizontal, base-mounted pump, with cast iron casing and stainless steel impeller and shaft capable of supplying 440 GPM at 155 ft TDH minimum. The motor shall be 30HP, 3500 rpm, TEFC furnished with the pump. An equivalent vertical pump configuration may be substituted.

The pump shall be arranged to take suction from the Engine Room sea chest. The pump discharge shall be connected to the sprinkler system via the sprinkler dry pipe valve. An overboard discharge shall be provided for system testing.

A simplex strainer, Hayward or equal, with cast iron body and stainless steel baskets, shall be installed at the suction side of the pump.

The firemain shall be cross connected to the sprinkler system allowing the fire pump to supply water to the sprinkler system.

The contractor shall install a 1,100 gallon vertical cylinder sprinkler system pressure tank with elliptical heads. The tank shall be designed to current ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, rated for 175 psig. The tank shall be fitted with the following:

- One 4 inch 150# ANSI flanged main sprinkler system connection, near bottom.
- Two 1 inch 150# ANSI flanged connections, vertically aligned at top and bottom for sight gauge.
- One 1 inch 150# flanged connection near the top for air supply.
- One 1 inch 150# ANSI flanged connection, for relief valve.
- One 12 in x 16 in inspection port on side.
- One GEMS Suresite sight gauge with side mounted 1 inch 150# ANSI flange connections. Gauge length shall accommodate range of level indication between approximately 200 and 800 gallons.

The sprinkler tank shall be provided with bottom legs suitable for mounting to the ship's structure, lifting padeyes, and delivered prepped and epoxy coated inside and out. There shall be no need for shipyard welding to the tank's shell.

The Contractor shall finalize tank geometry, and size and location of all tank connections as required to suit the installed sprinkler system arrangement. Prior to tank purchase, the proposed tank location on the ship, as shown on Reference (K), shall be reviewed to verify suitability of the tank size and



orientation of tank fittings. Submit tank drawings to the Resident Engineer for approval prior to purchase.

Sensors and indicators, including tank level indicators, temperature, pressure, and valve position monitors, shall be provided as required by NFPA 13, and interfaced with the ships alarm and monitoring system. See Section 436

526 Scuppers and Deck Drains

The Contractor shall layout and install weather deck drains and scuppers to clear water from the housetops, superstructure, and vehicle deck.

Where practical, route weather deck drains inside the structure, behind linings, down to the deck below, then penetrating the house side at 45° and discharge to the weather just above the deck. Otherwise, route weather deck drains outside the structure down to the deck below, where the drain shall discharge near the deck. Provide and route sufficient drains to ultimately discharge overboard at the main deck level. Drains serving aluminum structure above the upper deck shall be fabricated from 2" Schedule 80 6061 aluminum pipe, with no takedown joints and as few bends as possible. Drains originating at the upper deck or below shall use 2" Schedule 80 A53 steel.

The deck drains shall be fitted flush to the deck and have stainless steel strainer plates. The weld around the deck drains shall be ground smooth so that water is not trapped at the edge of the drain.

Drains may be combined provided the combined drainpipe area is not less than the total area of the joining drains, and a clean out is provided at the juncture.

Provide additional drains, where necessary, to prevent water standing on the decks under ordinary conditions of list and trim.

Scuppers shall be fitted at the perimeter of the vehicle deck for effective drainage of water. The arrangement, size and spacing of the scuppers shall be sufficient to clear firefighting and sprinkler system water from the deck and shall also meet the requirements of 46 CFR 178.430 and as required . See Reference(Y). The freeing ports shall be arranged to prevent water from waves backflowing onto the vehicle deck.

Drains exposed to weather or in unheated spaces shall be heat traced as described in section 508.

528 Plumbing Drainage

The Contractor shall layout and install a black water and grey water drainage piping system generally as shown in Reference (L).

Black and gray water shall be collected via a gravity system that drains to a 1,000 gallon sewage holding tank located in the tank room. The sewage tank shall be an externally stiffened independent steel tank, fitted level indication per Section 436.

Slope drain piping continuously to the sewage tank. Drain piping shall be routed as directly as possible and provide a sufficient number of accessible cleanout connections for clearing the drains with a plumber's snake or a pressurized water hose.



Piping in interior passenger spaces shall be concealed behind ceiling panels or bulkhead liners. Piping shall be run as directly as possible using a minimum of fittings.

Drains exposed to weather shall be insulated and heat traced in accordance with Section 508.

Where a drain is combined with other drains, "Y" or "Y-Tee" branches shall be used to facilitate flow. All drains shall be independently trapped and provided with an accessible cleanout connection.

Lavatory fixtures shall be furnished generally shown in Reference (B) and (L) complete with valves, faucets, stops, drain fittings, vents, and hangers. Fixtures and accessories shall be installed in a manner that does not impair the integrity of structure or damage decorative linings.

Each washroom and the cleaning gear locker the cleaning gear locker shall be fitted with a deck drain. Deck drains shall be commercially manufactured, heavy-wall steel, weld-in style deck drains with removable bronze strainer plates and integral traps. Drains shall be flush with the finished deck surface with no protrusions that would prevent water from flowing into the drain.

Sanitary fixtures are described in Section 644.

A sewage discharge pump shall be installed for emptying the black water tank. The pump shall be a solids handling, self-priming, centrifugal pump. Final pump selection shall ensure pump is sized to be capable of discharging to the shore connection on the Main Deck at a rate of 80 GPM. The discharge pipe shall lead to the Vehicle Deck level and shall be fitted with two valved discharge connections with 2" camlock fitting. One shore connection shall be located in a pocket in the vessel's side shell with access from the dock. The second shall be accessible from the Vehicle Deck.

529 Bilge System

A bilge system shall be installed generally as shown on Reference (M) and in accordance with Regulatory body requirements. The bilge system shall be capable of pumping out all compartments below the Vehicle Deck. Bilge suctions from each compartment shall be routed to the bilge manifold in the Engine Room.

Bilge piping shall be hot dip galvanized Schedule 40 steel. Bilge suction lines shall terminate as close to the Vessel's centerline as feasible. All bilge suctions shall be located as close as possible to the lowest point of the space served. The bilge suction line penetrating the collision bulkhead shall have a shut off valve capable of actuation from the Main Deck via a remote operator and flush deck access box. Bilge piping shall be routed inboard of 1/5th of the Vessel's beam. The bilge piping shall be constructed with flanged takedown joints at regular intervals.

The bilge system shall have two self-priming centrifugal bilge pumps. One bilge pump shall be located in the engine room, and the second in the pump room. A cross connection to the fire pump shall allow it to serve as a backup bilge pump. The bilge pump shall take suction from the bilge manifold and discharge overboard. An emergency bilge suction shall be installed near the pump suction in the Engine Room.

The bilge pump shall have a duplex type strainer installed between the suction manifold and pump.

Suction strainer boxes built in accordance with ASTM F986 (type 1) shall be installed at the suction end termination of all bilge suction lines.



533 Potable and Sanitary Water System

Install potable and sanitary water systems generally as shown in Reference (N). The systems shall meet the applicable requirements of USCG.

Means to shut off and drain the piping system down to the Engine Room for winterizing shall be provided. Exterior hose bibbs shall be non-freeze type. Interior hose bibbs shall be located in lockable enclosures. Exterior hose bibbs in passenger accessible areas shall be tamper resistant and key operated.

Normally filled piping exposed to weather or in unheated spaces shall be insulated and heat taped in accordance with Section 508.

533.1 Potable Water

The potable water system shall be installed as generally shown on Reference (N). Potable water storage shall be provided by a 1,000 gallon structural steel tank as generally shown on the Contract Plans. Piping shall be installed to distribute potable water to the vessel's lavatories, sinks, drinking fountains, and hose bibbs.

Hose bibbs shall be installed forward and aft on each deck for cleaning and washdown. A hose bib shall also be provided in the engine room. Exterior hose bibbs shall be arranged to prevent freezing through the use of frost-free hose bibbs or isolation and drain valves.

One hydro-pneumatic tank shall be installed on the system and sized to suit the potable water pump installation.

A crossover connection with backflow preventer and isolation valve shall be fitted to supply potable water to the sanitary system.

A fill station for the potable water system shall be installed at the port-aft mooring station. The fill connection shall be a minimum 24 inches above the deck fitted with a threaded cap. Mark with an engraved label plate stating POTABLE WATER ONLY. The fill station shall be fitted with valves and across over allowing it to be used to charge the potable water system when the vessel is in port.

533.2 Sanitary Water

The sanitary water system shall be installed as generally shown on Reference (N). Water for the sanitary system shall be lake water drawn from the sea chest. Piping shall be installed to distribute flushing water to the toilets.

The sanitary flushing water pump shall take suction from the sea chest and supply flushing water to the toilets.

One hydro-pneumatic tank shall be installed on the system and sized to suit the potable water pump installation.

Note: If the vessel is placed in seawater during construction or delivery, the sanitary water system shall be isolated at the sea chest to prevent seawater from entering the sanitary system. The system shall be filled and tested with fresh water only.



543 Lube Oil, Oily Water, and Waste Oil Systems

The Contractor shall install lube oil, waste oil and oily water systems generally as shown in Reference (O) and in accordance with USCG requirements. Drip pans shall also be installed under machinery to contain oil.

543.1 Lube Oil Storage, Filling, and Transfer

The engine lube oil storage and transfer system shall be installed in accordance with Reference (O) and as described herein. A 400 gallon capacity lube oil tank shall be installed to provide lube oil storage for the main engines and generators.

Transfer of clean oil between the tank and the diesel engines in the Engine Room shall be achieved with an electrically powered, positive displacement pump and a hose reel. The transfer piping shall be fitted with camlock quick disconnect fittings and isolation ball valves as shown on Reference (O). Reinforced rubber hoses with corresponding quick disconnect fittings shall be provided to connect the hose reel discharge to the permanently installed piping.

The storage tank shall be fitted with a spigot and an oil can/bucket filling station. The Contractor shall install a drip pan with adequate clearance to allow the placement of a 5-gallon bucket underneath the spigot.

The lube oil storage tank shall be located in the main Engine Room as shown in Reference (G). The tank shall be fitted with the following.

- One 3 inch fill line led from the shore fill station located near the port-aft mooring station on the vehicle deck. The fill shall be fitted with quick disconnect coupling and lockable dust cap
- One 4 inch goose neck vent fitted with a stainless steel flame screen
- One 1 inch drain fitting with valved spigot located near the bottom of the tank
- One sight gauge, Gems Suresite or equal
- One inspection and access manhole

Level indication shall range within 2" from the top and bottom of the tank.

Drip pans shall be provided under the tank vents, quick disconnects, and spigot valves.

After installation the lube oil storage tank shall be cleaned and be made free of water, dirt, paint, rust, or primer on the inside surfaces. After the Owner's inspection and approval, the tank shall be filled with the type of lube oil appropriate for the engines.

543.2 Oily Water Holding and Transfer System

The Contractor shall install an oily water holding and transfer system generally as shown in Reference (O). The system shall consist of a small electric pump that draws suction from the Engine Room bilge and discharges to the oily water holding tank. The piping arrangement shall also allow the pump to take suction from the tank and discharge to a shore hose connection located near the port aft mooring station.

The oily water tank shall be located in the main Engine Room as shown in Reference (B). The tank shall be fitted with the following.



- Two 1-1/2 inch fill and discharge pipes
- One 1-1/2 inch sounding tube/ fill port with a self-closing valve and funnel
- One 2 inch goose neck vent fitted with a stainless steel flame screen
- One inspection and access manhole

Provide tank level indication as described in Section 437.

543.4 Waste Oil Holding and Transfer System

The Contractor shall install a waste oil holding and transfer system generally as shown in Reference (O). The system shall consist of a small electric pump, a waste oil holding tank and a system of piping and valves that allows for the following functions:

- Take pump suction from the Main Engine, Reduction Gear, BT Engine, or SSDG Engine sumps and discharge to the waste oil tank
- Align for drip tray pans underneath the Main or SSDG engines to gravity feed to the waste oil tank
- Pump contents of the waste oil tank to a shore hose connection located near the port aft mooring station

The waste oil tank shall be located in the main Engine Room as shown in Reference (B). The tank shall be fitted with the following.

- Two 1-1/2 inch fill and discharge pipes
- One 1-1/2 inch sounding tube/ fill port with a self-closing valve and funnel
- One 2 inch goose neck vent fitted with a stainless steel flame screen
- One inspection and access manhole

Provide tank level indication as described in Section 437.

543.4 Drip Pans

The Contractor shall provide and install drip pans under all oil pumps stations, filters, and other equipment likely to drip oil. The drip pans shall be constructed of 20 gauge galvanized sheet metal, with minimum 2" flanged sides properly sealed to prevent leakage of engine oil into the bilges or on deck. Drip pans shall be provided with necessary supports to restrain movement and shall be easily removable for cleaning and maintenance.

551 Compressed Air Systems

A compressed air system shall be installed as described herein and as generally shown in Reference (P). The system shall be configured to store air at high pressure and distribute the air at reduced pressures for various functions, including engine starting, sea chest blowdowns, and service air stations.

All reducing stations shall be fitted with self-piloted reducing valves. Regulating valves sized 1 inches or larger shall have an upstream wye strainer, inlet/outlet isolation valves, relief valve, and globe bypass valve as shown in Reference (P). The wye strainers shall be fitted with moisture drains and drain ball valves connected at the low point of the strainer housing. Smaller reducing stations shall have isolation valves only.



All air receivers shall be cylindrical with elliptical heads and shall comply with the applicable requirements of the ASME pressure vessel code as referenced in 46 CFR Part 54. In general, all receivers may be mounted horizontally or vertically as final arrangements permit and shall have separate process connections for inlet, outlet, drain, and relief valves.

In general, all low points where moisture can accumulate shall be fitted with dirt legs and drain valves. Long horizontal runs of piping shall drain to low point drains or to the receivers, whichever is closest.

The system shall consist of the following major components:

- Two air compressors, 250 psig, 29.6 CFM @ 200 psig
- Two main air receivers, 120 gallon capacity each
- One 200/150 psig pressure reducing station (starting air pressure)
- One 200/100 psig pressure reducing station (ship's service air)
- One 200/105 psig pressure reducing station (SCR air supply)
- One air filter (located at each pressure reducing station)
- Associated valves and piping

The system shall provide air for:

- Air starting for each main engine, 150 psig
- Service air, 100 psig
- Ship's Horn, 100 psig
- Sea chest blow-down
- Main Engine SCR system, 20 SCFM @ 105-150 psig

551.1 Compressors

There shall be two air cooled compressors, Quincy QR-25 D340 or equal. Each compressor shall deliver not less than 28 CFM of free air and shall discharge at 200 psig. The compressors shall be V-belt driven by electric motor and removable personnel safety guards shall be fitted over the drive belts. Electric motor driven air compressor shall have load-less starting and shall have a controller with hand-off-auto switch. In the "auto" position, a pressure switch shall automatically start the compressor when the main system pressure drops below 140 psig and stop it when the pressure reaches 200 psig. Each compressor shall be fitted with an inter-stage relief valve.

551.2 Air Receivers

The two main air-receivers shall be cylindrical with elliptical heads. The receivers shall be arranged for mounting vertically in a side-by-side configuration, or horizontally in a stacked configuration. Each receiver shall have at least 240 gallon capacity and be designed for 200 psig working pressure.

The receivers shall be designed and constructed in accordance with the requirements of Section VIII, Division 1 of the ASME Code, and shall be stamped with the ASME "U" symbol. Each receiver shall be approved for use on USCG-inspected vessels. Each air receiver shall have the following fittings:

- Relief valve set at 220 psig
- Manual valved drain, piped to bilge



- Charging inlet connection located at about mid height
- Discharge outlet connection located near or in the top
- Hand inspection port (unobstructed), flat oval, nominal size 5 inches by 8 inches
- Nameplate, showing maximum allowable working pressure, test pressure, and approval and date stamps
- Pressure gauge, 0 to 300 psig, liquid filled 2 1/2 inch diameter with shut off valve
- Mounting brackets

551.3 System Description

Major components of the air system shall have isolation valves as shown in Reference (P). Each compressor shall discharge through a flexible, stainless steel hose followed by a lift check valve, relief valve, and ball valve to the air receivers.

The main air receivers shall discharge through stop check valves to a common header. Air shall be delivered from the header to the main engine starting air, the ships service air, and the ships whistle /air horn supply.

551.4 Starting Air System

Branch lines off the main air common header shall supply starting air to the main engines as illustrated in Reference (P). The pressure shall be reduced from the 200 psig main pressure to 150 psig via a pressure reducing station. The reducing station shall include a pressure reducing valve suitable for dead end service, preceded by a wye strainer. Isolation valves, globe bypass valve, and air filter shall also be provided as illustrated in Reference (P). A pressure gauge shall be provided on the downstream side of the reducing station.

Each engine air starter shall be fitted with a shutoff valve, control valve, and flexible stainless steel hose.

A pressure switch shall be installed upstream of the 250/150 reducing station in the common receiver discharge line to actuate the low starting air pressure alarm.

551.5 Ship's Service Air System

Branches lines off the main air common header shall supply the service air fittings, the air horn, and the main engine AUS dosing systems. as shown in Reference (P). Reducing stations shall be provided to regulate service air and compressed air to the main engine AUS dosing systems. Each station shall have a reducing valve suitable for dead end service preceded by a wye strainer. Isolation valves, globe bypass valves, and an air dryer shall also be provided as shown in Reference (P). A pressure gauge shall be provided on the downstream side of the reducing station.

A minimum of ten hose stations with globe valves and quick disconnect fittings shall be provided. Stations shall be located in the Engine Room, Bow Thruster Room, Vehicle Deck, and in a crew or exterior location on each deck.

The Contractor shall provide two (2) self-retracting air hoses 50 ft flexible hoses for compressed air service, McMaster-Carr number 5245K12, or equal. Each hose shall be fitted with quick disconnect fittings compatible with the fittings on the service air stations.



A refrigerated air dryer, Quincy QED-30 or equal, shall be installed in the branch line serving the AUS dosing systems.

551.7 Spare Parts

- Compressor Belts – 1 set
- Filters and Dryers – 1 set sufficient for a complete replacement of all installed units
- Relief Valves – 1 of each size and type

555 Clean Agent Extinguishing Systems

A fixed fire extinguishing system shall be installed to protect the Bow Thruster Room as required by 46 CFR Part 118 and as described herein.

Fixed, manually operated, total flooding clean agent fire extinguishing systems utilizing FK-5-1-12 (Flouro-K) shall be installed to meet the vendor-specified minimum design concentrations to protect the Engine Room and Bow Thruster Room.

The design, installation, testing, and maintenance of the clean agent fire extinguishing system shall be in accordance with USCG and NFPA 2001 Rules and Regulations.

The Contractor shall utilize the manufacturer's authorized technicians for final connections and system tests of the fire extinguishing systems.

All components of the fire extinguishing system shall be products of the same manufacturer or listed by the manufacturer as compatible with those devices, components, and equipment.

The remote manual release for the space shall be located immediately outside the space served, and in a second location proposed by the Contractor and approved by the Owner before installation.

The system shall include all necessary storage cylinders, piping and control systems, alarms, warning lights, relief valves, discharge nozzles, solenoid shut down and pressure release cylinders, and interfaces with engine, damper, and ventilation controls.

Nozzles shall be arranged to evenly distribute and diffuse the clean agent throughout the protected space. Design size and flow requirements per the manufacturer's design manual and Regulatory Body requirements.

Pressure switches shall be configured and integrated with Vessel systems to stop the ventilation supply and exhaust fans, close the fire dampers, and shut down fuel transfer pumps and all diesel-fired equipment in the protected space upon release of the clean agent system serving the space protected.

All fixed clean agent cylinders shall be mounted on elevated foundations and securely fastened in a vertical position. Cylinders shall be secured with circumferential band/steel strap type bolted clamps around the cylinder body. Individual band clamps for each bottle shall be used to permit maintenance service and removal.

Clean agent cylinders shall be new, fully charged, and fitted with safety caps where required to protect discharge heads during handling and transportation.



561 Steering Gear

A complete steering system shall be installed. The rudders, as described in Section 562, and steering system shall be fully compliant with USCG 46 CFR §58.25 including all regulatory documentation, failure modes analysis, and testing and verification procedures.

The steering gear shall be manufactured by Autonav, Engine Monitor Inc., or equal, and shall be a two-speed system with non-proportional hydraulic valves.

Detailed design of the steering gear, tillers, and tie bar shall be submitted to the Owner for approval in writing prior to manufacture.

561.1 Tiller and Tie Bar

A tiller for each rudder, sized to suit the steering gear installation, shall be installed. The port and starboard rudders shall be mechanically linked with a tie bar. Each tiller assembly shall be of steel construction with a mechanical tubing hub and plate steel arms. Tillers shall be bored and keyed to suit the rudder stocks.

The tie bar shall be fabricated of steel pipe or mechanical tubing with reinforced plate end connections. Each tie bar end connection being fitted with a bronze bushing.

Clevis pins for connecting the tie bar and steering cylinders to the tiller shall be fabricated of hardened stainless steel. Grease channels and zerk fittings shall be provided in each clevis pin for lubrication of the tie rod and tiller bushings. Clevis pins are to be inserted from the top.

Fabricate and install direct reading rudder angle indicators on both rudders, engraved and labeled for every 5° of rudder travel. Index the direct reading rudder angle indicator so that 0° coincides with rudder amidship.

561.2 Steering Control System

The steering gear control system shall have four control stations, one in the pilot house, one in the aft steering station, and one at each of the two bridge wings. The pilot house and aft control station shall each have one full-follow-up lever, one non-follow-up lever, rudder angle indicator, and a steering control panel. Each Bridge Wing steering station shall be fitted with one non-follow-up lever and one rudder angle indicator.

The rudder angle indicator in the Aft Control Station shall be reversed so the indicating needle matches the physical rudder orientation.

Provide controls for starting and stopping the hydraulic power units and transferring steering control between steering stations at the pilot house and aft control station.

Provide local controls in accordance with USCG requirements and an emergency steering station with a remote/local switch, non-follow-up lever, and rudder angle indicator in the Engine Room

561.3 Steering System Performance

The steering system must be capable of moving the rudder from 40° port helm to 40° starboard helm, hard-over to hard-over, within twenty two seconds. The steering system shall also meet the performance



requirements set forth in 46 CFR Subchapter K Subpart F. The steering system shall be capable of moving, stopping, and holding the rudders at any angle within their operating range with the vessel speed at 15 knots ahead and 7 knots astern.

561.4 Steering Alarm System

Provide and install an independent steering gear alarm system for each steering gear. The system shall alarm for motor overload, hydraulic tank low level, and control power failure, and shall have motor running indication. The alarm system shall include alarm annunciator panels in the Pilot House, aft control station, and the Engine Room. Acknowledgement of an alarm from one station shall silence annunciators at all consoles.

561.5 Steering Gear Hydraulic System

A dual-HPU hydraulic system shall be installed, incorporating two independent hydraulic pump sets on a common reservoir. Each pump set shall include a pump, 208V/3ph/60Hz TEFC electric pump motor, control valves, filters, and all required gauges and accessories. The reservoir shall be divided into two halves, one half serving each pump set. Each side of the reservoir shall have a bolted and gasketed access port for inspection and servicing, a fill port with breather, a drain plug, visual level indicator, and a level switch for actuation of the sump tank low level alarm in the IAS.

Only one pump set will be used at any one time with the other as a standby unit. Install the HPU in the Motor Room generally where indicated on Reference

The steering system shall have a pair of steel cylinders sized and arranged to meet that performance and Regulatory Body requirements. Cylinders shall have tie-rod type construction with SAE straight thread O-ring ports. Each cylinder shall have a stainless steel piston rod and rod eye connections with bronze bushing. The opposite end of the cylinder shall have an eye bracket for connection to the ship's structure.

Auxiliary valves for the steering systems shall include shutoff, bypass, and relief valves not located on the HPU. A relief valve shall provide over-pressure protection to the steering gear as well as provide bypass flow for both cylinders. Shutoff and bypass valves shall be installed as necessary to allow isolation of either steering cylinder in the event of a failure and allow the steering gear to function on one cylinder.

561.6 Steering System Spares

Provide a complete set of spare parts for the rudder as recommended by the manufacturer. Spares shall include one of each part necessary to quickly address failures such as transducers, relays, feedback linkages, control levers, electronics modules, relays, motor starter components, directional control valves, and power supplies. Provide two fuses of each type and size used and filter replacements for one year of operation.

562 Rudders

The Contractor shall install two steel rudders as indicated on Reference (B). Design and construct the rudders with double-plate construction, NACA 0012 foil section, adequately stiffened, and fitted with flush docking/drain plugs both fore and aft of the rudder stock. Build and seal the rudders completely watertight. Float-coat the rudders with an environmentally benign rust preventative, Esgard Bio-Float or equal. Drain the float coat and seal the rudders.



Maximum rudder angle shall be 40° port and starboard of rudder centerline. Provide positive steel hard-over stops to limit rudder travel. Rudder stops shall be faced with ultra-high molecular weight (UHMW) blocks or similar.

Fabricate and install rudder stocks. Fabricate rudder tubes or carriers from mechanical tubing. Accurately machine and install the carriers to support upper and lower stock bearings.

568 Bow Thruster

The Contractor shall furnish and install one fixed-pitch transverse tunnel thruster, ZF TTL 3001 FP, Schottel STT 170 TFP_Diesel_STA_P990, or equal. The bow thruster shall have an outside tunnel diameter of 40 to 42 inches. The thruster shall be diesel engine driven via a CAT C9.3 engine rated 416 BHP at 2100 RPM and an appropriate ZF reversing reduction gear to suit the engine and bow thruster.

The bow thruster engine shall be provided with an electric, thermostatically controlled jacket water heater and fitted with a fuel oil cooler.

The engine and reduction gear shall be close coupled, and installed on resilient mounts approved by the Owner, engine, and gear manufacturer. The engine shall be provided with an electronic monitoring system. A display panel shall be located at each control station. Local engine monitoring and control shall also be provided at the engine. Propulsion controls are described in Section 252.

The drive shaft shall be rated for the maximum input horsepower and speed. A protective shaft cover for personnel safety and whip preventer shall be provided.

Appropriate lifting eyes shall be provided for removal of the thruster engine and reduction gear.

571 Winches

The Contractor shall install two electric capstans, Markey CEP-40 or equivalent, on top of the bulwark at the transom as shown on Reference (B). Capstans shall be electric type, 5 hp capacity, with a maximum pull of at least 3,000 lb and a zero load line speed of at least 60 ft per minute. Each capstan will have a local control.

581 Anchor Handling Systems

The vessel will be fitted with an Anchor and anchor handling equipment.

581.1 Anchor

The Contractor shall install a 1,500 lb Danforth type anchor. The anchor shall be stowed generally as shown on Reference (B).

581.2 Anchor Chain

The Contractor shall attach 195 fathoms of 1 inch ABS Grade 2 chain with shackles and swivel, to the anchor. The chain shall be stowed in the chain locker on top of a fiberglass grating, with the bitter end secured to a pad eye inside the locker. The pad eye installation shall be designed to 1.5 times the breaking strength of the chain.



581.3 Anchor Winch and Support Structure

An electric anchor winch, Markey Model WEW-12 or equivalent, shall be installed on the Fore Deck. The winch shall have the capability to free spool for rapid anchor deployment, and a manually operated band brake to regulate anchor deployment. It shall be equipped with two warping heads for handling mooring lines with the chain gypsy disengaged.

The installation shall be complete with anchor winch foundation, hawsepipe, sheave, and chain stopper.

582 Mooring and Towing Systems

The Contractor shall install mooring fittings of an approved design generally as shown on Reference (B). The arrangement of transom openings, bitts, chocks, and capstans should be similar to the existing ferry EMERALD ISLE. Drawings of the fittings and installation shall be submitted to the Owner for approval.

Chocks shall be cast steel. Corners and weld bead shall be ground smooth to prevent chafing of mooring lines. The Contractor shall provide necessary insert plates and additional stiffening to local structure.

Chafing protection, round bar or pipe, shall be provided on vessel structure (i.e. bulwark stiffeners) where lines may lead from cleats and chocks.

The Contractor shall provide four mooring lines, 1 1/4" diameter double braid nylon rope, 100 feet long, each with a four foot spliced eye in one end and with the other end seized. Mooring lines shall not be used during construction.

583 Life Saving Appliances

The Contractor shall provide four 50-person IBAs in accordance with USCG regulations. Life rafts shall be stowed in kick-over cradles on the Upper Deckhouse top, two per side, in the general location shown in Reference (B). Life rafts shall have hydrostatic releases and comply with all regulatory requirements.

The Contractor shall supply additional lifesaving equipment, as described in Section 681.

584 Stern/Vehicle Ramp

The vessel shall be fitted with a stern ramp generally as shown in Reference (B). The ramp shall be fabricated of steel and capable of handling the maximum axle loads allowed by the State of Michigan Department of Transportation. The ramp deployment and retraction shall be effected by electrically powered winches, steel cables, and sheaves. The ramp shall have a positive locking system to store the ramp in the retracted position.

The stern ramp shall be fitted with a socket type mounting base for the man overboard rescue davit and deck sockets for deploying the man overboard rescue ladder described in Section 681.8.

Three removable pipe and chain safety guard rails shall be fabricated and installed. Their arrangement and configuration shall be similar to those on the Owner's existing vessel. Each guard rail shall consist of a series of stainless steel pipe posts with three courses of stainless steel chain connected between them. The posts shall fit into deck sockets in the stern ramp with deployed.



The stern ramp shall be fit with three rows of deck sockets to receive the removable safety rails. The safety rails sockets shall be located on the port edge of the stern ramp, approximately 4 feet inboard from the port edge of the stern ramp, and at the starboard edge of the stern ramp.

Dedicated storage racks shall be installed on the vehicle deck near the stern ramp for stowing the guard rails when not in use.

585 Elevator

The Contractor shall install one elevator to connect the Vehicle Deck with the Passenger Deck and Upper Deck as shown on Reference (B). The elevator will be designed and constructed for marine service and will be equipped with all necessary controls and alarms.

The elevator car shall have 18 sq. ft. of passenger space and shall match the dimensions for Limited Use/Limited Availability elevators in accordance with ADA requirements. The unit shall be rated for six persons, 1,400 lbs., and 30 fpm. Interior and fixtures shall be brushed stainless steel.

The elevator may utilize an electric or electro-hydraulic drive system. If hydraulic systems are used, the hydraulic system shall meet the requirements of 46 CFR 58.30 and Section 505 of these Specifications.

Elevator electrical installations and components shall be in accordance with applicable IEEE standards, or alternative Regulatory Body-recognized standards, and 46 CFR Subchapter J for installation of electrical items onboard passenger ferries.

A telephone and backup battery power supply shall be included with the elevator. The elevator shall be driven by 208VAC, 3-phase power from the switchboard. The elevator machinery will be located in the main Engine Room in proximity to the elevator sump.

The elevator installation shall be approved by the USCG and by the State of Michigan Department of Licensing and Regulatory Affairs, Elevator Safety Division.



Group 600 – Outfit and Furnishings

This Section describes requirements for the Vessel's outfitting and furnishings. The interior and exterior finishes, outfitting, and furnishings described herein shall be installed in strict accordance with the requirements and recommendations of the Regulatory Bodies and manufacturers.

All engineering, equipment, services, materials, and labor necessary for the complete installation and commissioning of the outfitting and furnishings identified in this Specification that is not otherwise detailed herein shall be the responsibility of the Contractor.

The Contractor is responsible for detailing the final arrangements and systems in connection with each outfitting and furnishing item described herein based upon final product selections, which shall be approved by the Owner prior to installation unless otherwise specified herein.

602 Hull Designating and Marking

602.1 General

The Vessel shall be outfitted with all applicable nameplates, signs, labels, notices, and other similar markings as required by the USCG and all other local, state, or federal regulatory agencies. Signage and information signs in passenger accessible areas shall comply with Reference (R7). Additionally, the lettering of nameplates, signs, labels, notices, and other similar markings and devices located throughout the Vessel intended for the public shall be of high contrast and shall be sized for the visually impaired passenger in accordance with Reference (R7). Signage, labeling, notices, and similar markings and devices in other locations shall comply with Reference (R20) unless otherwise specified herein.

Wording shall be clear and concise with minimum abbreviations. Particular attention shall be given to the wording intended for use by the public to ensure that the message is clear and unambiguous. Abbreviations, where used, shall be in accordance with Owner's standards and ASME Y14.38.

All sign mounts shall use welded 3/8-inch stainless steel mounting studs or adhesive tape where appropriate. Under no circumstances shall screw holes be made in structure.

Prepare a label plate and markings summary which lists the material, location, wording, and mounting details for all such signage and submit to the Owner for approval. The label plate and markings summary shall be approved by the Owner prior to fabrication and installation.

602.2 Builder's Plaque

A cast bronze builder's plaque shall be furnished and installed. The final location of the builder's plaque shall be proposed by the Contractor and approved by the Owner. The builder's plaque shall include the Vessel name, Owner's name and location, the Naval Architect's name and location (Elliott Bay Design Group, LLC, Seattle, WA), Contractor's name and location, hull number, and year of delivery.

602.3 Display of Notices, Drawings, Licenses, Etc.

All certificates, drawings, licenses, etc. required to be posted aboard the Vessel by Regulatory Bodies shall be provided and posted using bulkhead or cabinetry mounted glass-faced aluminum frames with glazed permanent or hinged fronts that are sized to display the full-scale document or drawing.

Documents required to be kept on board shall be stowed in the space noted.



The specific posting locations shall be approved by the Owner prior to frame installation. Recommendations are as shown in Table 10, however final placement shall be proposed by the Contractor and approved by the USCG and Owner.

Table 10: Notices, Licenses and Documents

Location	Document Posted
Pilot House	Tonnage Certificate USCG Certificate of Documentation (COD) USCG Stability Letter Radio Operator Licenses FCC Radio Station Authorization FCC Vessel Bridge-to Bridge Radio Telephony Certificate FCC Communications Act Safety Radio Telephony Certificate Archived in binder: Builder's Certificate Portable Fire Extinguisher Certificates Fixed Fire Suppression System Certificates
Elevator car	Elevator Inspection Certificate
Upper Deck, Aft Pass Lounge	Fire Control Plan Title VI Notice ADA Accommodations Notice
Pass Deck, Observation Lounge	USCG Certificate of Inspection (COI) Fire Control Plan Title VI Notice ADA Accommodations Notice

Additional documents and drawings shall be posted in accordance with Section 810.5.

Display cases or frames shall be appropriately sized for the documents posted in each location. Where multiple notices or licenses will be mounted in one location, provide a single large frame of sufficient size as is practicable for the available space.

602.4 Door, Hatch, and Manhole Markings

All doors, hatches, and manholes shall be labeled with engraved identification plates. Interior labels in crew and passenger spaces shall be phenolic. Stainless steel label plates with engraved, black filled letters shall be used in machinery spaces and exterior locations. Characters shall be at least 3/8 inches high. The labels shall identify each space by its designation and location.

For access doors, these labels shall be affixed to, or just above, the center of the upper horizontal frame of each access door. Compartment designations shall be as shown on the Profiles and Arrangements, Reference (B).

For watertight hatches and manhole covers, identifying labels shall be affixed on the outside of each hatch and cover. Label height shall be a minimum of 1 inch with 1/2-inch-tall lettering and shall identify the compartment designation and location.



602.5 Service System Labels, Nameplates, and tags

General

Except as specified herein, service system labels, nameplates, and tags shall be black engraved phenolic with white lettering 3/16-inch high or greater as needed for legibility. Primary information shall have lettering of a larger size than secondary information. Labels and nameplates shall be permanently mounted using 3M 200MP adhesive tape, or equal. Tags shall be hung with swaged stainless steel wire tag fasteners unless specified otherwise herein.

Notwithstanding the aforementioned sizes and details, all markings, nameplates, and labels shall be provided in accordance with Regulatory Body requirements and Reference (R20).

Access panels in the joinery, linings, and ceilings shall be labeled in a manner that clearly identifies the service and components served at each panel.

Heating and Ventilation Systems

Labels or nameplates shall be provided to clearly identify each fire damper, fan, controller, heater, motor, access plate, thermostat, damper, weather supply, exhaust outlet, and other major components of the heating and ventilation systems throughout the Vessel.

Labels for fire dampers shall have a red background and white lettering.

Electrical Systems

Identifying nameplates or labels shall be provided for each piece of electrical equipment and for each electrical cable installed in the Vessel.

Electrical equipment shall be fitted with identifying nameplates, including the equipment's name, its power source by circuit number, size, model, manufacturer's name, cycle, phase, voltage, and power. Any special instructions or precautions shall be included on the nameplate, or on a separate plate attached on or adjacent to the equipment. Manufacturer's standard label plates may be accepted in lieu of or in addition to the above nameplates with Owner approval, provided they are clearly visible after installation and contain required information not provided on a Contractor-provided nameplate.

Power distribution panels shall have nameplates with the following information:

- Space, apparatus, or circuits controlled
- type of service (power, lighting, etc.)
- Voltage, number of phases, ampere capacity
- circuit designation shown on wiring diagram
- Feeder designation

Each circuit breaker on a distribution panel shall be clearly labeled, having a nameplate showing the circuit designation and number, circuit destination, trip setting, maximum ampere capacity, and the breaker frame size.

Nameplates shall be made from laminated phenolic, white text on black background; labels of particular importance shall be white text on red background. Inscriptions shall be clear and concise with a



minimum amount of abbreviation. Standard marine abbreviations may be used. Lettering shall not be less than 1/8 in high with primary information in letters of larger size than secondary information.

Each cable shall be labeled with its cable name per the cable schedule on the exterior of each enclosure, equipment, or junction box penetration, and on each side of each deck or bulkhead penetration. The labels shall be embossed aluminum, robustly banded to the cable. Cable banding shall be stainless steel. Cable tags shall be aluminum or other non-corrosive metal with embossed figures. Conductors shall be provided with identifying floaters or embossed plastic sleeves at terminals.

Wires within control, alarm and monitoring, and communications enclosures shall be labeled with adhesive labels or alpha-numeric floaters at each end. Labels shall correspond to as-built drawings.

Emergency light fixtures shall be labeled in accordance with Regulatory Body requirements. Each emergency lighting fixture shall be labeled with an engraved laminated phenolic label having a white letter "E" on a red background. Locate the label in relation to the fixture to clearly associate one with the other. The letter "E" is to be proportional to the size of the fixture and shall be a minimum of 1/2 in high.

Any device or enclosure with more than one power source shall be provided with a red warning label. Circuit numbers of the power sources shall clearly be indicated on the label plate. Label plates for precautionary notices and emergency operations shall also have a red background.

Piping Systems

Operating systems, associated components and/or equipment, piping, and appurtenances shall be labeled so as to ensure components and systems are readily identifiable.

Metal engraved label plates shall be affixed to all tanks.

All instruments shall have a label listing the purpose of the instrument.

Except where the function of a valve or component is obvious, such as a freshwater cutout valve immediately adjacent to a lavatory fixture, each valve throughout the Vessel shall be identified as to its service and function.

Exposed piping shall be stenciled or labeled to indicate the medium contained in the system and the normal direction of flow at least once between takedown joints, on each side of bulkhead penetrations, and at least once in each compartment through which the pipe passes. The letters and numerals shall be proportional to the diameter of the pipe, and the color of the figures shall provide a sharp contrast to the background (normally black letters on white pipe). The size of letters shall be generally as follows:

- All insulated pipe 1 1/2-inch-high lettering
- 2 inches and above, bare pipe 1 1/2-inch-high lettering
- 1 1/2 inch to 1 inch 1-inch-high lettering
- 3/4 inch and 1/2 inch 1/2-inch-high lettering
- 3/8 inch 3/8-inch-high lettering
- Ventilation ducts 1 1/2-inch-high lettering

All piping shall be color coded and labeled with commercial marking tape indicating service and direction of flow. All valves are to be color coded to match their respective piping system.



System Color Coding:

Refrigerant	white
Ventilation duct	black
Potable water	blue
Compressed air	gray
Sea water	green
Diesel	black
Lube oil	yellow
Jacket water	light blue
Hydraulic	orange
Fire extinguishing	red
Plumbing drains and blackwater	brown

Firemain piping shall be painted red throughout the Vessel.

Fill and discharge connections shall be painted colors to indicate their function.

Valve nametags shall be engraved with the system service, valve number, and the valve function. Valve tags shall be attached to the valve operating lever or body by a short brass chain or flexible stainless steel safety lock wire, as appropriate to the type of valve.

Labels identifying the service and/or space served for each remote valve operator, fill, discharge, and vent shall be provided. Text for each label shall be deeply engraved on a 3/16-inch stainless steel plate label and continuously welded in place.

A 5-inch × 8-inch oil waste discharge placard, suitably photo-etched or epoxy painted on anodized aluminum, shall be fixed adjacent to bilge pump control station in a conspicuous place and be in accordance with 33 CFR Part 155.450.

Prior to fabricating and installing nameplates and labels or painting and marking pipes, the Contractor shall prepare a schedule of markings and labels along with label and nameplate samples to the Owner for approval. The schedule shall indicate all text to be included on each label, nameplate, or pipe stencil and indicate colors used for pipe identification

602.6 Regulatory Markings

All label plates, markings, signs, and instruction plates, and other markings required to comply with the requirements of the Regulatory Bodies shall be installed. These include, but are not limited to, exit signs, pollution abatement placards, non-smoking signs, general alarm bell labels, fire alarm pull-box labels, and labels pertaining to aids for mobility impaired persons. This requirement includes all signs as required for ADA compliance as described in Reference (R7).

As a minimum, nameplates, signs, labels, notices, instructions, and other similar markings as described in this Section shall be provided. Final placement, design, and quantity must satisfy the Regulatory Body requirements.

Fire Extinguishing Equipment

Identification labels for fire stations, fire hoses, portable extinguishers, sprinkler system, fixed gas fire suppression system, water mist system, ventilation shutdown mechanisms, and fire dampers shall be provided.

Instructions and Related Markings

Labels and plastic laminated operating instructions and emergency procedures required to safely navigate and operate the Vessel shall be provided including, but not limited to, the items in Table 11. The layout and content of such instructions and procedures shall be proposed by the Contractor and approved by the Owner prior to fabrication.

Table 11: Operating Instructions and Emergency Procedures

Location	Marking or Instructions posted
Pilot House	Ventilation emergency shutdown procedure Engine and Generator emergency shutdown procedures Steering control transfer procedure Propulsion control transfer procedure Maximum load overall and axle loading by lane
Main Deck	Lighted exit signs
Passenger Deck	Boarding locations Life preserver donning instructions, near each personal flotation device (PFD) locker Lighted exit signs in passenger areas
Upper Deck	Life preserver donning instructions, near each PFD locker Lighted exit signs in passenger areas
Shore Power Receptacle	Equipment rating for appropriate connecting device
Flouro-K Locker	Fixed firefighting system procedure
Engine Room	Oil pollution prevention procedures Main Engine and Generator startup procedures Engine Order Telegraph /Emergency maneuvering procedures Shore power connection and switching procedure
Sprinkler Pump	Sprinkler system operating procedures
Fire Pump	Fire pump operating procedures
Steering Gear	Emergency maneuvering procedures (near emergency steering controls)

Security Signs

"RESTRICTED AREA - NO UNAUTHORIZED PERSONNEL" signs shall be provided at each entrance door or gate to crew-only areas. Signs shall have 3-inch white lettering engraved on a red phenolic placard and shall be affixed to the center of the outside of each door approximately 66 inches above deck.

Directional and Information Signs

Signs and markings as described below shall be installed using vinyl letters in a color as specified below or brightly contrasting the surface to which they are applied. Final locations, sizes, and colors shall be proposed by the Contractor and approved by the Owner.



- "NO SMOKING" in 9-inch-high red letters shall be located on the inside of the curtain plate. Markings shall be located port and starboard on both ends of the Vessel. The lettering shall be located approximately 6 feet above the deck on the bulkheads facing the vehicle lanes.
- Plastic laminate signs for each of the flashing lights or beacons installed in the Engine Room and Auxiliary Machinery Space shall be installed. The signs shall identify the function of each light with large lettering easily visible from across the space.
- Signs reading WATCH YOUR STEP shall be installed wherever passengers may encounter a change in walking surface height of more than 1/2 inch. The edge of such changes in height of walking surface shall also be painted yellow. The signs shall be located to ensure high visibility to passengers. Letters shall be 8 inches high and painted with a contrasting color and white background.
- "HIGH NOISE AREA - HEARING PROTECTION REQUIRED" notices shall be installed at entrances to the Engine Room and Bow Thruster Room.
- The size and number of PFDs contained within the locker shall be labeled on each PFD locker door/lid with a placard or neat paint-stenciled lettering 2-inches high.
- Signs with directional arrows directing passengers to the life preserver lockers shall be installed throughout all passenger areas in quantities sufficient to ensure that directions to the nearest locker is visible from all seating locations.
- "NO SMOKING" signs shall be posted throughout the following locations:
 - passenger and crew areas
 - heads
 - exterior passenger areas
 - Engine Room
- Garbage dumping placards complying with the dimensions, lettering, and information requirements of 33 CFR 151.59 shall be installed.
- Overhead clearance signage shall be mounted on the bulkheads above the vehicle lanes. The signs shall be clearly visible. Numerals shall be 6" high and black in color.

603 Hull Marks

603.1 Ship's Name and Hailing Port

1/4-inch-thick steel plate letters shall be installed denoting the Vessel's name and hailing port on the aft end of the vessel, port and starboard of the loading ramp. The Vessel name and port of register shall be approximately 6" high. In addition, the Vessel's name shall be installed on the bow, port and starboard, generally where shown on Reference (B), in letters approximately 18" high.

Letters shall be welded continuous to the hull. The final location, font, and wording shall be proposed by the Contractor and approved by the Owner prior to installation.

603.2 Draft Marks

Draft marks meeting regulatory requirements shall be installed and shall be located on port and starboard sides of the Vessel at the stem and at the aft perpendicular. Draft marks shall be Arabic numerals, 6-inches true projected vertical height; the bottom of each numeral shall be at integral feet above the bottom of the keel. The numbers shall be 1/4-inch plate cut using a computer-controlled high-pressure water/abrasive grit cutter, seal welded ground smooth and painted white.



603.3 Official Number

The Vessel's official number shall be center punched and painted with high gloss black on the aft Engine Room bulkhead in accordance with 46 CFR 67.121. Letters and numbers shall be 3" high.

603.4 UWILD Marks

Reference marks shall be added to the underwater portion of the exterior hull surface as required for the Vessel's participation in the UWILD program, including Reference (R17). All sea valves and hull penetrations shall be permanently marked on the hull. Reference marks or targets that can be used to determine a diver's position along the hull shall be added in pre-determined locations. All markings shall be in accordance with Regulatory Body Requirements. All UWILD marks shall be shown on the hull marking and docking plan described in Section 810.6.

Video or photographic evidence of the Vessel's hull marking system shall be submitted to the Regulatory Bodies and the Owner to provide a baseline for all future surveys and shall be to the satisfaction of the Owner and the Regulatory Bodies. The video or photographs must be done with the Vessel out of the water.

612 Interior and Exterior Railings

Handrails and railings meeting the regulatory and accessibility requirements of Reference (R1), Reference (R7) shall be installed, generally where shown on Reference (B).

612.1 Interior Railings

Storm rails shall be installed on open interior bulkheads and in accordance with Regulatory Body requirements and generally as shown on Reference (B). Unless otherwise specified, the grab rails shall be continuous within six inches of doors, and the top of each rail shall be located 34 inches above the finished deck surface. The grab rails shall be supported by 316 stainless brackets that provide at least 1 1/2-inch clear between the rail and the bulkhead, and 1 1/2-inch clear between the bottom of the rail and the bracket horizontal projection.

Interior railings and grab rails in passenger stairways, passenger spaces, and crew spaces above Main Deck shall be fabricated from 316 stainless steel. Railings shall be fitted with stand-offs. Interior railings shall have routed ends and no protrusions. Mitered joints shall be avoided unless specifically approved by the Owner.

Railings in spaces accessible by passengers shall satisfy the requirements of Reference (R7) .

612.2 Machinery handrails and guards

Handrails shall be provided at the boundary of floor plates around machinery and where required for safety. All handrails shall be removable to allow for maintenance and overhaul activities. Handrails shall be fabricated from 1 1/2-inch schedule 40 stainless steel pipe. Handrail stanchions shall be supported at the lower end by bosses fabricated from 2-inch schedule 40 stainless steel pipe. Support bosses shall be welded to the grating support framework or inclined ladder frame as applicable. Rails shall be fastened to the bosses with stainless steel fasteners.



612.3 Exterior Railings

Rails and guards shall be provided and installed to meet requirements, and generally as shown on the arrangement drawing Reference (B).

Rails shall be free of clothes entangling projections. Welds shall be ground smooth. Rails shall be formed to radius corners and storm rails shall return against the bulkhead.

Handrails surrounding the pilot house top shall be three course, 39 1/2" high. The top rail and stanchions shall be 1 1/4" pipe and intermediate rails shall be 1 inch pipe. Every other stanchion shall be fitted with a diagonal brace. The entire assembly shall be stainless steel.

Handrails on decks accessible to passengers shall be 39-1/2" high. The top rail and stanchions shall be 1 1/4" pipe. Intermediate rails shall be 1 inch pipe with tabs to hold stainless steel hardware cloth panels bolted in place. Every other stanchion shall be fitted with a diagonal brace. The entire assembly shall be stainless steel.

622 Floor Plates and Gratings

Grating, platforms, and deck plates shall be installed as necessary for convenient safe access and operation of machinery, apparatus, and controls and escape ladders and stairs. The final arrangement of floor plates and gratings shall be proposed by the Contractor and approved by the Owner prior to installation.

Floor plates in the Engine Room, Steering Gear Room, and Bow Thruster Room shall be 3/16" steel plate, with raised anti-slip pattern.

In the Engine and Bow Thruster Rooms, the floor plates shall extend between the tonnage frames out to the side shell, port and starboard. Floor plates shall be supported on 2 1/2" x 2 1/2" x 3/16" steel angles and secured to the angles with recessed stainless steel Phillips flat head machine screws in each corner. Floor plate boundaries shall be supported by inverted angle coamings. Floor plates shall be installed in sections not larger than 6 ft² each.

The Steering Gear space shall be the same as that described for the Engine Room, except that the raised walking surface need only be 30" wide surrounding the steering gear.

Hinged floor plates with flush grabs shall be provided where necessary for access to valves, strainers, couplings, and similar items. Supports and coaming angles shall be bolted in way of machinery that will require periodic removal for overhaul.

Sharp edges and corners shall be ground smooth.

623 Ladders and Stairways

Stairways and ladders used exclusively by the crew shall meet the requirements of the USCG. Ladder inclination and width shall conform to 46 CFR116.438. Clear tread width shall not be less than shown in Reference (C) to accommodate egress. Stairways used by the passengers shall additionally comply with ADA requirements.



Exterior inclined ladders shall be installed providing access between the Upper Deck/Bridge and the Upper Deck Housetop and the Pilot House top. Ladder treads shall be 30" wide minimum and shall have handrails installed on both sides.

Interior inclined ladders shall be installed to provide Engine Room and Bow Thruster Room access from the Vehicle Deck. The ladders shall be removable. Fasteners to attach the ladder shall be stainless steel. Ladder stringers shall be fitted with pad eyes to facilitate removal. Ladders shall be 30" minimum width and shall be of steel construction.

All inclined ladder assemblies shall steel and shall be hot dip galvanized after fabrication or painted. At the Contractor's option, the assemblies may be fabricated entirely from stainless steel and remain unpainted.

Ladder construction shall consist of ladder treads supported by two parallel channel stringers. Tread spacing shall be arranged to provide a consistent step height at both top and bottom of ladders and shall be spaced with approximately 8-9 vertical inches. Treads shall be grip strut, non-slip pattern.

Inclined access ladders shall be fitted with 1 1/4" NPS steel pipe handrails. Handrails shall fit into 1 1/2" NPS steel pipe bosses. Handrails shall be secured to the bosses with stainless steel fasteners.

Vertical ladders of steel construction shall be provided for access to bottoms of tanks, voids, the Bridge top, the Steering Gear Room, in the uptakes, and to provide necessary access to other locations of the vessel as shown in Reference (B).

Where a continuous vertical ladder would be impractical, 3/4" steel square bar rungs may be substituted. Bars shall be installed such that the edge is vertical. The rungs shall be turned up at the ends to prevent slipping off the side and shall be spaced 12" on center with a minimum foothold depth of 7".

Hand grabs shall be provided at the heads of vertical ladders.

624 Doors

624.1 General

The Contractor shall provide access to all spaces in the vessel for proper working purposes, inspection and maintenance as shown on Reference (B). The Contractor shall submit manufacturer's drawings of all proposed closures to the Owner for approval.

Exterior doors shall have watersheds over them where not otherwise protected. All doors and frames, interior and exterior, shall be stainless steel or aluminum, as appropriate for the installation and as approved by the Owner.

Tops of doors shall, in general, be 6'-8" above the finished deck.

Weather doors shall be filled with fibrous glass thermal insulation. Fire-rated doors shall be filled with USCG-approved structural insulation necessary to comply with the structural fire protection requirements. Door frames shall be filled with insulation of the same type and rating as the door. Provide certification with each door that clearly indicates that each door is in full compliance with the required structural fire rating.



The Contractor shall fit gaskets between the door and frame stops of weather and fire rated doors. See Section 624.6 for door hardware.

The doors on the vessel shall be as noted in Table 12. Clear opening height is 68" unless otherwise noted.

Table 12: Doors

Location	Type	Clear Opening	Qty	Hardware	Fixed Light
Below Main Deck					
Elevator Machinery Cage	Expanded Metal	36"	1	Padlock Hasp	No
Sprinkler System Comp. Room	Joiner Door	28"	2	Latch	No
Vehicle Deck					
Side Loading Port	See Section 642.2	9'x7.5'	2	Latch Bolt	No
Port Side Access	Weathertight	30"	1	Dogs	Yes
Evacuation Door	Weathertight	50"	2	Dogs	No
Engine Room Access	A-60 Fire Door, Weathertight	28"	1	Security Lock	Yes
Flouro-K Locker	Fume Tight	30"x56"	1	Security Lock	No
Stair Tower Entrance	A-60 Fire Door	36"	2	Latch	Yes
Engine Room Escape	A-60 Fire Door, Weathertight	28"	1	Security Lock	No
Chain Locker Access	Weathertight	22"x60"	1	Dogs	No
Passenger Deck					
Stair Tower to Observation Lounge	A-60 Fire Door	50"	2	Latch, Magnetic Holdback	No
Weather Deck Entrance	Double Weather Door	60"	2	Latch w/Lock Set, ADA Power Assist	Yes
Pipe Trunk	Joiner Door	19"	1	Flush Lock Set	No
Access to Sprinkler Room Escape	Fume Tight	28"	1	Security Lock	No
Washroom Entrances	Joiner Door	36"	2	Latch w/ Security Lock	No
Family Washroom Entrance	Joiner Door	36"	3	Latch w/ Security Lock, ADA Power Assist	No
PFD Locker	Joiner Door	36"	1	Latch	No
Emerg Gear and Cleaning Gear Lockers	Joiner Door	24"	2	Latch w/ Security Lock	No
Fore Deck Crew Access	Weather Tight	28"x48"	1	Latch w/ Security Lock	No
Upper Deck					
Aft Control Station	Weather Door	28"	1	Security Lock	Yes
Aft Passenger Lounge Entrance	Weather Door	36"	1	Latch w/Lock Set, ADA Power Assist	Yes
PFD Locker	Double Weather Door	36"	1	Latch	No



Location	Type	Clear Opening	Qty	Hardware	Fixed Light
Ext. Stair Tower Entrances	Weather Door	36"	3	Latch w/Lock Set	Yes
Int. Stair Tower Entrances	A-60 Fire Door	36"	3	Latch, Magnetic Holdback	Yes
Crew Weather Deck Entrances	Weather Door	30"	3	Security Lock	Yes
HVAC Fan Room	Joiner Door	30"	1	Security Lock	No
Crew Washroom and Dayroom	Joiner Door	30"	2	Latch	No
Electronics/Security Room	Joiner Door	30"	1	Security Lock	No
Aux Fan Room Access	Joiner Door	36"x44"	1	Latch	No
Interior Entrance to Pilot House	Joiner Door	30"	1	Latch	No
Upper Deck					
PFD Locker	Joiner Door	36"	1	Latch	No

624.2 Vehicle Deck Side Loading Ports

The Contractor shall provide and install two segmented loading ports with a minimum clear opening width of 9' and a minimum clear opening height of 7'-6", one on each side of the Vehicle Deck as shown in Reference (B).

The loading ports shall have three stiffened panels that span the width of the opening. The bottom panel shall be steel and 40" tall. The two upper panels shall be aluminum and 25" tall. The panels shall be held in place by lockable stainless steel sliding latch bolts.

624.3 Metal Joiner Doors

Joiner doors and frames shall be of stainless steel construction. Frames shall be furnished with the doors. Joiner door sills shall be of the channel type, 304 or 316 stainless steel.

Doors shall be operable from both sides and shall be furnished complete with latches, locks, key hooks, holdbacks, bumpers, and closers as required for each particular door. Reinforcing plates shall be provided in way of door closers. Doors to weather from the passenger cabin shall be fitted with panic bars. Hardware installed on doors that are passenger accessible shall comply with ADA requirements.

Joiner doors shall be furnished with a factory applied baked-on enamel finish. Door frames shall be furnished with a factory primed finish. Submit finish colors to the Owner for approval.

Door sills on all doors accessible to wheelchair passengers shall be "ramped" in accordance with ADA requirements.

624.4 Expanded Metal Doors

Provide a 30" x 78" expanded metal door with 1" undercut and diagonal bracing at the entrance to the elevator machinery cage. Door construction details shall be in accordance with ASTM Volume 01.07 "Shipbuilding" Standard F1072-87. Edges shall be well rounded. Fit a hasp and staple for locking the doors in addition to the other usual hardware. See Section 624.6 for door hardware.



624.5 Weathertight Doors

Exterior doors to all spaces on the Vehicle Deck and above shall be flush weathertight, hollow construction, 1-3/8" minimum thickness, insulated, and gasketed. "Exterior doors" include Vehicle Deck doors which, though technically "interior," nevertheless open out onto the Vehicle Deck and as such are subject to exterior weather conditions.

624.6 Door Hardware

Complete all necessary detail design, provide and fit all doors, and hatches with locksets, closers, and accessory hardware.

Door hardware shall be heavy-duty marine type, stainless steel with satin finish, unless otherwise specified. Hardware not specifically mentioned by the specifications shall be of no less quality than that described herein.

Use tamper-proof, stainless steel, oval head screws to attach coat hooks, toilet stall latches, toilet paper holders, mirrors, identification plates, and similar items. Bring deviations or substitutions to the attention of the Owner for approval.

Prepare and submit a hardware list, along with manufacturer's drawings or catalog sheets, for approval prior to issuing a purchase order.

624.7 Locks and Latches

Provide all doors with locks and/or latches, including levers, lock cylinders, keys, strikes, fasteners, and other similar items and devices as are required to provide a complete, functional, and fully operational door installation.

Provide three keys for each lockset, three master keys for each subgroup (if any), and three grand master keys. Provide keys with rings and tags. Provide and install a metal lockable key cabinet with capacity to accommodate all vessel keys in the Crew Dayroom. Provide keying scheme to the Owner for approval prior to ordering any locks.

Fit joiner doors designated "Security Lock" on Table 12 with waterproof digital proximity security locksets with lever handles, "Alarm Lock PDL3000" series or equal.

Locks and latch bolts in 1-3/4" thick joiner doors shall have a 3/4" throw. Others shall have a minimum 1/2" throw.

Provide passenger toilet space access doors with 6" x 16" pull plates. Install No. 4 finish stainless steel kickplates, 12" high x full door width, on both sides of these doors.

Fit fixed pin hinges, 1-1/2" x 4", with button tips on all outside doors. Inside doors may have loose pin hinges with button tips. All hinges shall have five knuckles and stainless steel pins. Hinges shall be "Hagar" or equal.

624.8 Door Closers

Doors shall be fitted with surface mounted UL-listed door closers. All doors exposed to weather shall have the closers installed on the interior side. All closers shall have a "back-check" safety feature built in



to slow the door when it reaches approximately 70° open. Closer covers shall have a stainless steel or satin chrome finish.

624.9 Hinges

Fit weather doors, fire rated doors, and doors exceeding 30" in width with three heavy-duty, five knuckle, ball bearing butt hinges. Provide doors not otherwise specifically mentioned with two hinges of the same type.

Hinge pins shall be stainless steel and shall have button tips on each end.

Privacy doors for the water closet enclosures in the toilet spaces shall have tamperproof adjustable spring hinges, installed to spring the door open. Hardware such as the thrust bearing, pins, spring, and similar items shall be stainless. Fit each door with a stainless steel swing latch and stop/keeper.

624.10 Miscellaneous Hardware

Weather doors and fire rated doors shall be fitted with concealed NO HOLD OPEN stops. Provide rubber tipped stop-holders on all other doors.

Provide four heavy-duty coat hooks, Bobrick No. B-2116 or equal, in the Pilot House. Provide six coat hooks in the Crew Day Room. Provide two coat hooks in the cleaning gear locker. All coat hook locations shall be approved by the Owner.

Doors to weather from the passenger areas shall be fitted with panic bars.

Provide rubber-tipped bumper manual holdbacks with heavy duty catch hooks for doors to cleaning gear locker, emergency gear lockers, crew dayroom, and electronics/security room. Hold backs shall not be fitted on fire doors, doors with magnetic holdbacks, security designated doors, or weather deck doors.

Fit partial manual holdbacks, in addition to full holdbacks, 6" in length, on all stateroom doors.

624.11 ADA Requirements

All door opening devices shall conform to the requirements of the ADA access regulations. They shall be lever, paddle, or crash bar type capable of opening the door with a closed fist.

625 Airports, Fixed Portlights, and Windows

625.1 Windows

The Contractor shall provide and install exterior windows, Pacific Coast Marine or equivalent, generally as shown on Reference (B) and in full compliance with USCG requirements.

Windows with frames shall have a frame design that allows for replacement of glass without removing the frame. All fasteners shall be stainless steel. The frames shall not be through bolted from the exterior of the vessel. The Contractor shall apply silicon releasable sealant between window frames and structure.

The Pilot House shall be fitted with horizontal sliding windows at the port and starboard sides. The Aft Control Station Shall be fitted with a sliding window on the port side.



Windows shall be insulated dual pane, except for the forward Pilot House windows and aft facing Aft Control Station window.

Size, shape, tinting, and type of windows shall be approved by the Owner prior to issue of a purchase order.

625.2 Heated Windows

All Pilot House windows and the aft facing window in the Aft Control Station shall be electrically heated. The heating elements shall be sized in accordance with ISO 3434.

625.3 Window Shades

The Contractor shall provide and install window shades for the port, starboard, and aft Pilot House windows.

Shades shall be Solar Screen Kool Vue window shades made of Du Pont's Mylar polyester film, or equal. Shade pattern shall be smoke/smoke 4.5 gage material consisting of two layers of smoke Mylar on one of silver in the middle, or similar.

The Contractor shall provide and install all mounting hardware including metal clips at bottom of windows to restrain movement while shade is covering window.

662.4 Window Wipers

The Contractor shall provide and install window wipers, Wynn Model 1850 pantographic type, or equal; three on the bridge centerline windows and one on the aft control station. Wiper motors shall be 24V VDC and furnished with interior controls. Controls shall offer two speeds and intermittent operation with self-parking.

631 Coating Systems

631.1 General

All paints used shall be high quality marine paint, Sherman Williams or Owner approved equal and shall be applied in accordance with the paint suppliers' recommendations.

The Contractor shall develop a coating schedule in accordance with industry best practices, the paint manufacturer's recommendations, and the guidelines herein for review and approval by the Owner's representative. Verify that paint products selected are acceptable for use in the state and local regulatory jurisdictions where the vessel is constructed. Verify that the paint products selected are acceptable for service in Lake Michigan. All paint, coatings, etc. used and methods used shall meet requirements of all applicable regulatory bodies, including the EPA.

Final color selections shall be determined by the Owner during construction.

The ferry will have special trim painted on the superstructure and bulwarks. The Contractor shall assume that at least two different colors of paint will be applied. Trim colors shall be selected by the Owner during construction.



All steel, stainless steel, and exposed aluminum surfaces shall be painted, except as specifically excluded by these Technical Specifications. Steel surfaces, not otherwise lined, shall be provided with finish coats in accordance with the paint schedule described herein.

Prior to fabrication all structural steel used for the construction of the vessel shall be wheelabrated and primed with inorganic zinc preconstruction primer immediately after blasting.

Prior to fabrication, all structural steel plates and shapes used in construction shall be wheelabrated or abrasive blasted to completely remove scale, rust, and other surface contaminants to a near white surface profile in accordance with SSPC SP-10. The abrasive chosen shall produce a uniform anchor pattern with a 2.5 mil maximum profile height. If steel shot is used, a suitable proportion of iron grit shall be mixed with the shot to remove rust, scale, or other impurities peened into the surface by the shot and to produce a sharp, jagged profile.

Structural steel shall be primed with inorganic zinc pre-construction primer immediately after wheel abrading or blasting. The Contractor or their steel supplier shall apply primer coats with inorganic zinc pre-construction primer to clean metal surfaces per the manufacturer's specifications. Primer shall be uniform, free of pinholes and holidays, and compatible with specified coating systems.

Blasting, priming, and coating welded assemblies after weld-out will not be accepted by the Owner's Representative. Unless otherwise specified, or approved of by the manufacturer, paint and other coating materials are not to be thinned with solvent or altered in any manner by the Contractor.

The Contractor shall seal off valves, machinery, equipment, exterior aerals, and all openings in way of abrasive blast operations to prevent damage from grit and paint. Engine room intakes, exhaust ports, ventilation louvers, and all other louvers and screens must be sealed during blasting and painting in order to prevent internal spaces from being contaminated.

631.2 Surface Preparation

All surface preparation shall be in accordance with the Steel Structures Painting Council's (SSPC) Steel Structures Painting Manual. In application of these standards, regardless of surface preparation method, the coating manufacturer's recommended surface profiles shall be explicitly followed.

The prepared surfaces shall be inspected by the Owner's Representative and the Coating Manufacturer's Representative for residual dust and other surface contamination and to ensure that the minimum or higher surface preparation was achieved. The Contractor shall give as much advance notice as is possible of the time the surface will be ready for inspection, at least one day in advance.

Grind off all weld slag and weld splatter prior to abrasive blasting. Fill weld undercuts and weld pinholes with weld material. Areas where temporary erection structure has been removed shall be ground smooth and gouges shall be filled with weld and ground smooth. Prior to abrasive blast cleaning of steel, remove oil, grease, weld smoke, and other contamination with a suitable detergent or SSPC-SP 1 solvent cleaning, followed by a thorough high-pressure, freshwater wash down.

When high pressure water washing the nozzles must be kept close enough to the surface being cleaned to work properly. In the case of handheld nozzles, the maximum effective distance is approximately 6 inches. The high pressure water washing units must be of sufficient size and pressure to properly clean the surfaces. The wetting of a surface with a high pressure water gun does not constitute high pressure



washing; it must be done correctly. If oil or grease is present, then a proper de-greaser must be used high-pressure washing.

The quality of the surface preparation specified is the minimum quality that is acceptable on the metal's surface at the time of the paint application. Previously accepted surfaces may be rejected if excess metal turning occurs prior to the completion of painting.

Where structure, machinery, or equipment will cover other structure in a manner that prevents access for maintenance, both structures shall be cleaned prior to installation of the covering structure, and both coated with one (1) coat of inorganic zinc followed by the applicable paint schedule as applied to the surrounding area as specified elsewhere herein.

All grease, dirt, and other contaminating properties shall be removed from surfaces before painting: all loose, blistered, cracked paint, all rust and mil scale shall be removed from surfaces to be painted by appropriate methods as specified elsewhere herein, and spot primed with appropriate primers prior to subsequent coatings.

Dry Abrasive Grit Blasting

Abrasive grit blasting shall be done using clean, oil-free, after-cooled compressed air. The compressed air used for blasting shall be dried with properly sized, working air filters and drying units, located just prior to the blast machines. The air pressure and air volume shall be sufficient to ensure at least 90 psi air pressure at all nozzles during the normal blasting operations. Care is to be taken to blast only those areas that can be coated within a short time. This must be determined in advance and agreed upon by the Contractor, the Coating Manufacturer's Representative, and the Owner's Representative based on atmospheric conditions at the time.

The grit used for blasting work shall be dry, oil free, clean, and essentially free of harmful contamination such as chloride and sulfate. The conductivity of the grit shall not exceed 300 micro-siemens when equal volumes of grit and distilled water are mixed together (per ASTM-D4940 testing). The grit stored at the site shall be kept in properly closed and clean storage containers. The grit size used shall consist of a mix of fine and coarse grit particles to ensure thorough surface cleaning.

Surface Preparation Standards

All steel surfaces shall be blasted to SSPC SP-10, "Near White" metal prior to fabrication as indicated in Section 631.1. Surface preparation for coating after fabrication shall be as described below.

Contractor's paint schedule shall include a statement of the degree of surface preparation to be utilized for each coating system selected.

Exterior Surface Preparation

Prior to coating, exterior surfaces shall be prepared as follows:

- Remove all weld splatter, smooth all weld seams and sharp edges.
- Remove oil and grease, dirt, etc. by detergent wash/solvent clean.
- High-pressure wash with 2,500 to 5,000 psi
- Abrasive blast hull surfaces up to 12 inches above the design load waterline to SSPC SP-10



- Abrasive blast all welds and disturbed areas 12 inches above the waterline and above (including superstructure) to SSPC SP-10.
- Sand sweep to SSPC SP-7 to remove contaminants and zinc salt
- Blow down with clean air

Hull Interior Surface Preparation

Prior to coating, hull interior surfaces shall be prepared as follows:

- Remove all weld splatter, smooth all weld seams and sharp edges
- Clean by suitable means such as pressure wash or scrubbing and solvent wipe at the discretion of the Contractor and to the satisfaction of the Owner's Representative
- Prepare all welds and disrupted areas by abrasive blasting to SSPC SP-10
- Sand sweep to SSPC SP-7 to remove contaminants and zinc salt
- Blow down with clean air

Oil Tank Interior Surface Preparation

Interior surfaces of oil tanks shall be prepared as follows:

- Remove all weld splatter, smooth all weld seams and sharp edges
- Clean by suitable means such as pressure wash or scrubbing and solvent wipe at the discretion of the Contractor and to the satisfaction of the Owner's Representative
- Prepare all welds and disrupted areas by abrasive blasting to SSPC SP-10
- Clean and vacuum to remove all dust, grit, and contaminants
- Immediately after preparation, wipe down or spray tanks with a suitable oil to protect surfaces from rust bloom.

Superstructure Interior Surface Preparation

Interior spaces in the superstructure shall be prepared as follows prior to coating:

- Remove all weld splatter, smooth all weld seams and sharp edges
- Clean by suitable means such as scrubbing and solvent wipe at the discretion of the Contractor and to the satisfaction of the Owner's Representative
- Prepare all welds and disrupted areas by abrasive blasting to SSPC SP-10. Where abrasive blasting is not prudent or feasible, welds may be prepared by mechanical means to SSPC SP-3
- Blow down with clean air

631.2 Weather Conditions – Minimum Standards

No paint shall be applied when weather conditions are below the minimum recommended standards as prescribed by the paint manufacturer's product data sheets. The Contractor shall provide a factory authorized technician to accept or reject surface preparation and environmental conditions prior to paint application. In the event of uncertain or unfavorable weather conditions, the Contractor shall advise and discuss conditions and paint applications with the Owner prior to applying paint.



If environmental conditions are outside the manufacturer's recommended requirements or adverse to good paint adhesions condensation, the Contractor shall stop or delay all painting operations until more favorable weather conditions exist.

631.3 Paint Application

Paint may be sprayed, brushed, or rolled on as the Contractor selects except as described below. Paint may not be thinned, except as approved by the Owner. Any coat applied without measurement or inspection of previous coats by the Owner will not be recognized as applied.

All hardware, windows, light fixtures, placards and signs, nameplates, gages, thermometers, and adjacent equipment and structure shall be properly masked off when the surrounding areas are being painted. Masking tape shall be removed within 24 hours from when it was applied. Items and surfaces to be protected may be removed, moved, or otherwise protected, at the preference of the Contractor, but shall be restored to their pre-removal form, appearance, and function at completion of the paintwork.

The Contractor shall mask hoses, gauges, and bright work prior to painting. Painted hoses shall be replaced, even if only partially painted.

Unless otherwise specified, or approved of by the manufacturer, paint and other coating materials are not to be thinned with solvent or altered in any manner by the Contractor.

Where minimum dry film thickness (MDFT) requirements are specified in the approved paint schedule they shall have precedence over the number of coats specified. The readings shall be made with a coating thickness gauge, Elcometer, Microtest, or other approved gauge, in accordance with the manufacturer's instructions.

Zinc primers shall be fully cured and all oxidation removed prior to subsequent coatings. All coats of paint applied must be compatible with primers and other paints. Sufficient time for proper drying or tacking shall be allowed between coats. All painting shall be accomplished to protect all surfaces liable to water, immersion, seepage, or condensation.

All topcoats shall be from the same lot, applied in continuous fashion. No curtains, holidays, or shadows. If any discoloration or fading of topcoat is evident at the completion of construction the topcoat shall be reapplied.

The final coat of finish paint above the water line shall not be applied until all other work has been completed and the vessel is otherwise ready for delivery. The final coat shall be applied by spraying only.

The Contractor shall provide Owner with one copy of painting report prior to each application of paint.

The vessel shall be shifted on blocks so that complete painting of the bottom area may be accomplished. Areas in way of block spots shall be shotblasted and coating system brought up as specified herein.

631.4 Repair of Damaged Coatings

Any painted surface that is damaged during construction or outfitting shall be restored to suit the adjacent area as follows:

- Remove any damaged coating system by sanding to a sound anchor profile.



- Sand surrounding paint to present an even contour with edges feathered and at least two of the three underlying coats separately visible and distinct from each other. Each layer or coat shall be a minimum of 2" wide.
- Where the disturbed area has penetrated through to the substrate, any scarred or damaged metal shall be repaired and a proper anchor profile renewed.
- Restore damaged epoxy coatings systems to a finished surface profile equal to adjacent and surrounding areas. Each coat to be as specified elsewhere herein.
- Apply topcoats as required by approved paint schedule

Finished paint shall blend with adjacent areas and present a smooth, even profile free of runs, contamination, or other unsightly coating defects.

The Contractor shall repair any areas damaged due to the use of destructive testing techniques, if used.

631.5 Clean-Up

After all construction and outfitting has been completed and just prior to vessels departure/delivery, the Contractor shall remove all paint from all windows, slides, and free up moving sashes.

The Contractor shall remove paint from all glass and bright work. All bright work shall be polished after all other work has been completed and vessel is otherwise ready for delivery.

Remove all paint and paint over-spray from machinery components, machinery label plates, signs, threads of wing nuts and bolts used for securing vent and storm covers etc., hinge pins, shafting, doorknobs, latching mechanisms, actuator rods, valve stems, etc.

Vessel shall be thoroughly cleaned throughout, including but not limited to the removal of all dust, grit, grease, solvents, and lint from all spaces, machinery, components, structure, void vents, drains, bilges, paneling, furnishings, deck coverings.

Thoroughly clean all decks, superstructure, and bilges prior to final delivery of vessel.

631.6 Tanks

The interiors of all tanks and voids shall be thoroughly cleaned and coated to the satisfaction of the Owner. The coating system used shall appropriate for the intended service.

Fuel and lubrication oil tanks shall be thoroughly cleaned of all debris, weld splatter, flux, and other foreign matter and approved by the Owner prior to initial filling and shall be kept closed thereafter until ready for use.

631.7 Piping, Machinery, and Electrical Coatings

Piping

In general, coat piping with a glossy finish in accordance with the paint requirements for the area through which the piping passes or is installed. All firemain system piping shall be painted red. Paint rigid pipe insulation as described herein for piping. Do not paint insulation blankets.



Do not paint flexible hoses, hose sleeves, and flexible connections. Mask all electrical cable to prevent coating and overspray. Flexible hoses, hose sleeves, and flexible connections with paint or overspray will be rejected and require replacement.

Machinery

New machinery and equipment in non-weather spaces shall retain the coating supplied by the factory, provided the coat is a finish coat, and shall not be further coated to match the above paint schemes. Where machinery coating is damaged during construction, carefully feather the edges and paint to match factory coating.

Equipment that is delivered with only a factory-applied primer coat shall be coated with a minimum of two coats of an appropriate epoxy paint and in accordance with the approved paint schedule.

Paint deck machinery and equipment installed in the weather or in public spaces in accordance with color schemes approved by the Owner's Representative.

Electrical

Do not paint electrical cable. Mask all electrical cable to prevent coating and overspray. Any painted electrical cable shall be replaced, even if only partially painted.

Electrical components such as power distribution panels, motor control enclosures, junction boxes, etc., shall retain the color and coating as supplied from the factory provided the coating is a finish coat.

Equipment that is delivered with only a factory-applied primer coat shall be coated with a minimum of two coats of an appropriate epoxy paint and in accordance with the approved paint schedule.

Protect and mask off factory lenses, switches, pushbuttons, label plates, etc. from damage by the coating.

633 Cathodic Protection

Sacrificial high purity magnesium anodes shall be provided and installed in accordance with the recommendations of the Society of Naval Architects and Marine Engineers (SNAME) T&R R-21, Fundamentals of Cathodic Protection for Marine Service. Bolt through type anodes shall be used, arranged equally divided port and starboard. The anodes shall be installed with the long axis fore and aft and affixed to the hull with stainless steel studs, washers, and nylock nuts. A minimum of three (3) threads shall remain exposed with washer and nut in place.

Any anodes installed on or in equipment shall be compatible with the hull anodes.

633 Deck Coverings

634.1 General

Decks shall be thoroughly cleaned and prepared as described in Section 631. Deck coverings shall be installed in accordance with manufacturer's recommendations. Colors and pattern of deck coverings shall be selected by the Owner's Representative.



Deck covering shall be laid under furniture except where the furniture is built-in to the vessel structure. Cove base shall be installed around boundaries, including built-in furniture.

Deck coverings shall be approved in accordance with USCG requirements.

634.2 Underlayment

Before flooring is installed, the deck shall be faired with underlayment to provide a smooth and even appearance and eliminate irregularities in the deck surface.

The Contractor shall level and fair interior decks with a flexible underlayment applied the minimum thickness required and in accordance with manufacturer's recommendations. Underlayment shall be suitable for application of the specified flooring. Irregularities in the surface of the deck shall be eliminated and the finished surface troweled smooth.

634.3 Deck Covering Schedule

The deck coverings shall be in accordance with Table 21. Deck coverings shall be installed in accordance with Regulatory Body requirements. The Contractor shall provide color samples and flooring cutsheets for Owner approval prior to procurement.

Table 13: Deck Coverings

Deck	Space	Covering
Deck House Top	Passenger Area	Non-skid paint
Upper Deck	Pilot House	Roppe Rubber Tile or Sheet
	Crew Hallway	Roppe Rubber Tile or Sheet
	Electronics Room	Roppe Rubber Tile or Sheet
	Crew Day Room	Roppe Rubber Tile or Sheet
	Crew Washroom	Poured Floor – Epoxy Flake
	HVAC Fan Room	Paint
	Stair Tower	Roppe Rubber Tile or Sheet
	Aft Passenger Lounge	Roppe Rubber Tile or Sheet
	Exterior Decks	Non-skid paint
	Aft Control Station	Poured Floor – Epoxy Flake
Passenger Deck	Observation Lounge	Roppe Rubber Tile or Sheet
	Washrooms	Poured Floor – Epoxy Flake
	Cleaning Gear Locker	Poured Floor – Epoxy Flake
	Dry Lockers	Roppe Rubber Tile or Sheet
	Stair Tower	Roppe Rubber Tile or Sheet
	Exterior Decks	Non-skid paint
Vehicle Deck	Vehicle Deck	Non-skid paint
	Stair Tower	Non-skid paint
	Aft Passenger Stairway	Non-skid paint
	Crew Stairways	Non-skid paint
Hold	Engine Room	Paint and Deck Plates
	Machinery Spaces and Voids	Paint and Deck Plates



Poured epoxy flooring shall have a 4 inch high, continuous epoxy cove with 1" base radius and stainless cove cap.

635 Hull Insulation

The Contractor shall furnish and install thermal insulation and structural fire protection insulation in accordance with References (D), (Q) and (R1). Installation of all types of insulation shall be per manufacturer's recommendations.

Structural fire protection insulation where required shall be foil faced mineral wool complying with USCG requirements and installed per the requirements of (R8). Additionally, A-60 rated structural fire protection shall be provided and installed in the following locations:

- Overhead of the Engine Room
- Overhead of the Bow Thruster Room
- Vertical inboard bulkheads around the elevator trunk and the port and starboard uptakes
- Overhead of the Novec Locker
- Vertical inboard bulkheads around the Novec locker
- Vertical bulkheads around the starboard stairway leading from the Main Deck to the Passenger Deck
- Underside of the starboard stairway where exposed to the open Vehicle Deck
- Underside of the Passenger Deck
- Vertical bulkheads between the Passenger Deck and the Upper Deck where exposed to the open Vehicle Deck

Exterior weather boundaries and boundaries separating air conditioned spaces from non-air conditioned spaces to be insulated with a minimum 3" of thermal insulating material over bulkhead and decks surfaces and 1" wrap over stiffeners.

Where acoustic insulation is required to meet the noise requirements in Section 073, acoustic insulation shall be installed. Where a flexible noise barrier is required to meet the noise requirements in Section 073, a USCG approved noise barrier such as Pyrotek Quadzero-NL may be used. Flexible noise barrier materials shall be installed in strict accordance USCG requirements.

Seams faced insulation shall be covered with matching facing tape to present a smooth surface.

Coat exposed cloth backed insulation with vapor-barrier sealer after installation and prior to bulkhead liner installation and/or paint application.

637 Linings and Joiner Bulkheads

The Contractor shall design, layout, and install linings for all exposed and interior insulated bulkheads within crew and accommodation spaces, passageways, and the Pilot House. Where possible ducts, pipes, cableways, etc. shall be installed behind linings; otherwise, they shall be boxed in with removable panels matching the surrounding linings.

Linings shall be 0.040" minimum thickness vinyl-clad aluminum panels, Arvinyl Metal Laminates, or approved equal. The Contractor shall present samples for color and pattern selection by the Owner.



Linings in way of stiffeners and ceilings shall be supported by a system of metal furring. Smooth steel bulkheads in the passageways and foyers on the Passenger Deck may be painted like adjacent areas. Furring shall be attached to the steel structure by Hilti Nail System, or equal. Fastenings shall be stainless steel or galvanized.

The public washrooms will have an additional lining of 18 gauge stainless steel sheet metal extending from the floor to approximately 40 inches above the floor on all bulkheads.

The Contractor shall layout, provide and install expanded metal bulkheads surrounding the elevator machinery in the Engine Room. Bulkhead construction details shall be in accordance with ASTM F1071. All edges shall be well rounded.

640 Furniture and Furnishings

Furniture and furnishings shall be provided generally as shown on Reference (B) and as described herein. Furniture and furnishings shall be of good marine quality and shall meet the requirements of 46 CFR §116.423.

644 Sanitary Spaces and Furnishings

Bulkhead mounted stainless steel countertops and lavatories shall be provided in the restrooms. Piping and drains under the lavatories shall be fitted with removable preformed insulating pads in accordance with ADA requirements or shall be fitted with removable stainless steel plate guards. There shall be no sharp edges or corners on the countertops or supporting structure that may cause injury to passengers.

The Contractor shall install a self-closing or automatic solid brass chrome plated faucet, stainless steel soap dispenser, and 12" x 18" commercial grade mirror with stainless steel frames at each lavatory. Lavatories and mirrors shall be ADA compliant.

Each family washroom shall have ADA grab rails installed at the back and side of the toilet. Rails shall be stainless steel tubing securely attached with vandal-resistant stainless steel fasteners.

Toilets shall be bulkhead mounted white vitreous china fixtures with stainless steel or chrome plated brass flushing valves. Toilet seats shall be commercial quality with open front and stainless steel hinges.

The Contractor shall provide and install one commercial grade roll toilet paper holder in each toilet stall.

Each passenger washroom shall be fitted with an electric hand dryer, Excel Xlerator or equal.

645 Passenger Lounges

Passenger lounges include the Observation Lounge and the Aft Passenger Lounge as shown on Reference (B). The lounges shall be fitted with chairs, benches, and tables with spaces for wheelchairs.

The Contractor shall propose and the Owner approve the makes, models, and colors of all furnishings.

645.1 Passenger Seating

The Contractor shall provide and install passenger seating generally as shown on Reference (B). Interior seating shall be Berteaux 'The Tourist' or equal, constructed of powder-coated aluminum pedestals and



unpadded powder-coated aluminum grab rails. Seats shall be secured to the deck with stainless steel studs welded to deck and secured with stainless steel acorn nuts and lock washers.

The Contractor shall provide and install bench seating in the Aft Passenger Lounge generally as shown on Reference (B). Interior bench seats shall be Berteaux 'The Nyra' or equal. Bench seats shall be secured to deck with stainless steel studs welded to deck and secured with stainless steel acorn nuts and lock washers.

Upholstery shall be transit grade with flame retardant vinyl and foam.

Seats shall be provided with three spare back and bottom covers for each size settee and seat, and three complete sets of replacement hardware.

645.2 Tables

The Contractor shall provide and install rectangular, 29" high tables in the Aft Passenger Lounge matching the booth bench seating, Berteaux or equal. Table sizes shall be generally as shown on (B). Tabletops shall be laminate.

645.3 Trash and Recyclables

The Contractor shall provide and stow four trash receptacles with self-closing stainless steel door and galvanized steel inner liner. Receptacles shall be 36" high x 15" diameter with a fifteen gallon capacity.

Provide and stow four sets of recycling bins with segregated sections for paper, plastic, and glass/metal.

Locate trash and recycling receptacles as directed by BITA.

646 Exterior Seating Areas

The Contractor shall provide and install bench seating on the exterior Upper Deck and Deck House top passenger areas as shown on Reference (B). Seats shall be constructed of aluminum or Owner approved alternative. Outdoor seating shall be Berteaux 'Outdoor CTC' or equal, Seats shall be mounted to the deck with stainless steel studs welded to the deck, sized to suit. Seat bottoms shall be arranged to avoid water entrapment

The upper deck will also feature a covered seating area for passengers. The aft end will be open to the weather. Seating will be benches and spaces for wheelchairs will be provided. Outdoor benches shall be Berteaux 'The Alby' or equal. Radiant heaters will be fit to the overhead structure (see Section 512.2).

A removable marine canvas and frame weather cover, spanning the aft end of the Solarium, approximately at Frame 41, from deck to overhead shall be provided with the vessel. The weather cover shall have clear vinyl windows sized to match the side windows in the Solarium and a door allowing passage aft.

651 Vending Machines

Vending machines shall be furnished and installed by the Contractor, generally as shown on Reference (B). Unobtrusive, but secure strapping shall be provided to prevent vending machines from movement.



652 Drinking Fountain

The Contractor shall provide and install a drinking fountain, Elkay Model LVZ08S or equivalent, in a location to be determined by the Owner. Provide water supply from potable water system and drain to gray water system.

654 Cleaning Gear Locker

The cleaning gear locker shall be equipped with the following:

- Deep slop sink, FRP construction and mounted to the bulkhead
- Two stainless steel shelves with sea rails over the slop sink
- Four stainless steel hooks on the bulkhead for hanging brooms, mops, etc.

655 Emergency Gear Locker

The emergency gear locker shown in Reference (B) shall be outfitted with the following items:

- Stainless steel shelving, hooks, and racks as appropriate for the gear.
- The lockers shall be equipped for hanging of the required gear with one bulkhead fitted with four shelves.

The configuration of the lockers shall be proposed by the Contractor and approved of the Owner prior to installation.

656 Crew Day Room

The Crew Day Room shall be arranged generally as shown on Reference (B). All furniture shall be of durable construction. Furniture shall include:

- One rectangular dining table
- Three side chairs
- Lockers

Galley equipment shall include:

- Stainless steel double sink with faucet and sprayer
- Light duty commercial microwave oven, 1.7 cu ft capacity
- Refrigerator/freezer, 20 cu ft with ice maker, stainless steel finish, Frigidaire Gallery Professional Series or equal
- Four slice toaster, stainless steel finish
- Automatic coffee maker, Bunn 8-cup capacity with stainless steel decanter, or equal
- Cabinets and counters

The table shall be secured to the deck with stainless steel weld studs and fasteners.

Final layout, colors, makes, and models shall be proposed by the Contractor and approved by the Owner.



658 Crew Washroom

The Contractor shall provide a lavatory cabinet with countertop and stainless steel sink in the crew head. Installation shall include a solid brass chrome plated faucet, stainless steel soap dish, and a 12" x 18" commercial grade mirror with stainless steel frame. The lavatory cabinet shall include under sink storage for linens.

The contractor shall install a bulkhead mounted, white, vitreous china toilet with stainless steel or chrome plated brass flush valves. Toilet seats shall be commercial quality with open front and stainless steel hinges.

The Contractor shall provide and install one commercial grade roll toilet paper holder near the toilet.

The Contractor shall provide and install one shower stall. The shower shall be stainless steel, molded fiberglass, or owner approved alternative. The shower stall shall have a built in shelf for soap and shampoo, built in grab rail, shower head, mixing valve, curtain rod, and curtain.

Install a towel bar adjacent to the shower and two clothes hooks.

661 Electronics/Security Room

The Electronics/Security room shall be furnished with the following commercial grade furniture:

- Desk with three tool drawers and two hanging file drawers
- Straight leg armchair
- Two 3-drawer file cabinets
- Bookshelf with three shelves
- 19" electronics racks as needed to support the ship's electronic systems.

Except for the chair, all furniture shall be secured to the deck or a bulkhead. Final furniture selection and arrangement shall be approved by the Owner.

662 Pilot House Outfit

The Pilot House shall have all equipment, instrumentation, electronics, lighting panels, etc., to enable the Vessel to be navigated properly as described in previous sections of this Specification. Additionally, the Pilot House shall be outfitted as generally shown on Reference (B) and with the following items

- Two pilot chairs with footrest. Height shall be determined after console design is developed. Color shall be selected by the Owner. Chairs shall be Berteaux The Helm or equal.
- Chart table of enameled steel construction with a single 5" deep chart drawer and cabinets below. The chart table shall have a Plexiglas surface and red light for night use. Provide two duplex electrical outlets at the chart table.
- Storage cabinets and shelving for navigational materials, equipment, and ship's manual.
- Raised Settee
- Live preserver storage suitable for up to four preservers

The final pilot house layout, colors, and outfit makes and models shall be proposed by the Contractor and approved by the Owner.



665 Engine Room Outfit

The Contractor shall provide and install one workbench as shown on Reference (G). The workbench shall be bolted in place so it can be removed to provide clearance for major equipment maintenance. In addition, the contractor shall install:

- One flammable liquid storage cabinet in the Engine Room, McMaster-Carr catalog #4495T53 or equal.
- One 21-gallon, steel, oily waste can, McMaster-Carr catalog #4070T54 or equal.
- One toolkit, GearWrench MEGAMODPRO 791-Piece Master Technician Set or equal.

671 Emergency and Firefighting Equipment Outfit

671.1 General

Emergency equipment shall be installed as required by all applicable regulations and as generally shown on Reference (B). The location of required equipment not shown on Reference (B) shall be proposed by Contractor and approved by the Owner prior to installation. The type, quantity, location, and installation of life saving appliances are subject to final approval of cognizant Officer in Charge, Marine Inspection (OCMI).

The emergency equipment shall be secured in the emergency gear locker as set forth in Section 655.

671.2 Portable and Semi-portable Fire Extinguishers

Portable and semi-portable fire extinguishers shall be installed as required to meet all applicable USCG regulations. The final quantity, location, type, and size required to be provided shall be as determined by USCG inspection and approval. Spare fire extinguishers shall also be provided in accordance with applicable USCG regulations. Dry chemical extinguishers to be supplied where approved.

Extinguishers shall be installed on USCG-approved manufacturer-matched brackets for stored pressure and cartridge activated extinguishers. Spares shall be mounted in a like manner and stowed as directed by the Owner.

Provide semi-recessed or fully recessed cabinets for portable extinguishers in interior passenger spaces.

671.3 Fire Axe

The Contractor shall provide and install a fire axe in a quick release stainless steel bracket. The axe shall be mounted in the pilot house

671.4 Additional Firefighting Equipment

Provide and stow the following additional firefighting equipment on the vessel:

- One under-car flood pipe, SUDZ-IT EV Utility Nozzle or equal
- One fire piercing nozzle, Flamefighter 2500 or equal
- Two (2) EV-rated fire blankets, Bridgehill standard or equal
- Two (2) Fireman's Outfits consisting of one self-contained breathing apparatus, one lifeline with a belt or a suitable harness, one flashlight, one oxygen depletion meter, one rigid helmet, boots



and gloves, protective clothing, and one fire ax. Fireman's outfits shall meet the requirements of 46 CFR 77.35

- One complete recharge for each self-contained breathing apparatus
- One handheld thermal camera

681 Lifesaving Equipment

681.1 General

The locations and quantities of all lifesaving equipment shall be as set forth as specified herein and as required per CFR 46 Subchapter K. The locations and quantities of same shall be proposed by Contractor and approved by the Owner prior to installation.

681.2 Personal Flotation Devices

USCG-approved Type I Personal Flotation Devices (PFDs) shall be stowed as required by USCG and as generally shown on Reference (B), include 296 adult passenger PFDs, 15 adult crew PFDs, and 30 child passenger PFDs. PFD details, locker construction, and installation locations shall be submitted to the Owner's Representative prior to purchase and installation.

PFDs shall be stowed in dedicated PFD storage lockers. The exterior of the lockers shall match the color of the joiner system.

PFDs shall be stowed as required by 46 CFR §117.70, and all PFD lockers and stowage locations shall be stenciled as required by 46 CFR §117.70. Child PFDs that are stored with adult PFDs shall be stowed in separate compartments and clearly marked. All PFDs shall be stenciled in accordance with 46 CFR 46 CFR §117.70.

681.3 Life Buoys

Three 30-inch orange life buoys (Jim Buoy HS-30 or equal) shall be furnished. One life buoys shall be fitted with a self-igniting light. One life buoy shall be fitted with a lifeline. Life buoys shall be stenciled in accordance with USCG requirements, with each life buoy being marked in clearly legible block capital letters with the Vessel's name.

Stainless steel mounting brackets shall meet USCG regulations. 3 stainless steel life buoy-mounting brackets, fitting the selected life buoys, shall be installed to satisfy 46 CFR §117.70. Mounting bracket details and installation locations shall be proposed by the Contractor and approved by the Owner prior to purchase and installation.

681.4 EPIRB

One FCC Type Accepted Category 1, 406 MHz EPIRB, installed to automatically float free and activate, shall be installed.

681.5 Signaling

One Signal flare kit meeting 46 CFR 117.68, Orion 3-50 Mile Commercial Vessel Kit or equal shall be provided and stowed on board where directed by Owner.



681.6 Immersion Suits

Four USCG immersion suits shall be provided and stowed on board where directed by Owner.

681.7 Automated External Defibrillators

Provide and install two Automated External Defibrillators (AED's). AEDs shall be FDA approved, fully automated, and stowed in a bulkhead mounted cabinet. Install one AED in the Passenger Deck observation lounge, and the second in the Aft Passenger Lounge on the Upper Deck. Final locations shall be proposed by the Contractor and approved by the Owner.

681.8 Man Overboard Rescue Equipment

Provide and install the following man overboard rescue equipment on the vessel:

- 1) One portable man overboard rescue davit with manual lifting winch
- 2) One man overboard rescue cradle
- 3) One portable man overboard ladder

The man overboard equipment shall be similar in arrangement and function to those on the Owner's existing vessels to promote crew familiarity. When deployed, the rescue ladder and rescue davit shall mount to the vessel using deck sockets in the stern loading ramp.

The man overboard davit and ladder shall be stowed in fixed brackets in the portside mooring area on the aft face the stair bulkhead at Frame 46.



Group 800 – Integration and Engineering

810 Engineering and Working Drawings, Calculations, and Review

This Group describes the engineering, drawing, calculations, and review requirements for the Vessel. The Contractor shall provide all engineering and other services necessary for the work in accordance with this Specification. Services shall include technical calculations, surveys, material selection, preparation of diagrams, sketches, schedules, data, and preparation of all functional design drawings, detail design drawings, and as-built drawings.

All efforts described herein shall be completed in strict accordance with the requirements and recommendations of the Regulatory Bodies and Contract Documents. In cases where these requirements contradict, see Section 030, which specifies the order of precedence.

810.1 General Review Process

As described in Section 030 of this Specification, Functional Design, and Detail Design drawings shall be completed in detail sufficient to gain Regulatory Body approval and fully describe the Vessel, including structural details and selected equipment specifications and systems functionality. Further, Functional Design and Detail Design drawings and other drawings noted on the Plan Schedule (see Section 040.2) as "as-built" drawings shall be updated to reflect the as-built condition of the Vessel to facilitate future use by the Owner for maintenance and repair activity.

All drawings shall be produced using Computer Aided Design (CAD), and all CAD files provided shall be accurately represented and readable in AutoCAD 2018 or the most current format. Data files shall be provided electronically in DWG and PDF format as applicable. Printed drawings larger than 11-inch x 17-inch shall be provided upon request of the Owner. All delivered PDF files shall be searchable. Booklets of details and calculations may be on sheets of 11-inch x 17-inch or 8 ½-inch x 11-inch with a minimum font size of 10pt single-spaced.

A full sample drawing format showing a typical sheet one and sheet two, including title block, reference, general notes, material list, and revision table format shall be submitted to Owner for approval at the commencement of engineering. Submitted drawings shall comport with this drawing to the maximum extent possible.

System drawings such as piping and wiring diagrams shall detail the complete system, identifying all branches or circuits and components.

Symbols on drawings shall conform to recognized marine commercial standards.

Materials shown on drawings shall have unique item numbers and be identified in a material list by material specifications, ASTM, ANSI, NEMA, etc. as appropriate.

Each drawing shall contain an overview page showing the entire scope of the drawing. All drawings shall be initialed and dated in the title block by the designer and engineer responsible for the design prior to submittal to the Owner.



When submitting system design drawings, such as piping diagrams and isometric wiring diagrams, the calculations by which the system components were sized shall be included. The Owner will not review these drawings without supporting calculations.

Whether explicitly stated in other portions of this Specification or not, the Owner shall have authority to review all aspects of the Contractor's Functional Design and Detailed Design to determine compliance with the Contract Documents. The Owner's review will not relieve the Contractor of responsibility for deviations from the Contract Documents unless the Contractor has called attention to the deviation in writing and received approval in writing from the Owner. Review or approval of a drawing by Regulatory Bodies does not constitute the Owner's approval of a deviation, mistake, or omission.

Owner approval of a deviation from the Specification will not relieve the Contractor of the responsibility for satisfactory operation of the system or equipment. Work performed by the Contractor prior to the Owner's review and approval of the Contractor's drawings will be at the Contractor's risk.

Each drawing shall be checked and finished before it is submitted to the Owner. Drawings that are incomplete, including those with incomplete title blocks, will not be reviewed by the Owner and will be returned to the Contractor for completion. Returned drawing submittals do not count towards fulfilling the Contractor's obligations regarding scheduling. All returned drawings must be resubmitted complete within the scheduled time.

Final functional design drawings for submittal to Regulatory bodies shall be stamped by a licensed professional engineer prior to regulatory submittal.

A copy of all written and electronic correspondence sent to or received from Regulatory Bodies shall be furnished to the Owner. If not included as a party to the correspondence (such as a carbon copy (CC) on an email), such correspondence shall be forwarded to the Owner within one business day. A consolidated list of documents and review comments from Regulatory Bodies shall be maintained by the Contractor. The Contractor shall update the log regularly and submit a copy to the Owner before each monthly progress meeting described in Section 040.1

All drawings, documents, and engineering calculations shall be submitted to the Owner in a timely fashion, according to the approved Schedule of Work and the Plan Schedule. The Contractor, in consultation with the Owner, shall establish a distribution list of responsible parties prior to the first submittal. The list shall include the names, phone numbers, and email addresses of all personnel who will receive submittals. Submittals shall be distributed via email or other agreed upon electronic tracking system to all listed parties.

Unless indicated otherwise within these Specifications, the Owner shall respond to submittals not later than 14 calendar days after receipt of the document with one of the following:

- "Reviewed" – The item has been reviewed; Contractor may proceed with no changes.
- "Reviewed With Comments" – The Contractor may proceed once changes identified in response have been implemented.
- "Returned for Revision" – The Contractor must correct issues identified in the response and resubmit revision for subsequent review by Owner prior to proceeding.

The Owner review responses shall be returned via email or other agreed upon electronic tracking system. In the event that the Contractor receives no response within the fourteen-calendar day period, it



shall assume the submittal has been responded to as "reviewed." The Contractor shall track comments and respond as required within 14 calendar days following receipt from the Owner. The Contractor shall maintain a log of such comments, update regularly, and submit a copy to the Owner before each monthly progress meeting described in Section 040.1

One copy in electronic format of each drawing, document, or calculation shall be provided when submitting to the Owner for review through a shared electronic document management and submittal control system provided by the Contractor. The Contractor shall identify the system proposed for such use in its bid submission.

810.2 Regulatory Procedures and Analysis

In addition to procedures and analyses identified elsewhere in this Specification, the Contractor, or its subcontractors, shall at a minimum develop and submit to Regulatory Bodies the following documents for approval, as well as any other documents required by same. The documents shall be developed in accordance with the applicable portions of Reference (R1) and Reference (R2), for steering systems, propulsion systems, control and monitoring systems, and power generation and distribution systems.

- Qualitative Failure Analysis (QFA): Examines the results of the failure of each control, alarm, and instrumentation system component, and verifies that a single non-concurrent failure will not prevent sustained or restored operation.
- Design Verification Test Procedures (DVTP): a detailed test procedure to verify each failure mode identified by the QFA.
- Periodic Safety Test Procedures (PSTP): Test procedures to periodically verify the proper function of vital system automation, alarm, and control.
- Overcurrent protective device coordination study: A comparison of the time and current relationships of each series set of protective devices, to verify selective tripping of circuit breakers and fuses.

The approved documents shall be submitted to the Owner, including electronic copies of approval letters, as well as the approved document in its native format and in PDF format.

810.3 As-Built Drawings

All drawings identified as "as-built" in the Plan Schedule described in Section 040.2 shall be updated to reflect the as-built condition of the Vessel and be stamped "AS-BUILT FINAL" in the title block. The 'as-built' drawings shall reflect systems and arrangements of the Vessel as finally installed and approved.

No later than four weeks prior to the Delivery Voyage, the Contractor shall submit as-built drawings for approval. These shall be provided to the Owner as three sets in paper format, as well as in electronic format with one file set AutoCAD (DWG) and one file set in PDF file format.

810.4 Vendor System Diagrams

All vendor-supplied systems must include system diagrams (mechanical, piping, and electrical) illustrating the installed configuration of the systems. Wiring and cabling diagrams shall include the cable type and unique designations for each cable. Connector pinout diagrams identifying each pin by function shall be provided for all equipment with electrical interfaces.



810.5 Documents and Drawings for Use on Board Vessel

Prior to Vessel Acceptance, the Contractor shall obtain a Stability Letter in accordance with 46 CFR Part 170.120. The Stability Letter shall be posted in accordance with 46 CFR § 115.306.

The Contractor shall develop and provide the following reduced size, non-fading positive prints of approved as-built drawings to be mounted in locations noted on board the Vessel. These drawings shall be mounted prior to Vessel Acceptance. Mount all drawings in anodized aluminum, or stainless steel frames with clear plastic covers, or in tubes as listed below. The tube mounted drawings shall be completely enclosed in clear plastic.

The set of prints shall include:

QTY	Description
9	Fire Control Plan, 11x17 inch size. One laminated copy of the Vessel Safety Plan shall be mounted in each Passenger Deck and Upper Deck passenger lounges; one laminated copy shall be mounted in the Pilothouse; one laminated copy in a document tube shall be located in the Pilothouse; two laminated copies, each in a document tube, shall be located in the EOS; one laminated copy shall be provided to the Owner for use on shore. Provide tube mounted Fire and Safety Plan drawings where required by USCG.
1	AC/DC electric power distribution system, one-line wiring diagram mounted near the ship service switchboard.
2	Fuel system diagram to be mounted at the fuel filling station and the Engine Room.
2	Steering gear piping diagram, wiring diagram, operating and lubrication instructions mounted near each steering gear HPU.
2	Bilge system piping diagrams with operating instructions mounted near each bilge manifold.
1	Shipset of Fixed Fire Suppression system diagrams and operating instructions, clearly showing separate and distinct operation of the Engine Room fire suppression system, Bow Thruster Room fire suppression system, and vehicle deck sprinkling system, to be mounted near the operating panels.

810.6 Hull Marking and Docking Plan

A Hull Marking and Docking Plan, which will be used by the Owner when dry docking the Vessel, shall be developed and submitted to the Owner for approval. This plan shall show the following, at a minimum:

- A primary and secondary block arrangement shall be shown, including:
 - keel and bilge block size and locations shall be shown
 - required keel block heights
 - minimum contact areas for all blocks
 - cross sections of the hull for building bilge blocks
 - keel block loads at full fuel load displacement
- Locations of the following:
 - propellers
 - bow thruster
 - rudders
 - drain plugs
 - sea chests



- keel coolers
- anodes
- over boards
- through-hull appurtenances such as depth transducer
- draft marks
- Locational references corresponding to the underwater hull markings for the UWILD survey program.

Locations of all items shall be with dimensions to physical common reference points. All overboard and hull projections as well as Vessel particulars such as major dimensions, tank capacities, draft, and lightship weight shall also be provided on this Plan.

810.7 Tank Sounding Tables

Tank sounding tables for all tanks shall be submitted in accordance with the Plan Schedule.

833 Weight Estimate

An as-built weight estimate shall be submitted upon completion of the Vessel. Refer to Section 096 for details.

835 Tonnage Admeasurement

The Vessel has been designed to admeasure less than 100 GRT. Within 45 days of Contract Execution, the Contractor shall obtain an independent validation of the tonnage scheme, based upon the Contract Guidance Drawings. The independent validation of the tonnage scheme shall be performed by a qualified Owner approved agent (e.g., ABS, DNV, etc.) and completed prior to commencing fabrication.

The Contractor shall contract with a USCG approved Classification Society (i.e., ABS, DNV, etc.) for determination and assignment of the Vessel's gross and net tonnage under the US (Regulatory) Tonnage Convention systems, as required by law. A Certificate of Admeasurement for Regulatory Tonnage and International Tonnage Convention shall be submitted to the Owner prior to Vessel Acceptance.

The admeasurer and Owner shall be advised when the Vessel is ready for inspection. After receipt of the Vessel's tonnage and official number assignments, they shall be marked on the Vessel as required. All costs associated with determination and assignment of the Vessel's Regulatory Tonnage, including all fees, shall be to the Contractor's account and shall be included in the price of the Vessel.

838 Field Office for Owner's Representative

Office facilities shall be provided at the Contractor's facilities sufficient to accommodate up to four Owner's staff beginning no later than date of NTP. The field office shall be furnished and equipped, as indicated below, to accommodate up to four persons in a normal office configuration.

Office facilities shall be made available to the Owner until 30 days after Vessel Acceptance. The expenses shall be borne by the Contractor. The field office shall be within short walking distance of the Vessel's construction site and Contractor project management and engineering offices. Such office may be a part of the Contractor's building, in which case it shall be completely partitioned off from the balance of the structure and shall be provided with a separate outside door equipped with a separate lock.



The office shall have proper lighting and ventilation; shall be heated and air-conditioned.

The office shall have 120 volt/60 hertz power, adequate electrical outlets, and lighting. Weekly janitorial and daily trash pickup shall be provided.

The equipment provided shall be fully operational (including operating manuals) upon occupancy. The Contractor shall ensure the functionality of all Contractor-provided equipment throughout the duration of occupancy. The office accommodations shall include:

Table 14: Office Accommodations

Qty	Item
2	Desks w/chairs
2	Side chairs
1	High speed internet connection (100 Mbps minimum) with secure Wi-Fi networking separate from the Contractor's
4	Dedicated parking spaces within 250 feet of the required office space.
-	Cylinder door locks and keys
1 (ea.)	Coffee maker, refrigerator, and microwave, adjacent to or included with required office space, sufficient to service two Owner's Representative staff
1	Complete sanitary facilities including toilet, sink, and hot and cold potable water adjacent to or within the required office space.
1	Shower

843 Stability

843.1 General

A stability test shall be completed in accordance with the requirements and procedures of the current versions of Reference (R22) and Reference (R23) to the satisfaction of the Regulatory Bodies and the Owner.

843.2 Stability Test

A stability test procedure shall be submitted to USCG MSC for approval prior to conducting the stability test. The Owner shall be notified of the date for the inclining experiment at least 30 calendar days in advance and shall be provided with a copy of the USCG-approved procedure.

At the time the stability test is to be conducted, the Vessel shall be essentially complete and afloat at the Contractor's dock. The stability test shall not be performed until the vessel is substantially complete with less than an aggregate of 2% weights to add, relocate, or remove from the vessel compared to the lightship condition. Remaining weights and their centers of gravity to be added and removed shall be fully identified, within permitted USCG tolerances, and in accordance with ASTM F1321 requirements. The USCG, Owner, and the Naval Architect shall witness the stability test.

Using the results of the stability test, a Stability Test Report shall establish the Vessel's as-built lightship weight and centers of gravity. The Stability Test Report shall be submitted to USCG MSC for approval.



843.3 Stability Assessment

A stability assessment shall be prepared in accordance with the MSC Guidelines for Review of Passenger Vessel Stability (H2-3) and submitted to the USCG for approval as the basis for the USCG Stability Letter. The stability assessment shall set forth the stability data necessary to permit safe and efficient handling of the Vessel, including loading examples to establish the operating boundary of the Vessel with a minimum of the following conditions: lightship, full load operation, mid voyage operation, arrival (burned out) operation with a full load of passengers and worst-case vehicle loading.

The stability assessment report shall be provided to the Owner's Representative for review prior to USCG submittal. Vessel stability shall be evaluated using General HydroStatics (GHS) computer software. The Contractor shall submit the data files, including the 3D hydrostatic model, electronically to the Owner.

Prior to Vessel Acceptance, the Contractor shall submit the USCG-approved stability assessment report to the Owner.

851 Training

Introductory training shall be provided to the Owner's personnel. The training shall include:

- An overview of the operation of the Vessel, its equipment, and systems.
- Start-up procedures, operating procedures, and shutdown procedures.
- Emergency and personnel safety procedures.
- Basic maintenance and trouble-shooting procedures and good practice.

The training shall be provided at the Owner's facility. Training shall be conducted onboard upon delivery and prior to the Vessel Acceptance. The Contractor shall assume two separate sessions to accommodate the Owner's crew schedule. The Contractor shall assume each session to be 16 hours training. An outline and syllabus of the training shall be provided to the Owner for approval. Training dates and session attendees shall be coordinated with the Owner.

856 Instructions, Manuals, and Technical Data Sheets

856.1 General

A list of instructions, manuals, and technical data sheets applicable to Vessel systems and equipment being provided at Vessel Acceptance shall be submitted to the Owner for approval no later than ninety (90) calendar days before Vessel Acceptance. The Owner shall review this list for omissions and corrections and return the document to the Contractor for revision and final approval.

Manufacturer's installation, maintenance, troubleshooting, repair, and operating manuals for all machinery, equipment, and systems provided. In the case such documentation cannot be obtained from the manufacturer, the Contractor shall develop this documentation. The combination of these documents shall provide complete installation, maintenance, operating, troubleshooting, and repair instructions and parts lists in sufficient detail for the operating personnel to operate, maintain, and repair all equipment. Technical data sheets shall be provided describing the system or equipment, inclusive of system and equipment specifications. The parts lists shall be complete with the parts described so that required spare repair parts may be easily identified and ordered by the operating personnel.



The Contractor shall submit to the Owner's Representative for review and approval, a complete draft set of instructions, manuals, and data sheets as described from the approved list no later than 60 days prior to the scheduled delivery voyage departure. Receipt and approval of a final set of documents shall be a prerequisite for Vessel Acceptance.

Manuals intended for final delivery to the Owner shall not be used as working manuals for use in installing and operating the equipment. If the Contractor requires this information, then additional information must be ordered for that use with the attendant cost borne by the Contractor. Instruction manuals and books clearly showing misuse shall not be accepted.

Items that are merely advertisements shall not be included in the books.

Photocopies of the original manufacturer's manuals will not be accepted and do not count towards fulfillment of this requirement. Each manual shall be complete with factory- or manufacturer-original information.

Instruction books shall contain information at least equivalent to that available to mechanics at an authorized overhaul facility of the manufacturer of the machinery or equipment covered. Omission of information due to reasons such as "not normally furnished by the manufacturer" or "factory only" are not acceptable.

Two complete copies of the manuals shall be submitted. Final copies shall be bound in loose leaf 3-ring binders appropriately marked on the front cover as to the content. Additionally, the Contractor shall furnish legible and searchable PDF files of the finished manuals. All manuals shall be delivered prior to the training sessions described in Section 851 above. Receipt of final manuals is a precondition for Vessel Acceptance.

Additional to the above, an abbreviated step-by-step, start-up, operation and shutdown procedures manual for the propulsion system shall be submitted. The operation and procedures manual shall include photos, as necessary, of the actual components to help identify and locate them. The final operation and procedures manual shall be provided bound in loose leaf 3-ring binders, as a Microsoft Word® file, and in PDF format.

856.2 Consolidated Maintenance Schedule

The Contractor shall develop and provide a consolidated maintenance schedule for all machinery and systems on board the vessel. The maintenance schedule shall be provided as an Excel spreadsheet. The file shall include all equipment data and attributes required for import into the Owner's asset management system in a compatible format. The Owner's Representative will provide an electronic file template for the Contractor's use in developing the maintenance schedule. The completed schedule shall be reviewed and approved by the Owner's Representative.

The maintenance schedule shall include all maintenance requirements for systems and machinery for daily maintenance to five year maintenance intervals or first major maintenance interval. Routine maintenance and inspection tasks for all vessel electrical distribution system and piping systems (for example checks of busbar bolts, terminal block screws, and ground connections) shall be included in the schedule.

Each individual maintenance task shall be entered as a separate record (or row if in Excel format). Where possible, the maintenance task will reference the location of the manufacturer's manual where the instructions for completion of the maintenance task are described (see Instruction Books described elsewhere in this section of the Technical Specifications), a list of required parts and consumables, and estimated time and resources to complete the task. The maintenance schedules shall include comprehensive nameplate data for all installed machinery.

The consolidated maintenance schedule shall be provided to the Owner's Representative as a printed book and in electronic file format.

856.3 Software Programs

Where equipment or systems such as propulsion system, monitoring systems, HMIs, PLCs, door locks, etc., are programmed for use on this Vessel, the Owner shall be provided with the specific program as installed on the Vessel and such licensed programs to allow their viewing, modification, updating, and troubleshooting. The Owner shall be the licensed owner/registered user of all programs provided. The Owner shall be provided with all data link cables for connection between the equipment and a PC.



Group 900 – Tests, Trials, and Delivery

982 Inspections, Tests, and Trials

982.1 General

A thorough inspection and testing program shall be developed and conducted to demonstrate the installation, capability, operation, and performance of all ship systems, equipment, outfitting, etc. and to prove compliance with Contract Documents and Regulatory Body requirements.

Regulatory Bodies may require more stringent test methods than those outlined in this Section; in those instances, the Contractor is required to satisfy the regulatory test requirements as part of the Total Contract Price.

Testing shall occur in the following sequence:

1. Shop Tests
2. Installation Tests and Inspections
3. System/Operational Tests
4. Dock Trials
5. Builder's Trials
6. Sea Trials

Shop tests, installation tests, and dock trials shall be conducted in accordance with applicable sections of Reference (R14) and Reference (R15). Builder's trials and sea trials shall be conducted in accordance with applicable sections of Reference (R15). Alternate test methods from those detailed in this section will be accepted with the approval of the Owner as well as the USCG inspector, if applicable.

A complete commissioning, testing, and trials plan and schedule shall be developed. The scheduling of such testing and trials shall comport with the following general requirements:

- Not less than 120 calendar days prior to the commencement of any testing, a proposed test plan listing the tests to be performed and test procedures to be developed for use during testing shall be submitted for Owner approval.
- Not less than 90 calendar days prior to the commencement of any testing, draft test procedures shall be submitted to the Owner for acceptance. Test plans requiring USCG approval shall also be submitted to USCG for approval at this time.
- Not less than 60 days prior to testing, a complete commissioning, test, and trials plan and schedule shall be submitted to the Owner for review and acceptance.
- Not less than 30 days prior to dock and builder trials, a dock trials agenda shall be submitted to the Owner for acceptance.
- Not less than 30 days prior to sea trials, a sea trials agenda shall be submitted to the Owner for acceptance.

The schedule of tests and trials shall be updated monthly as part of the project schedule required in Section 040.1.

Tests and trials that are not completed successfully; do not meet all manufacturer, supplier, or Regulatory Body specifications and requirements; or do not pass the criteria delineated within Contract



Documents shall be corrected and repeated until such deficiencies are cleared without an increase in the Total Contract Price or an Owner-responsible extension to the project's duration. Test/trial reports shall include the date of each test/trial, testing deficiencies, and corrections made for each test/trial through satisfactory completion of each test/trial. All shop tests, installation tests, and trials shall be scheduled and completed to the satisfaction of the Owner and Regulatory Bodies.

Reports shall be provided for all tests and trials, with such reports containing the complete results of each test, including the retesting data described above. Reports shall be submitted to the Owner for approval within seven calendar days of test/trial completions; however, all test and trial reports shall be approved by the Owner prior to Vessel Acceptance. Reports shall be legible, easily readable scanned PDF files of each completed test and trial and shall, at a minimum, include the content set forth in Reference (R14) and Reference (R15) applicable to the test or trial.

The Contractor shall ensure that manufacturer's technical representatives attend commissioning, testing, and trials as applicable for major equipment and systems, including:

- Main Engines
- Propulsion Controls
- Reduction Gears
- Bow Thruster
- Generator Sets
- Elevator
- HVAC Equipment

982.2 Shop Tests

All equipment shall have passed factory shop tests before delivery to the Contractor's facility. The manufacturers or suppliers shall provide the Contractor with certificates demonstrating compliance with this requirement. Testing shall be in accordance with Reference (R14).

Shop tests shall include the following:

- Main engines shall shop tested in accordance with Regulatory Body requirements and industry testing standards as applicable.
- Generator set load testing shall be performed at the manufacturer's facility. Measure and record the insulation resistance of the armature windings "hot" immediately upon the conclusion of the factory load test.
- Electronics and navigation equipment shall be tested at the manufacturer's facility to ensure proper operation.
- Pumps shall be hydrostatically tested and inspected in accordance with Hydraulic Institute standards and as required by Regulatory Body requirements.
- Safety relief valves shall be tested and calibrated.
- All instruments and controls, including analog pressure/temperature gauges, continuous pressure/temperature signal transmitters, automatic thermal control devices, alarm, and indicator devices and pressure/temperature switches shall be tested, calibrated, and certificates regarding same submitted to Owner prior to systems/operational testing.
- Elevator equipment shall be tested in accordance with manufacturer and regulatory requirements.

982.3 Installation Tests, Systems/Operational Tests, and Inspections

982.3.1 Hull Tests

The purpose of hull tests is to demonstrate the watertightness and fairness of the structure and fittings, as well as of all items of outfit, where applicable.

Structure

The hull, skeg, watertight bulkheads, Main Deck, superstructure, and watertight closures shall be air box or air jet tested to prove tight all exterior surfaces. Structural ducts and main ventilation trunks shall be air tested to verify tightness of structure. All watertight tests shall be performed prior to painting.

Tanks

Tanks shall be hydrostatically tested independently, by filling each with freshwater to the height of the overflow. The tests shall be made after air pipes, sounding tubes, and all other connections have been fitted but prior to being painted out. Pneumatic testing in lieu of hydrostatic testing is acceptable when approved by ABS. Upon completion of testing, tanks shall be thoroughly cleaned and painted in accordance with Section 631.

Doors, Scuttles, Manholes, and Closures

Doors, scuttles, manholes, and similar closures which are gasketed shall be chalk tested to prove full gasket contact. Visually inspect other doors, scuttles, manholes, and closures to demonstrate proper workmanship and operation.

Windows and Fixed Lights

Windows, fixed lights, and the adjacent frames/plating shall be hose tested. Hose testing shall be accomplished by directing a stream of freshwater against the structure at a pressure of not less than 30 psig from a minimum 1/2 inch inside diameter nozzle held at a distance of five feet from the structure.

982.3.2 Machinery Tests

Machinery, equipment, piping, and systems shall be tested according to the applicable portions of the following procedures:

Heating, Ventilation, and Air Conditioning.

A HVAC manufacturer's representative, which is duly authorized, competent, and has been factory trained in system configuration and operation shall be retained for commissioning and start-up supervision of the heat pump systems. The HVAC manufacturer's representative shall provide proof of manufacturer certification indicating successful completion within no more than two years prior to system installation. This certification shall be included as part of the test plan submittal.

At a minimum, the following shall be completed as part of the HVAC system testing:

- Test the electrical circuits of all fans.
- Balance and test each system to ensure delivery of designed air quantities. Before testing and balancing, ensure the following conditions shall exist:
 - Systems shall be clean
 - Normally open closures and dampers shall be open



- Fans and motors shall run in the proper direction of rotation with correct speed
- Operate each system at full design capacity and measure air flow.
- Operate all ventilation system weather closures and fire dampers to demonstrate free operation without binding.
- Confirm the proper operation of each hold level ventilation control system.
- For the Engine Room, confirmation includes ensuring proper system response to input temperature settings.
- Ensure the ventilation shutdowns operate properly. Fans and dampers that are interlocked with water mist or fixed fire extinguishing systems shall use acceptable methods to simulate actuation of system release.
- Confirm the proper operation of accommodation heating, cooling, and ventilation control systems.
- Controls shall be tested to ensure proper function passing control limits. These tests may be performed by changing control limits in lieu of changing space conditions.

Piping Systems

At a minimum, the following shall be completed as part of the piping system testing:

- Pipes, valves, and fittings shall have material and test certificates submitted to the Owner prior to test commencement when such certificates are required by Regulatory Bodies.
- Inspect the system for completeness.
- Piping shall be hydrostatic tested in accordance with the applicable Regulatory Body requirements. Pneumatic testing in lieu of hydrostatic tests is only acceptable when approved by the Regulatory Bodies. Test pressures and test fluids for piping systems shall be as noted in Table 14. For applications not specified in Table 14, the test fluid used shall be compatible with the system being tested and Owner-approved. Pressure shall be maintained long enough to check thoroughly for leaks. Retesting shall be completed after any leaks have been repaired to prove system tight.
- All hydraulic, fuel oil, and lube oil hose assemblies shall be hydrostatically tested and provided with metal tags attached showing their test date and pressures.

Table 15: System Test Pressures

System	Test Pressure (PSIG)	Test Fluid
Firemain	150	Fresh water
Bilge	Operating Pressure	Fresh water
Vehicle deck sprinkling	Operating Pressure	Fresh water
Interior and exterior deck drains	Fill system to top fixture or vent	Fresh water
Vents and overflows	Fill system to top fixture or vent	Fresh water
Generator engine jacket water/after cooler	Operating Pressure	Fresh water
Shaft seal lubrication	Operating Pressure	Fresh water
Fuel oil service	45	Oil
Freshwater cooling	Operating Pressure	Fresh Water
Steering gear hydraulic	See Section 561 – Steering Gear	Oil
Black and gray water system	Fill system to first fixture or vent	Fresh water
Lube oil, waste oil	Operating Pressure	Oil



System	Test Pressure (PSIG)	Test Fluid
Potable water	Operating Pressure	Fresh water
Sanitary (flushing) water	Operating Pressure	Fresh water
Elevator hydraulic	2.5 times the working pressure or as required by Regulatory Bodies, whichever is greater	Oil

Note: Flushing and testing of piping systems shall use fresh water only. If the vessel is placed in seawater during construction or delivery, the sanitary system shall be isolated at the sea chest to prevent seawater from entering the system.

- After hydrostatic testing, each piping system shall be thoroughly cleaned and flushed of all foreign matter with the applicable system's medium or an Owner-approved substitute, with the following exceptions:
 - Weather Deck Drains - Flush with water or air to verify the pipes are clear of debris.
 - Systems conveying hydraulic oil shall be cleaned after spool fabrication by pickling in hot acid. Following the acid bath spools shall be washed, acid neutralized, washed again, dried, and internally coated with oil.
 - The potable water system and potable water tank shall be properly treated with a sufficient chlorine dosage to ensure decontamination and flushed, then tested to verify safe for drinking by a competent authority.
- All relief valves and pressure safety devices shall be demonstrated to operate at their set pressure or shall be provided with current test certification.
- All pressure gauges shall be provided with lab calibration test and certification stickers along with certifying documents provided to the Owner.
- Manually operate all valves from stop to stop to demonstrate free operation without binding.
- Remote valve operators (reach rods, hydraulically actuated quick closing devices, etc.) shall be tested to demonstrate proper operation.
- Identification tags shall be checked for accuracy.
- After completion of installation tests, the complete system shall be tested in operation to demonstrate proper movement and processing of fluids at the correct flow rates, temperatures, and pressures.
 - Equipment shall be run at a steady state for a period of one hour or one full duty cycle, whichever is less.
 - For systems with multiple alternative flow paths, flow through all parallel branches or anticipated system line-up configurations shall be tested. Where fitted, bypasses shall be tested.
 - Flow through balancing valves and orifices shall be measured by use of pressure sensing ports located upstream and downstream of the balancing device. Valve settings and orifices sizes shall be altered, as needed, to achieve the desired system flow rate.
 - All modes of equipment control (i.e., hand/off/auto, local/remote) shall be tested. Auto start/stop control shall be demonstrated to initiate action at the correct set points. Pressure and temperature settings of control instrumentation shall be adjusted as needed.



Diesel Generator Sets

At a minimum, the following shall be completed as part of diesel generator operational testing:

- Each generator set shall be checked prior to system/operational testing for proper alignment and clearances, as well as completion of all systems serving the generator set, including the fixed firefighting systems serving the space.
- Each generator shall be tested for insulation resistance.
- A complete propulsion switchboard installation load test shall be conducted consisting of an adjustable industrial resistor bank rated to match the generators. The loads used in these tests shall be measured as functions of the rated full load current. The load shall be built up in 25% increments of 30 minutes each to 100%, which shall be maintained for four hours.
- Pressure/temperature regulating valves or control features shall be tested to demonstrate that the correct set point is maintained. Set points shall be adjusted as needed to ensure proper system function. Mechanized control actuators for valves and dampers shall be tested for proper operation.

Auxiliary Machinery

At a minimum, the applicable portions of the following system/operational tests shall be completed on auxiliary machinery, including pumps and other equipment not otherwise tested during the system/operational testing phase:

- Each pump shall be tested with its respective system, both hydrostatically to determine tightness, and in operation. Pump shaft seals shall be confirmed as rated for the test pressure.
- Check each item for proper installation, alignment, and rotation prior to the operating test.
- Data shall be recorded such that equipment performance can be evaluated and compared with the requirements of the Specification. Generally, the required data shall include the pressure change across the machine, rpm, power consumption, and, where applicable, the performance of controls and functions.
- After data collection as listed above, and before test acceptance, auxiliary machinery, and related equipment subject to cyclic operations shall be operationally tested for five full, rapid cycles to the satisfaction of the Owner.

Independent Tanks

At a minimum, the following shall be completed as part of independent tank operational testing:

- Independent tanks vented to atmosphere shall be tested to 5 psig or 1.5 times the maximum head to which they may be subjected in service, whichever is greater.
- Independent tanks not vented to atmosphere shall be tested in accordance with Regulatory Body requirements.

Steering Gear

At a minimum, the following shall be completed as part of steering gear system testing:

- Test the hydraulic piping hydrostatically before the system has been cleaned thoroughly in accordance with the requirements of the equipment vendor and as described in Section 561.
- Verify operation of all controls, monitoring, and functional devices in all modes of operation.



982.3.3 Electrical Power, Control, and Monitoring Tests

General

At a minimum, the following shall be completed as part of testing each electrical system:

- Inspect the electrical installation for completeness, including tagging, labeling, and phase balancing of single-phase loads.
- Operate circuit breakers manually under load to demonstrate proper action.

Generators

At a minimum, the following shall be completed as part of generator operational testing:

- The generator load test shall be conducted as described in Section 982.3.2 above.

Stray Grounds

At a minimum, the following shall be completed as part of the stray ground operational testing:

- Stray ground current shall measure a maximum of 100mA at the neutral ground connection within the switchboard.
- The contractor shall trace and eliminate any stray ground connections until the measured ground current is less than 100mA.

Insulation Resistance

At a minimum, the following shall be completed as part of the insulation resistance operational testing:

- Measure and record the insulation resistance of each circuit between conductors with branch and main circuit breakers open for all AC power circuits, DC power circuits over 20 AT protection, and elsewhere as required by USCG.
- Where applicable, the main neutral conductor shall be temporarily ungrounded.
- Disconnect the equipment from each circuit to enable satisfactory resistance values to be obtained and to protect the equipment.
- This test does not apply to signal and control circuits.

Harmonic Content

At a minimum, the following shall be completed as part of the harmonic content operational testing:

- Under operational conditions, record and analyze the AC waveform at the ship service bus, and/or other locations identified by Regulatory Bodies.
- Verify that total harmonic distortion does not exceed regulatory limits.

Operational Tests

Each electrical and electronic system, equipment item, and device aboard the Vessel shall be methodically tested.

At a minimum, the following shall be completed as part of operational testing:

- Check all switches, control devices, etc., for proper function.
- Check automatic thermal control devices, alarm, and indicator devices.



- Perform a thermographic imaging inspection of the generators, all switchboards, distribution panels, bus transfer switches, generator rectifiers, transformers, and all power distribution circuit connections. The imaging shall be performed with the subject equipment under load or within seconds of shutdown for equipment which cannot reasonably be accessed while energized. Imaging shall be performed under all design power system configurations. Inspection results shall be submitted to the Owner as a narrated video file in 1080 full HD resolution MP4 format and as an interpreted printed color report.
- Check electronic equipment under the supervision of the equipment manufacturer's representative.
- The electronic systems shall not be considered complete until the FCC inspection and certification has been accomplished or addressed to the satisfaction of the Owner.
- Test all motor driven appliances under normal operating load conditions. Record operating volts and amps for each motor for each phase.
- Check all operating pushbuttons, selector switches, pilot lights, remote pushbuttons, pressure switches, and control devices to assure their proper operation; electronically interfaced systems shall have equivalent functions on electronic buttons or touch screens tested.
- Check overload-tripping devices for the proper size heater element and freedom of operation.
- System specific components and functions such as heat detectors for the fire detection system, magnetic fire door hold backs, and sound powered phone bells shall be tested.
- Sound levels of the public address system for both spoken announcements and automated broadcasts shall be tested and the system adjusted.
- Test all lighting systems for adequate illumination and functionality of switching.

Automation Testing

At a minimum, the following shall be completed as part of automation system testing:

- Check all switches, control devices, etc., for proper function.
- Check automatic thermal control devices, alarm, and indicator devices.
- Test all alarm circuits by simulating the troubles monitored and record performance observed.
- Monitoring and alarm circuits shall be demonstrated to not alarm under normal transient conditions when equipment is being started or shut down or during operator command changes such as rapid RPM reduction of the main propulsion system.
- Each sensor or switch shall be tested, and the expected result at the system level shall be verified.

982.3.4 Propulsion System Commissioning

The Contractor shall prepare a detailed propulsion system commissioning schedule and pre-commissioning checklist to ensure all items in this plan are addressed and all work is completed by the responsible party.

982.4 Dock and Builder's Trials

982.4.1 Dock Trials

The Owner may attend all dock and builder's trials. Five business day advance notice shall be provided to the Owner for all dock and builder's trials.



Following the completion of prior testing phases, dock trials shall be conducted in accordance with Reference (R15) and the Owner accepted dock trials agenda. At a minimum, the following shall be completed as part of dock trials:

- The propulsion system and auxiliary machinery shall be operated at the dock for a period of two hours to demonstrate readiness for sea.
- The propellers shall be run at maximum safe rpm.
- The steering, control, and navigating equipment shall be checked to verify their readiness for builder's trials.
- During dock trials, perform full range rudder movements from each steering station, for all steering modes. The same tests shall be performed during sea trials running both ahead and astern.
- All parts of the machinery shall operate without undue heat, noise, or vibration.
- Record all temperatures, pressures, electrical readings, etc. and include same in trial report(s).

982.4.2 Vital System Automation Documentation and Testing

The procedures for, and performance of, Design Verification Test Procedures (DVTP) and Periodic Safety Test Procedures (PSTP) shall be developed and completed as required by the Regulatory Bodies for all automated vital systems. The Contractor shall develop all required documentation, including but not limited to a Failure Modes and Effects Analysis (FMEA), a PSTP, and DVTP. Equipment suppliers shall be engaged as required to complete the FMEA, PSTP, and DVTP documentation for the Vessel. The equipment suppliers shall be responsible for providing all data and engineering assistance necessary for completion of these documents in cooperation with the Contractor.

Prior to developing the DVTP and PSTP, an outline procedure delineating the equipment and systems to be included shall be submitted to USCG and the Owner for approval.

The FMEA and PSTP shall comply with 46 CFR Parts 61.40 and 62.20 as applicable. The FMEA, PSTP and DVTP shall be submitted to Regulatory Bodies and the Owner for approval.

Upon receiving Regulatory Body and Owner approval the DVTP and PSTP shall be performed with the guidance of the on-site technical representatives for the propulsion engines, reduction gear, propulsion controls, and alarm/monitoring system. The Owner and USCG shall be present during testing for final review and acceptance.

982.4.3 Builder's Trials

Upon satisfactory completion of dock trials, the DVTP, and PSTP, builder's trials shall be conducted in accordance with Reference (R15) to satisfy the Contractor that the Vessel will satisfactorily perform all requirements, ensure operating and trial personnel are adequately trained, and trial equipment and instrumentation are properly set up and calibrated.

See Section 982.4.1 regarding Owner's attendance at builder's trials.

982.5 Sea Trials

The Owner may attend all sea trials. Ten business day advance notice shall be provided to the Owner for all sea trials. Provisions shall be made for up to 10 Owner's Representatives and crew to attend sea trials.



Upon satisfactory completion of the dock and builder's trials, the Vessel shall be taken on sea trials, which shall be conducted in accordance with Reference (R15) and the Owner accepted sea trials agenda. The sea trials shall be conducted in open water 50 feet deep or greater, under fair weather conditions and calm seas, and for a sufficient length of time to accomplish the following tests and trials.

Sea trials shall be conducted with the Vessel having clean underwater hull surfaces. Approximately 14 calendar days prior to scheduled sea trials, the condition of the underwater hull surfaces including appendages, thrusters, propellers, and sea chests shall be documented via video and submitted to the Owner for approval. If necessary, for the purpose of conducting proper trials, the underwater surfaces of the hull, including appendages, thrusters, propellers, and sea chests, shall be cleaned.

The trial draft shall be within two inches of the design load waterline with minimal list and trim. A vessel loading plan for sea trial shall be approved by the Owner prior to sea trial commencement.

At a minimum, the following shall be completed as part of sea trials:

- A. Full speed run for thirty minutes to record vessel speed. This test is to be conducted twice in opposite directions.
- B. Speed Runs at 13.5 knots, 12 knots, 10 knots, and at idle speed twice each in two direction for a minimum of 15 minutes each.
- C. Crash stops from full ahead to stop.
- D. Steering and maneuvering, including two turning circles each, port and starboard (four circles total). Steering shall be accomplished with rudders only.
- E. The vessel shall be steered hard over ahead and astern.
- F. Anchor winch testing: Anchoring trials shall be conducted to ensure correct functioning of the anchor winch.
- G. The thruster will be checked at sea to record the time to rotate the vessel through 90°, 180°, 270°, and 360° of rotation with the engine at low, medium, and high RPM ranges.
- H. All machinery equipment shall be tested during sea trials with the performance recorded in the test records to be turned over to the Owner.
- I. Each propulsion engine and generator shall receive a sea trial audit in accordance with manufacturer requirements. Engines shall be tested using manufacture provided testing equipment as required to provide an accurate PAR (Performance Analysis Report) test, providing a baseline for future testing of equipment by the Owner.

A ship's vibration and noise survey throughout the whole Vessel shall be made during the trials as described in section 073.

In addition to the items set forth in Section 900, the Contractor shall also provide suitable accommodations and meals for all personal aboard for the sea trials, as well as all paper, tissue, soap, and hotel service products required on the Vessel during sea trials.

The Vessel shall be in a state of material readiness to meet any possible emergency at sea, such as collision, fire, man overboard, personnel injury or grounding. The minimum readiness shall include:

- 1. Life rafts properly stowed and operable.
- 2. Life buoys and float lights in stowage brackets.
- 3. PFDs for all personnel, plus 5 percent spares shall be on board and properly distributed.



4. A first aid kit on board.
5. Firefighting systems shall have been satisfactorily demonstrated and all items properly stowed.
6. All navigation, navigating, and communications components and systems operational.

982.7 Test and Trial Instruments

All instruments for operational tests shall be Contractor-furnished to provide sufficient data to analyze the performance of systems, machinery, and equipment.

Ship's gauges and instruments may be used for tests of the systems they serve. Test instruments and means of connection shall be furnished as necessary for additional readings required to test machinery and systems.

Instruments shall be checked against standards at the beginning and end of the test program. If readings taken during a test or trial appear unreasonable, the Owner shall require the Contractor to check all the instruments, gauges, and thermometers used on the test in question.

For trials described above, each shaft shall be fitted with strain gage type torsion meters and with data processed to provide torque and horsepower output.

Following completion of sea trials, diagnostic analysis shall be performed on all lubricants. The tests shall include the standard diagnostics recommended by the engine manufacturer, including tests for water and fuel contamination. Tests shall include a sample of fresh oil of each type, prior to filling machinery, and an operating sample. The operating oil sample shall be drawn from a machine operating at normal temperatures. Samples shall not be drawn from stagnant points in the equipment system.

The tests shall also include a spectrographic analysis for trace metals, employing an emission spectrometer for the following elements:

- Aluminum
- Chromium
- Copper
- Iron
- Lead
- Magnesium
- Molybdenum
- Nickel
- Silicon
- Silver
- Tin

The following machinery shall be sampled:

- Generator engines
- Reduction Gears
- Steering gear hydraulic system
- Elevator hydraulic system



983 Delivery and Acceptance

983.1 Regulatory Certifications

The following documents, in original hard copy and electronic format, stamped by the appropriate agency, shall be submitted to the Owner prior to Delivery Voyage departure:

1. Builder's Certificate
2. Tonnage Certificate
3. USCG Certificate of Documentation (COD)
4. Temporary USCG Certificate of Inspection (COI) for Vessel delivery to Owner's facility
5. Stability Letter
6. Fire Control Plan
7. FCC Radio Station Authorization
8. FCC Vessel Bridge-to Bridge Radio Telephony Certificate
9. FCC Communications Act Safety Radio Telephony Certificate
10. Portable Fire Extinguisher Certificates
11. Fixed Fire Suppression System Certificates
12. Elevator Inspection Certificate (both manufacturer-supplied and state issued)

983.2 Vessel Documentation

Unless otherwise specified in other sections of this Specification, the following documents, in original hard copy and electronic format (both native and PDF), shall be submitted to the Owner prior to Delivery Voyage departure:

1. All Equipment Documentation, including the following (see Section 856):
 - a. Installation Instructions
 - b. Operating manuals
 - c. Technical data sheets
2. Functional design drawings and documents
3. As-built drawings (See Section 810.3)
4. Approved Trim and Stability Booklet
5. All USCG correspondence and document approval letters

983.3 Contract Performance Survey

A Contract Performance Survey, including a compartment sign off, shall be conducted following sea trials. This survey is to be conducted jointly by the Contractor and Owner to affirm that the construction of the Vessel is complete; the form, fit and function of installed materials and equipment are satisfactory, and the Vessel is clean and clear of rubbish, excess material, etc. A survey checklist shall be submitted to the Owner to include all Vessel compartments and operational areas, survey items, criteria, and related documentation.

The existence of any uncorrected deficiency affecting the safety, operation, performance, or immediate efficient use of the Vessel for its intended service will be sufficient cause for rejection and delay acceptance for closeout. Likewise, the existence of a significant number of uncorrected deficiencies will be a cause for rejection.



The Contractor shall immediately take appropriate action to correct and complete any work that is determined to be unsatisfactory or incomplete and shall be responsible for any delay in the project associated with correcting deficiencies. The cost of such delay and required retesting shall be at the Contractor's expense. Owner acceptance of the Contract Performance Survey shall be obtained by the Contractor prior to the Vessel leaving the Contractor's facility on its delivery voyage.

983.4 Delivery Voyage

Prior to the delivery voyage, the Contractor shall obtain a provisional COI with the only outstanding requirement being the required USCG testing with the Vessel's crew.

Upon completion of construction, operational tests, sea trials, Contract Performance Survey, and after all known defects have been corrected, all manuals and equipment documentation has been received, and the Vessel is ready and able to be put into passenger service, the Vessel shall be delivered safely afloat to the Owner's facility.

The delivery voyage plan shall be submitted for Owner's approval. The delivery voyage route shall be approved by the USCG per their "Port to Port" delivery route instructions. The delivery voyage shall not use supplemental fuel tanks or bladders. During transit, the Vessel shall remain a safe distance from land, in the case of an encounter with weather conditions in which the Vessel is not intended to operate.

983.6 Substantial Completion Survey

A Substantial Completion Survey shall be conducted at the Owner's facility. The Substantial Completion Survey will be conducted jointly by the Owner and Contractor. The Contractor shall provide appropriate survey check-off lists and related documentation for use by survey personnel for approval by the Owner no less than 48 hours prior to conducting the survey. Information that would be duplicative of that provided need not be provided.

The work will be determined to be substantially complete by the Owner following the Contract Performance Survey and the Owner-created Final Approved Punch List has been accepted by the Contractor. The Final Approved Punch List shall identify the remaining work items to be completed and the date of completion of those items.

At the time of the Substantial Completion Survey, it is expected that the Vessel will be in first class condition throughout. The Vessel shall be thoroughly cleared of all dunnage, staging, debris, spatters, and dirt and shall be washed down, painted out, and left clean. Special care shall be taken to see that all surfaces in bilges, tanks, voids, piping, wireways, machinery, floor plates, and gratings are clean and free from any foreign substances.

The existence of any uncorrected deficiency affecting the safety, operation, performance, or immediate efficient use of the Vessel for its intended service will be sufficient cause for rejection and delay acceptance. Likewise, the existence of a significant number of uncorrected deficiencies will be a cause for rejection.

The Contractor shall immediately take appropriate action to correct and complete any work that is determined to be unsatisfactory or incomplete and shall be responsible for any delay in the project associated with correcting deficiencies. The cost of such delay and required retesting shall be at the Contractor's expense.



983.7 Vessel Familiarization

As described in Section 851 of this Specification, the Contractor shall conduct training to familiarize the Vessel's crews with operation of the Vessel, and its systems. This training is to be provided prior to Vessel Acceptance.

983.8 Vessel Acceptance

The fuel tanks shall be sounded following Delivery. The soundings shall take place at the Owner's facility and be witnessed and approved by the Owner. Fuel oil remaining on the Vessel at Vessel Acceptance shall be purchased by the Owner at the demonstrated cost to the Contractor.

Prior to Vessel Acceptance, generator engines shall be drained of lubricating oil, have all new filters installed, and properly filled with clean lubricating oil. Prior to draining, lubricating oil, gear oil and hydraulic oil from each engine and hydraulic system shall be collected and sent to a certified laboratory for testing.

The on-board lubricating oil storage, gear oil storage and hydraulic fluid storage tanks shall be topped off to 95% capacity.

The urea tank shall be topped off to 95% capacity.

Prior to Vessel Acceptance, the potable water system and storage tank shall be properly treated and flushed, tested to verify safe for drinking, and refilled with the potable water tank being topped off to 95% capacity.

If the vessel was constructed, tested, or delivered in seawater, the vessel shall be thoroughly washed down to remove salt spray from the vessel's exterior and deck mounted equipment using fresh water after arrival in the Great Lakes. Similarly, the firemain system and stern tube seal and bearing cooling system shall be thoroughly flushed with high velocity fresh water.

Vessel Acceptance by Owner shall be granted upon completion and Substantial Completion Survey (see Section 983.6), and Vessel familiarization training (see Section 983.7). The date of Owner's acceptance of the Vessel shall be the Date of Substantial Completion.

The Contractor, with Owner assistance, shall be responsible for completing the requisite Vessel documentation requirements.

996 Launching and Drydocking

Launching of the Vessel shall be scheduled at a time proposed by the Contractor and agreed upon by all parties concerned. In accordance with the Contractor's standard launching policies and procedures to properly launch a vessel of this size and type, the Contractor shall provide all necessary facilities, personnel, bunting, etc.

The Contractor shall make provisions for a launching ceremony immediately prior to the launch. The Owner reserves the privilege to invite up to 30 guests.

Dry docking, as may be required in advance of sea trials, shall be completed as set forth in Section 982.5.

