



NEW LUMMI ISLAND FERRY

Outline Specification

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GENERAL NOTES

1. This specification outlines the basic requirements and features of the New Lummi Island Ferry. It is subject to change during further design development.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
-	Initial Issue	10/06/20	RKW
A	Added clarifying terminology; Revised requirements in Sections 200, 300, 400, 500, and 600.	12/11/20	RKW 34779

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GROUP 0 - GENERAL GUIDANCE AND ADMINISTRATION

011 Vessel Principal Characteristics and General Description

Length overall (molded)	184'-0"
Length on design load waterline	180'-6"
Breadth (molded) over guard	54'-0"
Breadth (molded) at DLWL	49'-0"
Depth (molded) amidships at side	13'-3"
Draft (molded) at DLWL	7'-6"
Lightship Weight, Estimated	485 LT
Service Life Margin	6% of lightship
Gross Tonnage, Estimated	Under 100 GT
Motor HP	2 x 715 HP
Generators	2 x 99 KW @ 0.8 pf, 60 HZ
Fuel Oil Capacity (95%)	6,500 Gallons
Automobile Capacity	34 Cars or 27 cars and 2 trucks Cars: 5,000 lb. and 8'-6" x 19'-6" each Trucks: 105,000 lb. and 10' x 65' each
Total Person Capacity (Passengers + Crew)	150 Passengers + 3 Crew
Trial Speed, Estimated	11.5 knots
Service Speed, Full Load @ 85% MCR	10 knots
Endurance	14 Days + 15% Reserve

The vessel will be a double-ended car and passenger ferry outfitted for year-round service between Lummi Island and Gooseberry Point. The hull shall be constructed of welded mild steel. There are six transverse watertight bulkheads, including the collision bulkheads at Frame 18, each end. The Engine Room is at midships.

Propulsion will be provided by a diesel mechanical / battery hybrid power plant. There will be two identical propulsion trains. Each propulsion train will consist of a controllable pitch propeller (CPP) system driven by a marine diesel engine and permanent magnet electric motor via a non-reversing reduction gear. The vessel may undergo future modification to operate as a fully electric vessel with all power provided from shore or other carbon neutral solutions. The vessel should be designed and constructed to minimize the complexity of such a modification to the extent practicable.

The vessel's ship service electrical power requirements shall be met by two identical diesel generators or power taken from the propulsion electrical system.

068 References

"Preliminary Plans" are architectural drawings and notes that illustrate contract requirements. At this level of design, the plans are not intended to be used for construction and are for design development only. They consist of the following:

Table 1: Preliminary Plans

(A)	17098.01-002-101-1	Profiles and Deck Arrangements
(B)	17098.01-002-101-9	Terminal Interface Plan
(C)	17098.01-002-120-0	Midship Section

070 Requirements for Design and Construction

071 Overhead and Clearances

Minimum headroom for crew and passenger spaces main deck and above shall be 7 feet 6 inches. Deviations from this requirement may be approved on a case-by-case basis. Headroom in spaces below the main deck shall be kept to the maximum height practical.

There will be four car lanes. The overhead clearance above the center two lanes shall be 16 feet and the clearance above the two outboard lanes shall be 14 feet 6 inches. This minimum clearance shall be entirely free of obstructions over the vehicle lanes.

072 Regulatory Requirements

The vessel will be designed and constructed in accordance with the applicable requirements of the United States Coast Guard (USCG) for subchapter T vessels. The vessel's structure shall be designed to American Bureau of Shipping (ABS) Rules for Building and Classing Marine Vessels, but the vessel will not be ABS classed or inspected by ABS. No other ABS requirements will be applied to the vessel design unless identified herein or incorporated by USCG regulation.

The ferry will be delivered to the Owner with a valid United States Coast Guard (USCG) Certificate of Documentation and Certificate of Inspection, for service on "Lakes, Bays, and Sounds" as a Subchapter T passenger/vehicle ferry. The Certificate of Inspection shall allow the ferry to operate with up to 150 passengers and 3 crew.

The vessel will be a part of the United States Coast Guard Underwater In Lieu of Dry-docking (UWILD) Survey Program. The Contractor will be responsible arranging USCG inspections, as well as any hull markings and modifications required to gain vessel acceptance into the program.

The applicable requirements of the various regulatory bodies and rules noted below, in force at the time of submission of bids, shall be complied with:

- a. 46 CFR Subchapter T, other applicable CFRs, and USCG Navigation and Vessel Inspection Circulars (NVIC)
- b. ABS Rules for Building and Classing Marine Vessels Under 90 Meters
- c. IEEE Standard No. 45: Recommended Practice for Electrical Installations on Shipboard
- d. U.S. Public Health Service: Handbook on Sanitation of Vessel Construction
- e. Federal Communications Commission
- f. U.S. Access Board: Proposed Passenger Vessel Accessibility Guidelines (PVAG)

073 Vibration and Noise

Particular attention shall be paid to design and construction of the vessel in order to minimize vibration and noise, both structural and airborne. The Contractor shall be responsible for locating and correcting unsatisfactory vibration conditions arising during tests or trials, or subsequently during the guarantee

period, which can be attributed to the design or construction of those elements accomplished by the Contractor. Allowable limits are prescribed in Table 2 and Table 3.

Table 2: Noise Limits

Space	Desired dB(A)
Interior Passenger Areas	65
Car Deck	65
Crew Lounge	60
Pilot House (doors & windows closed)	55
EOS	60

Table 3: Vibration Limits

Space	Vibration Velocity Limit (mm/s)
Interior Passenger Areas	4
Interior Crew Areas	4
Pilot House	4

During trials, the subcontractor shall conduct a survey of airborne noise and vibration survey in all of the spaces listed in Table 2 and Table 3 in order to verify the design requirements. This survey shall be performed during full power endurance runs. All HVAC equipment shall be running at full capacity during the trials.

074 Welding

Welding procedure, size of electrode, type of electrode, current values, and details of welding and reinforcing shall be in accordance with standard practice as approved by the American Welding Society and the ABS, except where such requirements are exceeded by the Specification or Drawings. Welding shall be carried out by welders who are certified by the American Bureau of Shipping.

080 Environmental Conditions

Machinery, structure, and outfit shall be designed to withstand the resultant forces from the following conditions of service environment:

- a. Permanent list of 10 degrees
- b. Permanent trim of 5 degrees
- c. Double amplitude roll of 22.5 degrees in a period of 4 seconds
- d. Double amplitude pitch of 7.5 degrees in a period of 5 seconds
- e. Worst case ambient air and seawater temperatures as tabulated in Table 4 below.

Table 4: General Environmental Conditions

Parameter	Units	Summer	Winter
Air Temperature (dry bulb)	(deg F)	100	0
Seawater Temp	(deg F)	56	28

GROUP 1 - HULL STRUCTURE**100 General**

The vessel will have an open car deck with superstructure as shown on the Preliminary Plans. The Pilot House will be elevated above the car deck on centerline. The main deck will have a passenger cabin on the starboard side, and crew space port.

The hull shall be welded steel designed in accordance with ABS Rules. The frame spacing in the hull shall be 24 inches on center. Hull fairness and tolerances shall be in accordance with fairness standards of IACS Standard No. 47 Shipbuilding and Repair Quality Standard.

Insert plates with chamfered edges and suitably radiused corners shall be used where reinforcement is required. Doublers shall only be used where expressly permitted in the structural design drawings or these specifications

110 Hull**110.1 Shell Plating and Keel**

Care shall be exercised to maintain a fair surface. Butts and seams shall be minimized.

110.2 Skegs

A centerline skeg of boxed plate construction shall be installed as shown on Preliminary Plans. The skeg shall be an integral part of the hull structure. Where inaccessible, the skeg shall be fitted with stainless steel fill and drain plugs. It shall be filled with an environmentally benign rust preventative, Esgard Bio-Float or similar, and drained.

120 Hull Structural Bulkheads

The hull will be compartmented by watertight bulkheads as shown in the Preliminary Plans

125 Tanks and Voids

Tanks will be installed as required to meet the endurance requirement in Section 011. Capacities listed herein will be verified during contract design.

130 Hull Decks

All decks will have straight line camber as shown on the Preliminary Plans.

The vehicle deck will be designed to accommodate all anticipated vehicle wheel loads.

Insert plates with radiused corners shall be installed under bitts, cleats, pad eyes, and similar fittings. The Contractor shall provide under deck strengthening as required. Deck beams shall be of the scantlings shown and shall be either slotted through non-tight bulkheads and girders or bracketed each side. In way of tight bulkheads, slotted beams shall be collared.

135 Bulwarks

The bulwarks will be fabricated from aluminum and stiffened with flat bar to minimize maintenance.

Freeing ports in the bulwarks will be sized to regulation. One-inch round bar shall be fitted around the edge of the openings, and parallel to the deck at approximately half of the opening height to ensure the opening cannot pass a 4 in diameter sphere, as required by USCG.

137 Vehicle Curbs

Curbs shall be provided on the main deck at the perimeter of the vehicle lanes generally as shown on the Preliminary Plans. Each section of pipe curb shall be sealed and fitted with fill and drain plugs. After construction, the curbs shall be filled with an environmentally benign rust preventative, Esgard Bio-Float or similar, and drained.

150 Superstructure

The superstructure will be constructed of aluminum. Connect the aluminum superstructure to the steel deck with explosive bonded bimetallic strip, Detacouple, or equal. All aluminum used shall be marine grade, type 5083, 5086, or 6061. Dissimilar metals shall be dielectrically isolated with dielectric tape or other means.

The Outboard sides of the deckhouse will have tumblehome to avoid piling damage.

170 Masts

One main mast shall be provided at midships on the Pilot House top. The navigation light mast shall be constructed of aluminum and fitted with yardarms. The mast shall be removable and fastened to the base with stainless steel fasteners. The Contractor shall fit pad eyes to allow removal of the mast with a crane.

The mast shall be fitted with stirrup ladder rungs for navigation light access. The stirrup ladder rungs shall be 6.25 in wide and welded to the mast structure. Mast fittings shall be suitable for use with a harness and twin-leg lanyard fall arrest protection.

180 Foundations

The shipyard shall provide foundations of suitable strength for all machinery and equipment. Foundations shall be of substantial construction and efficiently tied into the main hull structure to provide structural continuity. Foundations shall be double-continuous welded. Foundations shall allow for ready removal of equipment and allow accessibility for maintenance.

GROUP 2 - MAIN PROPULSION**200 General****200.1 Introduction**

This section describes requirements for the vessel's main propulsion system and supporting auxiliary systems. Refer to Sections 500 through 505 for general piping requirements.

The propulsion system will be a double-ended design, with a propeller and rudder at each end of the vessel. Each propeller will be driven by one of two identical independent propulsion trains, each consisting of a controllable pitch propeller (CPP) system driven by a marine diesel engine and permanent magnet electric motor via a non-reversing reduction gear.

Together with the propulsion electrical system (see Group 300) the vessel will operate as a diesel mechanical / battery hybrid. Propulsion power will be provided by either the marine diesel engines, the propulsion electric motors, or both in combination. A power management system will be provided to monitor and coordinate power distribution between all generators and consumers in all propulsion modes. (see Section 302). Total power to the propulsion train will not exceed that of the main engines in any propulsion mode.

The vessel may undergo future modification to operate as a fully electric vessel with all power provided from shore or other carbon neutral solutions. The vessel should be designed and constructed to minimize the complexity of such a modification to the extent practicable.

Engines, generators, steering, propulsion control, battery management system and all other major equipment components must have service representatives stationed locally in the Puget Sound Region. This is to ensure availability of timely and responsive equipment repairs/replacement/support. Any major propulsion or powering equipment proposed by the Contractor that does not have locally available factory trained service representation, must receive pre-approval from WCPW.

200.2 Vibration and Noise Control

The entire machinery installation shall be free of excessive vibration while operating. Machinery vibration levels shall not exceed manufacturers' requirements and shall generally comply with the machinery vibration limits described in SNAME T&R 2-29A and ABS Guidance Notes on Ship Vibration. See section 073 of this specification for additional details and guidance on noise control and vibration.

The main engines and generators shall be mounted on vibration isolating mounts. Air compressors and other equipment shall also be resiliently mounted as required to meet the noise requirements of Section 073 of this specification.

200.3 Machinery Arrangement

Machinery shall be arranged and installed to allow easy access for maintenance and disassembly. Provision shall be made for handling all major components of the main and auxiliary machinery, with unobstructed path for removal of machinery from the vessel. To facilitate machinery removal and re-installation, wiring and piping installed in the Engine Room overhead shall be routed clear of the machinery removal hatches.

The Contractor shall provide and install pad eyes throughout the Engine Room, voids, and steering gear compartment, for maintenance and removal of all major equipment. Arrangement of pad eyes shall provide means to move major equipment (including pumps and compressors) from its installed location, to directly beneath maintenance hatches or soft patches in the car deck. Propulsion engines/motors/reduction gears will all be outfitted with self draining soft patches above as well as

there will be no interferences under the soft patches for ease of machinery removal for maintenance or replacement. An I-beam and trolley system are to be installed where soft patches are not positioned directly over propulsion machinery.

Adequate air space shall be provided around machinery for cooling air circulation.

All rotating machinery in the Engine Room that presents a hazard to crew shall be fitted with removable bolt-on guards.

Where practicable, similar items of machinery and equipment shall be identical, and shall be supplied by a single local manufacturer for spare parts interchangeability.

233 Propulsion Engines

Two (2) marine diesel engines with a continuous rating of 700 to 750 bhp shall be installed. The engines shall be four-cycle turbocharged/after cooled engines meeting the EPA Tier 3 emissions standards (Cummins, Caterpillar, or equivalent approved in advance of purchase by WCPW). Provide all necessary documentation to demonstrate compliance with MARPOL Annex VI and EPA emissions requirements.

Propulsion engines shall be keel cooled, with electric start.

Both engines shall have Society of Automotive Engineers (SAE) standard rotation (counterclockwise when viewed from flywheel end).

241 Reduction Gears

Reduction gears shall be non-reversing with single reduction. The gears will be provided by the CPP manufacturer with built in servo controls for the CPP. Gears shall be remote mounted from the engine and aligned on their foundations using adjustable stainless-steel chocks, Rotachock or equal. [Details for cooling the reduction gears and CPP system will be developed as the design progresses.]

Each gear will have a clutched main input, and a clutched power take off/power take in (PTO/PTI). The main engine will drive the propulsion train via the main input. The propulsion electric motor will be connected to the PTO/PTI. A PTO/PTI configuration shall be used for the propulsion electric motor in order to minimize down time in the event of motor failure. Therefore, the PTO/PTI shall be capable of being fully declutched so that the vessel can operate in conventional diesel mechanical mode while a propulsion electric motor is repaired or replaced. Note that this precludes the use of an inline electric motor.

After alignment is completed, fitted bolts or dowels shall be installed to maintain alignment.

243 Shafting

Propulsion shafting between the reduction gear and CPP shall be certified ABS Grade 4 forgings, straightened, turned, and polished, supplied by the CPP manufacturer. Stern tube and tail shafts shall be clad with fiberglass, Phillyclad™ or equal between stainless steel journals.

High speed shafting between the main engines, electric propulsion motors, and reduction gear shall be Centa or equal, and incorporate suitable torsional and misalignment couplings.

243.1 Couplings

Line shaft segments shall be connected to each other with bolted split muff couplings provided by the CPP manufacturer. A similar flanged, split muff coupling shall be used to connect the propulsion shafting to the reduction gear.

243.2 Shaft Bearings

Split roller bearings, Craft Bearing or equal, shall be installed as needed to support each shaft line. The bearings shall be factory drilled and fitted with resistance temperature detectors (RTD) sensors for remote monitoring. The RTD sensors shall be integrated with the ships alarm and monitoring system. Each bearing shall be aligned on its foundation using adjustable stainless-steel chocks, Rotachock or equal. After alignment is completed, fitted bolts or dowels shall be installed to maintain alignment.

243.3 Bulkhead Seals

Where the propulsion shafting passes through a watertight bulkhead, an effective, USCG approved bulkhead seal shall be provided and installed. Bulkhead seal assemblies shall be split to allow replacement without removal of shafting.

243.4 Stern Tubes

The stern tube shall be constructed of mechanical tubing with substantial thickness, machined at each end to accept stern tube bearings. The stern tube assembly shall be drilled and tapped to accommodate 1/2 in Allen head alignment screws for fore and aft stern tube bearing alignment. Fill and vent holes, drilled, tapped, and plugged, shall be provided at each bearing location to allow casting of poured resin chocks.

243.5 Stern Tube Bearings

Water lubricated bearings shall be fitted in each stern tube. Stern tube bearings will be aligned using Chockfast Orange resin, or equal.

243.6 Stern Tube Seals

The stern tube seals shall be Simplex Simplan, or equal. The stern tube seals shall be drilled for installation of RTD temperature detectors. Stern tube seals will include an inflatable emergency secondary seal. All tools needed to inflate the secondary seal shall be provided with the vessel. Sealing elements shall be replaceable without drydocking the vessel or removing the propulsion shafts.

243.7 Shaft Ground Assemblies

Each shaft line shall be fitted with a shaft grounding assembly. The shaft ground assembly shall be installed an adequate distance away from the stern tube seal to allow working room for seal maintenance. A copper grounding strap shall be fastened to nearby primary structure.

245 Controllable Pitch Propeller System

Two complete controllable pitch propeller systems, Hundested MP 500 or equal will be installed. The CPP system will include a marine gear with integrated CPP servo controls, propulsion shafting, couplings, and all necessary ancillary components. The CP propeller shall utilize a push-rod control system with grease filled hub and no hydraulic components outside the Engine Room.

The CPP shall have a Ni-Al-Bronze hub, with four (4) Ni-Al-Bronze propeller blades, right-handed pitch, static balanced, ~ 60-inch diameter. The propellers shall be manufactured to minimum tolerances in accordance with ISO Standard 484/2, Class I.

The CPP manufacturer shall prepare propeller calculations to validate the propeller selection. The propeller calculation along with material certification, design characteristics of the propellers, dimensions and tolerances, blade thickness calculations, and a propeller drawing shall be submitted to the Owner for approval. Submitted calculations shall include operational assumptions and the curves for the selected propeller.

252 Propulsion Control System

The vessel shall be fit with two independent electronic propulsion control systems, one for each driveline. Each system shall be capable of controlling all necessary propulsion system parameters for its driveline and shall be compatible and integrated with the hybrid propulsion system controls.

The propulsion control systems shall have two stations, one (1) in each Pilot House console. An emergency cross-over shall be provided between the two stations.

Each Pilot House control station shall be provided with a dual lever control head, one lever for each end of the vessel. Control handles shall provide linear speed and direction control of the propulsion engines and motors, from full ahead rpm to neutral to full astern rpm.

An Human Machine Interface (HMI) digital display with built-in dimmer control shall be mounted in each the Pilot House console to display all propulsion related information.

Positive control transfer between stations shall be provided. The fore and aft drive trains shall be the transferred between stations concurrently. Control transfer between stations shall provide a signal to the navigation light panel, setting the navigation lights for matching direction of vessel travel.

Independent, guarded, manually actuated emergency shutdown switches shall be provided at each control station. One (1) emergency stop switch shall be provided for each propulsion train.

Propulsion controls shall be fault tolerant. In the event of an electrical propulsion system fault or failure, control of the main engines and CPP system shall be maintained. Local backup controls shall be provided in accordance with USCG regulation.

256 Machinery Cooling Systems

256.1 Freshwater Cooling

The propulsion and auxiliary engines shall be fitted with closed circuit, freshwater cooling systems. Propulsion engines, reduction gears, and ship service generator shall be cooled via keel coolers affixed to the hull below the waterline. The propulsion electrical system shall be cooled via a separate dedicated freshwater cooling system and keel coolers.

Keel coolers shall be Fernstrum Z-series or equal, with flanged piping connections external to the hull. Keel coolers shall be protected by welded steel guards in accordance with the manufacturer's instructions. Keel coolers shall be sized for operation in 58 °F seawater. Generator keel coolers shall be sized for full power at a minimum speed of 0 knots. The main engine coolers shall be sized for half power at a speed of 0 knots.

256.2 Sea Water Cooling System

A pressure and flow balanced sea water cooling system shall be installed to provide forced shaft seal and bearing lubrication to each stern tube. The system will be fabricated from 90/10 copper nickel piping. Two (2) sea water cooling pumps shall be installed, each sized and controlled to provide the required volume of sea water to both stern tubes. One pump will operate under normal operation, with the second on standby.

259 Exhaust Piping

Each diesel engine shall have an independent dry exhaust system led to weather. Exhaust system shall be fabricated from steel and stainless-steel pipe. A critical grade spark arresting silencer shall be fitted in each exhaust system, Harco Manufacturing or equal. Exhaust piping and silencers shall be supported using vibration and heat isolating mounts, Rubber Design or equal.

Type 321 Stainless steel flexible multi-ply bellows shall be provided where required to accommodate vibration and thermal expansion. All expansion joints are to be designed, manufactured, and installed in accordance with EJMA Guidelines.

Exhaust piping shall be insulated with 2" thick removable exhaust blankets fabricated from needled glass mat with a stainless-steel mesh interior liner and silicone impregnated glass cloth covers.

261 Fuel Oil System

Fuel oil piping shall be SCH 40 seamless steel pipe ASTM A53 or A106. Fuel piping shall utilize welded fittings except at end connections, valves, and takedown joints.

The fuel oil service system shall consist of combined remote and locally controlled isolation valves immediately adjacent to their respective tanks, and a common fuel main crossover leading between the two fuel tanks. The crossover line between tanks will be subdivided by an isolation valve located at approximately mid length to allow fuel tank equalization. The fuel system shall be arranged so that one propulsion engine and one ship's service generator (typically) operate from each fuel tank, respectively. However, piping arrangements and provisions are to be made that allow full operation of all propulsion and electrical generating equipment to simultaneously run off either fuel tank, independent of the other tank. Each engine served shall have a separate USCG approved turbine-type filter between the tank and the engine driven service pump, Racor or equal. USCG approved flexible hose assemblies shall be installed at engine fuel oil connections.

264 Lube Oil System

Provide and install a steel engine oil storage tank with 165-gallon capacity at 95%. The inside of the tank shall be left unpainted. It shall be vented into the Engine Room. A fill line shall be routed from the tank to the car deck. The tank shall be fitted with an access hatch, sight gauge, spigot, and a drain at bottom of tank.

Transfer of clean oil between the tanks and the machinery shall be achieved with a pneumatically operated diaphragm pump, Wilden or equal. The pump shall be mounted above the tank.

GROUP 3 - ELECTRICAL**300 General**

Primary propulsion and ship's service power shall be 480V, 3 phase, 60 Hz. Power for smaller ships service loads may be 208V, 3phase or 120V. Power for control and alarm systems shall be 120V or less.

The ship's electrical system shall be configured for hybrid propulsion. The electrical system shall consist of a propulsion switchboard, AC ship's service switchboard, a propulsion battery bank, two permanent magnet motors, propulsion variable frequency drives, ship service generators, shore power connection, and power management system.

The electrical system shall be arranged so that the ship's generators and ship's service loads can be isolated from the propulsion electrical system and operated independently.

When connected, the shore power connection shall provide power for battery charging and dock side ship's service loads. Shore power connections shall be located on the Lummi Island end. Shore power available is 480V, 3-phase, 60-100A.

301 Propulsion System Integrator

A single vendor shall be responsible for final design and integration of the hybrid propulsion system. The propulsion system integrator (PSI) shall be responsible for supply of the main propulsion switchboard, propulsion electric motors and variable frequency drives, power management system, propulsion controls, and ships alarm and monitoring system.

In addition, the (PSI) shall be responsible for coordinating and performing design integration, analyses, documentation, and orientation for all aspects of the propulsion system. This shall include, but not be limited to, physical and mechanical design, thermal management, overcurrent protection and coordination, and harmonics analysis and mitigation. The PSI is responsible for ensuring that all propulsion system components operate together as an integrated system, and that the complete system is functional and reliable.

The PSI shall be an experienced hybrid propulsion system integrator with a successful history of designing, constructing, and integrating hybrid propulsion systems on marine installations classed by ABS, DNV, or LR or on vessels inspected by the USCG. The Contractor shall provide the qualifications and experience of the PSI for approval by the Owner's Representative prior to the purchase of the electric propulsion system.

302 Power Management System

The power management system shall monitor and coordinate power distribution between power batteries, propulsion motors, diesel engines, generators, and ship's service loads to assure continuity of power under all operating conditions. The full capabilities of the power management system will be developed during contract design.

An HMI digital display with built-in dimmer control shall be mounted in each the Pilot House consoles for control of the power management system.

Hybrid modes shall be controlled from the pilot house consoles or automatically. The vessel shall have at least the following modes:

- EV (electric vessel) mode: All propulsion and ship service loads are supplied from batteries. Diesel main engines are clutched out and may be shut down, and operation is avoided until

minimum battery state of charge or peak propulsion loads require their start-up. Ship service generators are off.

- Hybrid Mode: The diesel main engines provide main propulsion power. When propulsion load is light enough to do so, excess engine power is used to charge the batteries and power ship service loads.
- Conventional propulsion mode: All ship service loads are supplied by one of two ship service generators, independent of the propulsion electrical system. The propulsion electrical system is inactive, and all propulsion power is supplied by the diesel main engines.

The power management system shall be fault tolerant. It shall be possible to operate the propulsion control system in conventional mode with the PMS and electrical propulsion components disconnected or non-operational, without utilizing the alternate/manual emergency propulsion controls.

304 Cableways and Wiring

Cableways will be arranged and routed for ease of maintenance over the life of the vessel avoiding access points like hard patches, soft patches, manholes, and tank covers. Cableways and bulkhead penetrations shall be sized to provide 25% capacity unused and available for future installations.

Cable shall be TriCab or equal, type BV for ordinary service, and DF for any VFD application.

310 Generator Sets

Two (2) ship service generators rated 99 kW, Northern Lights or equal, will be installed. Generator size will be finalized during contract design, and each generator will be sized to supply the vessel's ship service load without parallel operation, plus 20% margin for load growth over the life of the vessel.

Generator engines shall be four-cycle turbocharged/after cooled engines meeting the EPA Tier 3 emissions standards. Provide all necessary documentation to demonstrate compliance with MARPOL Annex VI and EPA emissions requirements.

Generator engines shall be keel cooled, with electric start.

313 Propulsion Batteries and Battery Management System

A propulsion battery system, nominally 237 kWh capacity, shall be installed on the vessel. The battery pack shall be finalized during contract design. Battery systems shall meet the portions of IEC 62619 referred to by DNV or ABS classification rules in addition to all applicable USCG requirements.

The vessel shall be capable of being fit with a propulsion battery system of approximately 900 kWh. This capacity is required should the vessel operate in fully EV mode.

The battery system shall be supplied with a battery management system (BMS). The BMS shall comply with either the ABS Guide for Use of Lithium Batteries in the Marine and Offshore Industries, or DNV Rules for Classification Part 6 Chapter 2 and all applicable USCG requirements.

314 Propulsion Electric Motors

The propulsion main motors shall be synchronous AC permanent magnet motors. There shall be two motors total, one per propeller. Each motor shall be rated 500kW minimum continuous at 2,100 rpm, liquid cooled, IP-54. The motors shall be designed to operate with VFDs under variable torque loads from 0 to 2,100 RPM in propulsion applications. They shall be capable of acting as a motor, providing power to the driveline, and as a generator supplying the AC distribution system.

Each propulsion main motor shall be controlled through a variable frequency drive (VFD) assembly. The VFD assemblies will be liquid cooled via a segregated freshwater cooling system.

320 Switchboards

The ships propulsion switchboard will be rated for 480VAC, 60 Hz, 3-phase power.

The ships service switchboard will be rated for 480VAC, 60 Hz, 3-phase power.

321 Power Distribution

Power distribution panels shall be provided as needed to supply installed circuits throughout the vessel. Panels shall generally be Square D or equal.

Transformers shall be provided where necessary. Rated transformer sizes will be calculated during the contract design phase. Transformers may be provided as either three phase transformers or banked single phase transformers.

The vessel shall be capable of back feeding power to the terminal in the even of a shore side power outage. Properly size power receptacles shall be provided on both ends of the vessel.

322 Receptacles

Provide electrical receptacles in the Pilot House, crew space, passenger space, Engine Room, and elsewhere as directed by Whatcom County. There shall be two double-gang electrical receptacles in the crew space.

Electrical wire reels 50 ft. in length shall be provided in the engine room and on the main deck.

330 Lighting

The vessel shall be adequately lit throughout with marine-type LED fixtures selected to suit the space and service. Task lighting shall be provided at each desk and workspace. In all instances, the quantity, size, type, and arrangement of lighting fixtures shall provide illumination in accordance with the ABS Guide for Crew Habitability on Ships, and IES std. RP-12, "Recommended Practice for Marine Lighting" as applicable. The vessel's lighting installation shall comply with USCG requirements and it shall be optimized through an independent engineering study, to maximize efficiency and minimize light pollution.

Each Pilot House console is to be provided with a common dimmer switch, to control back lighting of all instrument lights on the console.

332 Lighting Fixtures

Below deck lighting fixtures shall be surface-mounted, drip proof. Fixtures in the passenger and crew spaces shall be recessed and compatible with the ceiling system. The Pilot House shall have separately switched white and red lighting and gooseneck spotlights at each console.

332.1 Exit Lighting

Illuminated exit signs will be installed above doorways as required by regulation.

332.2 Floodlights

LED deck floodlights will be installed to illuminate the main deck and each end of the vessel. They shall be mounted under the Pilot House Deck and at each end of the superstructure at the upper deck level. Lights shall be switched from the Pilot House. Floodlights shall have stainless steel construction be and rated for extreme marine duty, Phoenix brand for fleet commonality.

332.3 Searchlights

Four (4) remotely operated searchlights shall be provided. One shall be mounted on the superstructure at each corner. Remote controls shall be installed in each Pilot House console.

340 DC Power Systems

The vessel shall have 12V and 24V DC systems as required to support control, navigation, and engine starting. Battery backup for navigation and control systems shall be provided as required by USCG regulation.

Independent starting circuits, with batteries and battery chargers, shall be provided for each diesel engine. Battery chargers shall be Newmar or equal.

GROUP 4 - COMMAND AND SURVEILLANCE / ELECTRONICS

421 Non-Electric Navigation Aids

The following items will be installed, subject to design development and owner approval:

Table 5: Non-Electric Navigation Aids

Qty	Item	Description
1	Barometer	Weems and Plath, Item No. 150700
1	Thermometer	Weems and Plath, Item No. 151200
1	Inclinometer	Moeller 456 or equal, ± 15 degrees of heel
1	Clock	Weems and Plath, Item No. 150500 One in Pilot House, second in crew lounge
2	Ships Whistle	Kahlenberg or equal
1	Fog Bell	12" Chrome or cast bronze

422 Navigation Lights

A navigation light panel and navigation light system meeting COLREGS all applicable USCG regulations will be installed. The lighting system shall be suitable for a double-ended ferry. Navigation lights shall be LED, DHR, Glamox/Aqua Signal, or equal.

426 Electrical Navigation Aids

The vessel will be fitted with a complete integrated GPS / Radar system with AIS, collision avoidance and chart overlays. All system components shall be compatible and from a single vendor to the maximum extent, Furuno NavNet or equal. The system shall include the following:

Table 6: Electrical Navigation Aids

Qty	Item	Description
4	Multi-Function Displays	Two flat screen displays at each pilot house station
1	Satellite Compass	
1	Depth Sounder	
1	Speed Log	
1	Ultrasonic Weather Station	

432 Interior Communication

432.1 Integrated Phone and Public Address System

The vessel shall have an integrated phone, public address, and general alarm system. The system shall provide fixed two-way communication between the Pilothouse, EOS, crew lounge, and elsewhere as required by regulation. The system shall meet all applicable requirements for internal communications and public address systems as set forth in 46 CFR 184.

433.2 ADA Visual System

An ADA visual messaging system which complies with the United States Access Board Accessibility Guidelines for Passenger Vessels shall be installed.

436 Alarm and Monitoring Systems

436.1 Machinery Alarm and Monitoring System

The vessel shall be fitted with an alarm and monitoring system meeting all applicable regulatory requirements. The system shall include all required machinery alarm and monitoring points, bilge level alarms for each space in the hold, and shall provide remote tank level indication and alarms as indicated in Table 7. A monitoring panel shall be installed in the EOS and each Pilot House console.

436.2 Fire Detection and Alarm System

USCG approved fire detection and alarm systems will be installed as required by regulation. The display shall be installed in the Pilot House.

436.3 Tank Level Indication

Sounding tubes, sight gauges, remote level indication, and level alarms shall be provided as indicated in Table 7. Sight gauges shall be magnetic flag sight gauges, GEMS Suresite or equal. Level alarms shall use independent alarm switches. Suitable 4-20mA electronic tank level transmitters shall be provided for continuous level indication.

Table 7: Tank Level Indication Schedule

Tank	Level Indication			Level Alarms	
	Sounding Tube	Sight Gauge	Remote	High	Low
FO Tank 1	✓	✓	✓	✓	✓
FO Tank 2	✓	✓	✓	✓	✓
Lube Oil Tank		✓			
Waste Oil Tank		✓			
Oily Water Tank		✓	✓	✓	
Potable Water Tank		✓	✓	✓	✓
Sewage Tank		✓	✓	✓	

436.4 Steering Gear Alarm System

Independent steering gear alarm systems shall be provided to alert operators to alarm conditions for each steering gear.

436.5 Rudder Angle Indicator System

Two independent rudder angle indicator systems shall be provided, one for each end of the vessel. The systems shall each consist of a rudder angle transmitter and three indicators. Rudder angle indicators for both rudders shall be provided at each Pilot House control station. Rudder angle indicators shall also be provided in the steering gear room for the rudder in that end.

436.8 Shaft Tachometers

Each propeller shaft shall have an independent tachometer system. The displays shall be placed at each Pilot House console adjacent to their corresponding throttle control handle.

439 CCTV System

A closed circuit-television (CCTV) system with 30 days of on-board storage shall be installed. Cameras shall be installed to provide coverage of all passenger spaces, the Engine Room, EOS, steering spaces, crew lounge, the entirety of the vehicle deck, and MOB stations. Monitoring capabilities of all cameras is to be provided in the Pilot House and EOS.

441 VHF Radios

There shall be four (4) VHF radios provided, two at each Pilot House station, located as directed by WCPW.

In addition to the four (4) fixed installation VHF radios in the Pilot House, Contractor shall provide six (6) handheld VHF radios with a central docking/charging station in the crew space. Two (2) additional solid mount radios that link to the six (6) handheld radios, is to be installed in the Pilot House – one (1) at each control station.

GROUP 5 - AUXILIARY MACHINERY**500 General**

The piping system design, equipment, materials, and workmanship shall fully comply with the applicable USCG regulations. Generally, all auxiliary machinery, equipment, and components installed on the vessel are to be supported by qualified, factory authorized or trained service personnel that are located locally to the Puget Sound Region. Any manufacturer or equipment proposed by the Contractor that does not meet these criteria is to be reviewed and approved in writing by WCPW, prior to equipment purchase.

503 Pumps

Pumps sized to meet the requirements of each system will be installed. Pumps shall be high commercial marine quality and made in America. Manufacturers of selected pumps shall have adequate parts and service availability in the Pacific Northwest.

505 Piping**505.1 General**

Piping systems shall be designed and installed in accordance with USCG requirements. Approved mechanical fitting systems, such as Viega SeaPress or ProPress, may be used where permitted by USCG regulation and in accordance with their approvals.

Wherever dissimilar metals occur in piping systems, provisions shall be made to minimize galvanic corrosion. Isolation kits shall be installed at all transitions between galvanically incompatible metals such as copper nickel and steel. Hangers supporting non-ferrous pipe shall be resiliently lined.

Pipe shall be routed to provide easy disassembly and maintenance of piping systems and equipment. Takedown joints will be provided at regular intervals to the satisfaction of the owner to allow removal of equipment, to allow removal of equipment normally blocked by the pipe, to access tanks, hatches, and soft patches normally blocked by the pipe, and to facilitate removal and maintenance of piping.

Piping shall be adequately supported by hangers suitable for the material and service, and in compliance with regulatory requirements. In general, pipe hangers shall meet the requirements of ASTM F708-92 (2018).

Valve remote operating gear will be provided for bilge suction lines penetrating the collision bulkheads, remote fuel tank closure, where required by USCG regulation, and elsewhere as needed to provide convenient access for operation. All vessel piping is to be labeled with directional flow indicators and color coated for fluid type.

Where not otherwise specified, rigid or flexible manual remote operating gear, Elliott Manufacturing's Uniflex-Stow or equal, shall be used.

506 Fills, Vents, and Sounds

Vents shall be provided for each tank and void. Vent terminals shall be ball check type with stainless steel mesh screens. Fuel, lubricating oil, oily water, and sewage tanks shall be fitted with flame screens. Potable water tank vents shall have insect screens.

A bunkering station shall be provided where shown on the Preliminary Plans. Tank fill and discharge lines will be installed as indicated in Table 8. The size and configuration of each fill and discharge connection will be selected to match the Owner's facilities.

Table 8: Fuel and Discharge Connections

Connection	Location
Fuel oil fill	Bunker Station
Lube oil fill	Bunkering Station
Potable water fill	Bunkering Station
Sewage pump off	Bunkering Station
Waste oil pump off	Bunkering Station
Oily water pump off	Bunkering Station

A spill containment with a capacity of at least 42 gallons will be provided at the bunkering station. The containment will be nominally 24 inches high, with a round steel bar around the top edge. A drain line with strainer and shut-off valve shall be led from the bottom of the containment to the oily water tank.

Sounding tubes and tank level indication will be provided as described in Section 436.3

508 Piping and Machinery Insulation

Piping insulation for hot and cold fluid piping systems will be installed as follows:

- Exhaust pipes and silencers (Refer to Section 259)
- Cold water piping such as sanitary, fresh water, or drains where dripping condensate could cause damage
- Hot water piping, valves, and pump casings
- HVAC ducting
- Heat pump refrigerant piping

512 Heating, Ventilation, and Air Conditioning Requirements

512.1 General

HVAC systems shall be sized in accordance with SNAME T&R 5-14, Recommended Practices for Ship Heating, Ventilation, and Air Conditioning Design Calculations. System design, equipment, materials, and workmanship shall fully comply with applicable USCG regulations.

HVAC systems shall not cause excess noise independently or in combination with machinery noise. As guidance, the noise limits for accommodation HVAC systems design should be 5dB less than the compartment noise limit specified in Section 073. Air intake and exhaust openings shall be located and sized to minimize noise. Acoustic treatments shall be installed as required to limit sound levels in passenger and crew areas. All HVAC equipment shall be mounted on vibration isolators.

Ductwork shall be fabricated from galvanized or stainless steel sheet metal in accordance with the standards of the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and USCG requirements. Machinery space ventilation ducts shall be fabricated from 16-gauge hot dipped galvanized or stainless steel sheet.

Inlet ducting from weather shall be fit with air lifts or mist eliminators. Exhaust ducting to weather shall be fit with louvers. Louvers and mist eliminator shall be stainless steel or aluminum and held in place with stainless steel fasteners. Weather terminals shall be fitted with drains to weather deck drains or to weather.

HVAC equipment shall be selected for efficient and quiet operation consistent with the nature of the spaces involved. Variations in sizes, type, rotation, and discharge shall be kept to a minimum.

512.2 Design Conditions

The heating, ventilation, and air conditioning equipment installed shall be capable of maintaining the indoor design conditions at the design outdoor air conditions noted in Table 9.

Table 9: HVAC Design Conditions

Design Condition	Winter	Summer
Outdoor Air	19°F	90°F
Air-Conditioned Spaces	68°F	72°F
Machinery Spaces	45°F	100 °F Max

Winter heating requirements assume spaces are empty of people. No credit shall be taken for heat from adjacent spaces, lighting, or equipment.

513 Machinery Space Ventilation

The Engine Room shall have a mechanical ventilation system capable of simultaneously and continuously providing combustion air as required by both main engines and (1) generator operating at 100% MCR loads, removing heat rejected to the space by the installed machinery, and maintaining the Engine Room temperatures stated in Table 5 above. Ventilation fans shall be driven by VFDs to maintain Engine Room pressure and temperature within acceptable limits.

Each Void and Steering Compartment shall have a forced supply / natural exhaust ventilation system sized to provide sufficient ventilation to maintain the spaces as safe for entry.

514 Passenger and Crew Space HVAC Systems

Passenger and crew spaces, including the passenger lounge, EOS, crew lounge and Pilot House will be heated and cooled with independent, split heat pump units sized as required for mixed, simultaneous heating and cooling. Electric unit heaters will be installed to meet extreme winter heat demands.

Window defrosting units with heating and fans will be provided for the forward and aft Pilot House windows.

520 Sea Chests

Sea chests shall be installed to service the sea water cooling system, fire main, and other systems as required. Each sea chest shall be vented to the main deck and equipped with an air blow down fitting.

521 Fire Main System

The vessel shall be fitted with a fire main system in accordance with the applicable rules and regulations. Fire main piping shall be 90/10 copper nickel. One electric driven self-priming fire pump will be provided. The fire pump shall be capable of remote start from the Pilot House and local start at the pump. Fire stations locations will be elected to suit USCG and owner requirements. Each station shall be equipped with a 50-foot length of 1-1/2" fire hose, valve, combination nozzle and storage rack.

526 Weather Deck Drains

Weather deck drains will be provided for the superstructure decks and Pilot House top. Drains will be located at each deck corner and as required to provide adequate drainage.

The drains shall be fitted with flush, stainless steel strainer plates. The weld around the deck drains shall be ground smooth to provide a smooth deck installation that will not present a tripping hazard or trap water. Deck drains shall provide a 4" nominal strainer size connected to a 2" stainless steel pipe routed close to structure to terminate at the deck below.

528 Sanitary System

The shipyard shall provide and install a sanitary drain system with separate black and gray water piping. Piping shall be USCG approved CPVC. The black and gray water will gravity drain to a 500 gallon fiberglass holding tank. One solids handling sewage discharge pump shall be provided. The pump will take suction from the tank and discharge to the deck connection.

There will be one non-ADA compliant crew head. Limited emergency use by passengers will be permitted with permission from the crew.

529 Drainage and Trim Systems

529.1 Bilge System

The vessel shall be provided with a bilge system meeting USCG Regulation. The bilge system shall be fabricated from SCH 80 steel pipe, ASTM A53 or A106. The bilge system will be served by two, self-priming bilge pumps. One pump shall be capable of crossover to the fire main system. The bilge pumps shall be capable of remote start from the Pilot House and local start at the pump. A visual pump running indicator shall be provided in the Pilot House.

529.2 Waste Oil System

Waste oil piping shall be SCH 40 seamless steel, ASTM A53 or A106. Piping shall utilize welded fittings except at end connections, valves, and takedown joints.

Provide and install a waste oil tank with 300-gallon capacity. The inside of the tank shall be left unpainted. The tank shall be fitted with an access hatch and sight gauge. The tank vent line shall be run to the main deck.

Each engine sump shall be connected to the waste oil system piping using a positive locking ball valve and a short section of hose. Waste oil system piping from each engine sump shall be led to a manifold located at the waste oil tank. An air operated diaphragm pump will be provided to transfer waste oil from each engine to the waste oil tank and from the waste oil tank to a deck discharge station.

533 Potable and Sanitary Water System

Potable water piping shall be K copper tubing with press-fit fittings, Viega Pro-press or equal. Potable water will be provided via a pump and pressure tank. Hot water shall be provided by one (1) 10-gallon electric hot water heater. The heater will be installed under a cabinet in the crew lounge. The potable water tank shall have a capacity of 500 gallons at 100%. Hose bibs will be provided in the Engine Room, car deck, upper deck port and starboard, and at the Pilot House. A 50 ft. hose reel shall be provided in the engine room and on the main deck.

551 Compressed Air System

A compressed air system will be installed on the vessel. The compressed air system will be sized to serve seas chest blow downs, the ship's whistles and other equipment requiring compressed air. Service air connections will be provided in the Engine Room, on the main deck, and elsewhere as required by Whatcom County. A 50 ft. hose reel shall be provided in the engine room and on the main deck.

555 Fixed Fire Extinguishing Systems

The Engine Room shall be fitted with USCG compliant fixed gas fire extinguishing system utilizing Novec 1230.

Each battery room shall be fitted with a fixed fire suppression system. The system shall be selected to suit the installed battery system, battery manufacturer's recommendations, and USCG requirements.

561 Steering System

The Contractor shall provide two complete robust steering systems, Jastram or equal, one for each end of the vessel. The design of the steering system and selection of equipment shall be to the satisfaction of the Owner. Additionally, Contractor shall provide a secondary back-up steering capability that will be able to operate the steering gear at either end – from the Pilot House - should there be a failure of the primary steering system for that end. The steering system shall comply with all applicable USCG requirements including all regulatory documentation, failure modes analysis, and testing and verification procedures.

561.1 Rudders

The contractor shall supply and install two complete rudder systems. The rudders shall be fixed foil or high lift, flap-type rudders, either Becker, Deflector, or equal.

562.2 Steering Gear

Each rudder shall be equipped with an independent, ram type hydraulic steering system. Each system shall have two hydraulic rams operating on each rudder via a tiller. The hydraulic power units for both steering gears shall be installed in the Engine Room.

Each steering system shall be capable of moving the rudder from 40 degrees port helm to 40 degrees starboard helm in less than 20 seconds and shall meet the requirements set forth in 46 CFR 58.25-10. The steering system shall be capable of moving, stopping, and holding the rudders at any angle within their operating range with vessel speed at 11.5 knots ahead or astern.

581 Anchor Handling and Storage Systems

The Vessel shall be equipped with a Danforth anchor with chain and braided synthetic line. The anchor will be stowed on a slide built into the bulwark where shown on the Preliminary Plans. The anchor line will be stored in a rope locker. The vessel will be fitted with an electric anchor windlass, Wintech or equal.

582 Mooring Systems

Vessel shall be equipped with cleats and chocks located on the main deck.

583 Lifesaving Appliances**583.1 Man Overboard Recovery System**

The Contractor shall provide and install a USCG approved man overboard recovery system, Jason's Cradle or equal, and a manual davit. The davit shall be fit with a heavy-duty stainless-steel hand winch. The davit shall be mounted inside the bulwark and arranged to swivel through 360 degrees. The davit swivel shall have self-lubricating composite bushings and thrust bearings.

A man overboard recovery platform shall be installed where shown on the Preliminary Plans

583.2 Life Jackets (PFDs) and Stowage

Life jackets will be provided in accordance with USCG requirements. Life jackets will be stowed under the seats in the passenger cabin and in other suitable lockers, as required by USCG Subchapter T requirements.

583.3 Life Rings

30-in diameter, USCG-approved life rings shall be provided, labeled, and stowed in stainless steel brackets. The number and installation of all life rings shall meet the requirements set forth by USCG Subchapter T requirements.

GROUP 6 - EQUIPMENT AND OUTFIT**600 General**

The vessel will be outfitted with all required nameplates, signs, labels, notices, and other similar markings as required by USCG and all other regulatory agencies, whether local, state, or federal, and as directed by Whatcom County.

Signage and information signs in passenger accessible areas shall comply with the Americans with Disabilities Act Passenger Vessels Accessibility Guidelines (PVAG) requirements.

Wording shall be clear and concise with a minimum number of abbreviations. Particular attention shall be given to the wording intended for use by the public to ensure that the message is clear and unambiguous.

All sign mounts will use stainless steel weld studs or threaded inserts with SS screws. No screw holes will be made in structure. Signs may also be attached by adhesives.

602.1 Ship's Name and Hailing Port

The ship's name and hailing port shall be located P/S on each end of the vessel.

Name boards of 1" (minimum) thick, varnished hardwood (mahogany or teak) shall be provided on the port and starboard side of the vessel on the upper deck level in a location designated by Whatcom County. Eight-inch tall letters shall be routed out and painted white.

602.2 Hull Marks

A hull marking and docking plan will be developed, suitable for submission to USCG for admittance into the UWILD program.

Draft marks shall be cut from 1/4" plate and installed fore and aft, port and starboard with continuous welding. Numerals shall be expanded so that the vertical projected height of each numeral is 6" and shall be painted in a contrasting color to the hull.

The vessel's official number shall be center punched and painted black on each Engine Room bulkhead. Letters and numbers shall be 3" high.

602.3 Door, Hatch, and Manhole Markings

Identifying labels shall be provided to show the compartment designation of each door accessible space in the vessel. Labels shall be affixed to the outside of each access door, approximately 5 ft 6 in off the deck, in the center.

Identifying labels or nameplates shall be provided on the outside of each watertight hatch, manhole cover, and scuttle in the vessel. They shall be a minimum of 1 in wide with 1/2 in lettering and shall identify the compartment designation of the space.

Labels shall be stainless steel with engraved letters, printed letters will not be accepted. Letters shall be black.

602.4 Service System labels and Nameplates

System and equipment labels or nameplates shall be provided throughout the vessel. Lettering shall not be less than 3/16 in high. Primary information shall be in letters of larger size than secondary information.

Valves shall be labeled stainless steel tags, stamped, or engraved with system service and unique identification number. Contractor is to provide bulkhead mounted, stainless steel, "as-built" piping schematics for the bilge, fire main, and fuel oil systems.

612 Interior and Exterior Railings

612.1 Interior Railings

Handrails will be provided where required for safety, particularly adjacent to the propeller shafts in the Engine Room, voids, grating edges, on both sides of incline ladders, and elsewhere as needed. All interior handrails shall be bolted and removable to allow for maintenance and overhaul activities.

612.2 Exterior Railings

The vessel shall be outfit with rails on the deckhouse exterior. Handrails shall be installed where shown on the Preliminary Plans. Exterior railings shall meet the applicable requirements for passenger or crew railings and will be built of 304 SS.

622 Floors Plates and Gratings

Floor plates shall be installed throughout the Engine Room and in the voids to provide access to shaft bearings and seals. Floor plates will be installed in sections no heavier than 55 pounds each and shall be removable to allow for maintenance.

Hinged floor plates with flush type grabs shall be provided for access to valves, strainers, couplings, and similar items located below the grating. Supports and coaming angles shall be bolted in way of machinery that will require periodic removal for overhaul.

623 Ladders

All ladders and stairways shall be constructed and installed in accordance with the applicable regulatory body requirements. Ladders will be constructed of 304 stainless steel.

Vertical ladders shall be provided for access to all voids, tanks, house tops, escapes, and elsewhere as required. Vertical ladders shall be removable for maintenance and secured with stainless steel fasteners. Ladder fabrication shall conform to the standard specification for fixed vertical ladders as described in ASTM F1166.

624 Doors, Hatches, and Manholes

Doors, hatches, and manholes will be provided as shown in the Preliminary plans and in full compliance with USCG requirements. Doorsill heights are to comply with all applicable regulations and kept at the minimum height allowed. Doorsill heights in passenger accessible spaces shall comply with PVAG requirements.

Doors shall be generally operable from both sides and shall be furnished complete with latches, locks, cipher locks, key hooks, holdbacks, bumpers, and closers as required for each door.

Hardware installed on doors that are passenger accessible shall comply with the ADAG.

624.3 Weathertight Doors

Weather tight doors shall be Pacific Coast Marine or equal with stainless steel doors and frames, hollow construction, insulated and gasketed.

Doors to weather from the passenger lounge shall comply with ADAG requirements and shall be fitted with panic bars and power assist operators.

Weathertight Dutch doors shall be installed on both sides of the Pilot House.

624.4 Joiner Doors

Joiner doors shall be installed in passenger and crew areas as indicated in the Preliminary Plans.

Joiner doors shall be flush, hollow core doors. All joiner doors and door frames shall have welded stainless steel construction.

624.6 Hatches and Manholes

Manholes shall be located as indicated on the preliminary drawings and elsewhere as necessary for access to all tanks, voids, and other spaces unless other types of openings are specified.

Flush, watertight hatches and manholes (with overboard drains) shall be provided and installed in the decks for egress from and access to spaces below deck.

To the extent possible hatches and manholes will be kept out of the vehicle lanes.

Hatches and manholes shall be Freeman Marine or equal.

Flush machinery removal hatches with overboard drains shall be installed over the Engine Room for maintenance and removal of the engines, reduction gears, and other equipment.

624.7 Locks Keys and Tags

Locks, keys, and tags will be provided.

624.8 Hinged or Sliding Bulwark Gate

The Contractor shall provide and install hinged or slide opening gates in the vessel bulwarks as required for emergency disembarkation and man overboard retrieval. Each gate shall be an integral portion of the bulwark, fitted with stainless steel hinges and latches, arranged to hinge inboard and stows fully open against the bulwark surface. The latch shall permit locking with a padlock. Nominal clear opening of each gate shall be 3 ft 6 in.

625 Windows and Fixed Lights

Windows shall be installed as shown on the Preliminary Plans. Exterior windows shall be clamp-in style.

Pilot House windows shall utilize single pane, clear, tempered glass. The windows in the sides of the Pilot House shall be opening, all others will be fixed. The forward and aft Pilot House windows will be fitted wipers, Wynn or equal.

Passenger and crew space windows shall have dual pane insulated glass with a low-E, low solar heat gain coating.

One A60 fire rated windows with steel frame shall be provided between the EOS and Engine Room.

631 Surface Preparation and Painting

All steel and exposed aluminum surfaces shall be painted, except as specifically excluded by these technical specifications. Paints, primers, and pigments shall be PPG except as noted in the paint schedule and approved by Whatcom County. The Contractor shall prepare and submit a painting schedule for the review and approval of the Owner's Representative.

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 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.

Paint shall be applied in strict accordance with the manufacturer's requirements. Ambient weather conditions and substrate temperature shall be within the manufacturer's recommendations during application and curing.

Piping systems shall be color coded per ISO 14726 or to the Owner's standard and shall also be stenciled indicated medium contained and flow direction.

633 Cathodic Protection

Sacrificial anodes will be installed on the underwater hull, rudder, keel cooler guards, and sea chests. The anodes shall be installed with the long axis fore and aft, bolted onto studs, equally divided port and starboard, in accordance with arrangements defined on the docking hull markings plan.

634 Deck Coverings

634.1 General

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.

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. Underlayment shall be applied only to the minimum thickness required.

A schedule of deck coverings will be developed during contract design of the vessel.

634.2 Switchboard and Fatigue Matting

Provide 36-inch-wide matting in front of the switchboards for their full length. Matting shall meet the requirements of ASTM D-178 and Mil Spec M-15562F. Provide and install anti fatigue mats on the deck in each Pilot House.

634.3 Safety Treads

Adhesive-backed, silicon carbide safety treads shall be installed at the head and foot of all interior and exterior inclined and vertical ladders, both sides of exterior doors, and in other locations where it is necessary to ensure safe footing. Treads shall not be applied to surfaces that have non-skid coatings applied, nor within tanks.

635 Insulation and Linings

635.1 General

Prepare and paint surfaces in accordance with Section 631 prior to applying insulation.

Insulation materials shall be USCG-approved for the intended use and free of asbestos containing materials.

20 GA perforated aluminum steel sheet metal sheathing will be installed over all bulkhead and deck head insulation in machinery spaces where subject to mechanical damage.

Where piping, electrical, and similar systems are concealed behind linings or ceiling panels, access panels will be provided where necessary for operation. Panels will be labeled appropriately.

635.2 Structural Fire Protection

Structural fire protection will be installed as required by USCG and as described herein. Structural fire insulation shall be a faced mineral wool product approved by the USCG under Series 164.007 Structural Insulation, installed in batts or blankets.

The Engine Room overhead and uptakes shall be entirely and uniformly lined with A60 structural fire protection. Each propulsion battery room overhead shall be entirely and uniformly lined with A60 structural fire protection. Share bulkheads between propulsion battery rooms and the Engine Room shall also be lined with A60 structural fire protection.

635.3 Thermal and Acoustic Insulation

Thermal insulation shall be installed where required in all crew and passenger spaces to reduce HVAC loads.

Acoustic insulation will be installed where required to meet the noise limits of Section 073.

635.4 Machinery and Piping Insulation

Refer to Sections 259 and 508 for machinery and piping insulation requirements.

635.5 Linings

Linings shall be installed throughout the crew and passenger spaces. Where possible, pipes, ducts and electrical cables will be installed behind linings. Where necessary, they may be boxed in with removable panels. The lining system shall be vinyl-covered aluminum as manufactured and installed by Marine Interior Systems or equal.

635.6 Ceilings

An aluminum 24 x 24-inch ceiling system, Dampa Marine or equal, shall be installed. Ceiling panels shall be integrated with HVAC, lighting, and speakers for a clean finished appearance.

640 Outfitting

640.1 General

Furniture and furnishings shall be provided as shown on the Preliminary Plans, and WCPW must approve the interior color pallet and interior design proposed on the Preliminary Plans before their release to Contractors and sub-contractors. They shall fit smartly with efficient use of space. All furniture shall be of commercial marine grade with non-combustible frames with finishes. All passenger spaces will comply with PVAG requirements. Built-in furniture shall meet the rat-proofing requirements of the Centers for Disease Control and Prevention. Furniture and fabric colors, themes, and patterns will be selected by Whatcom County.

640.2 Pilot House

The Pilot House will be furnished with the following items:

- Two (2) aluminum Pilot House consoles facing in the longitudinal direction
- Two (2) Pilot seats
- Built in lockable file cabinet

The Pilot House consoles will be designed and constructed for ergonomic operation and easy maintenance over the life of the vessel, with no sharp edges or corners that may cause damage to equipment or personnel. Adequate ventilation will be provided for installed electronics. The arrangement, material, finish, and color shall be submitted to Whatcom County for approval. The Contractor shall develop a full-scale plywood or foam core mockup of a console for Whatcom County's approval prior to final console fabrication. The mockup will be used to confirm the location of all propulsion controls and navigation aids installed in the console.

640.3 Crew Lounge

The crew lounge will be furnished with the following items:

- Galley counter and cupboards
- Galley sink
- Fixed table with seating for three
- Desk with lockable drawers
- Microwave
- Coffee Maker
- Refrigerator
- Bulletin board
- White board
- (6) Crew lockers to accommodate foul weather gear and boots (Location TBD and approved by WCPW)

640.4 Crew Restroom

The crew restroom will be furnished with the following items:

- Vitreous china toilet, deck mounted, with flush valve.
- Bulkhead mounted stainless steel countertop and lavatory
- Mirror
- Towel dispenser
- Towel bar
- Waste receptacle
- Soap dispenser
- Hand sanitizer dispenser
- Commercial grade toilet paper (roll) holder
- Coat hook

640.5 Passenger Lounge

The passenger lounge will have fixed seating for 80 passengers. Seats shall be constructed of aluminum, Berteaux or equal. There will also be a purser's station, with desk, chair, and a lockable 3 drawer file cabinet.

640.6 Engine Room Office

The engine room office will be furnished with the following items:

- Log desk with locking drawer
- One chair
- Lockable file cabinet
- Phone communications with Pilot House

- Shelving for manuals

640.7 Machinery Space Outfit

The Engine Room will be furnished with the following items:

- One workbench with vice will be installed in the Engine Room
- Six storage cabinets will be installed in the Engine Room.
- Toolbox, MAC Tools or equal, to be approved by the Owner
- Cleaning station with stainless steel utility sink

671 Emergency and Firefighting Equipment Outfit

671.1 General

Emergency equipment will be installed as required by regulation and as required by WCPW.

671.2 Portable and Semi-Portable Fire Extinguishers

USCG approved fire extinguishers will be provided and located in accordance with USCG requirements.

671.3 Fire Axes

Contractor shall provide and install fire axes with stainless steel mounting brackets as directed by the USCG and in accordance with 46CFR 76.60.

673 Bicycle Stowage

Two (2) bicycle racks with capacity for five (5) bicycles will be provided. One shall be installed at each end of the passenger lounge where indicated the Preliminary Plans.

GROUP 8 – INTEGRATION / ENGINEERING

[This section is to be completed during the next design phase.]

800 General**802 Contract Drawings****836 Models and Mockups****840 QA****842 Trials Agenda Preparation****843 Inclining Experiment****856 Technical Manuals and Other Data**

Prior to vessel delivery and final Owner acceptance trials, Contractor will provide 2 full sets and digital copies of the following:

- 1) Operational and Parts Manuals for all systems. At a minimum, these manuals are to include the following:
 - a) Trouble Shooting Guides
 - b) Instructions how to properly use a piece of equipment, how all systems integrate with each other, and how to operate them as a whole
 - c) 20-year Integrated Maintenance and Replacement program for all components on the vessel
 - d) Written Maintenance Procedures that lay out the job, list of needed parts, safety equipment, man hours, tools, etc.
 - e) "As-Built" Ships Drawings and Schematics for all systems

Manufactures of installed propulsion equipment are to provide initial crew training for all vital systems, with the ability to receive additional training as needed within the first year of operations.

System integrators are to provide initial training and be available for technical support as needed within the first year of operations.

897 Project Management

GROUP 9 – SHIP ASSEMBLY & SUPPORT SERVICES

[This section is to be completed during the next design phase.]

900 General

982 Trials