DI-001 Regional Class Research Vessel
Contractor's Ship Specifications

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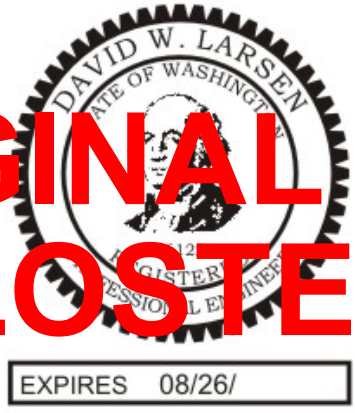

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SECTION 600 OUTFIT AND FURNISHINGS

The vessel shall comply with SOLAS requirements. The following SOLAS certificates shall be obtained and provided:

- Cargo Ship Safety Construction Certificate
- Cargo Ship Safety Equipment Certificate
- Cargo Ship Safety Radio Certificate

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

The vessel shall be designed, constructed, outfitted, and documented such that the Government may obtain a SOLAS Safety Management Certificate, Safety Management Plan, and Vessel Security Plan.

The IMO Ship Identification Number shall be provided and permanently marked as required by regulatory bodies.

The vessel, as delivered, shall comply with all applicable regulatory body requirements in effect at the time of the Phase II Contract Award, including those regulatory body requirements formally approved and scheduled for implementation prior to the scheduled delivery of the vessel(s).

In case of conflict between regulatory body requirements and these specifications, regulatory body requirements take precedence, unless the specifications exceed regulatory body requirements, in which case the specifications take precedence.

070.3 General Characteristics

Length Overall	155'-0"
Length on Design Waterline	152'-1"
Beam	38'-0"
Depth, Baseline to Main Deck	17'-6"
Total Installed Power, Continuous	1,275 kW
Sustained Speed, Calm Water	10 knots
Max Speed, Calm Water	11.8 knots
Range, Sustained Speed	5,400 nm
Endurance	21 days
Single Staterooms 01 Deck	6
Double Staterooms 01 Deck	3
ADA Stateroom (Double+1 Fold Down) Main Deck	1
Double Stateroom Hold Deck	7
Design Draft	12'-0"
Displacement at Design Draft	1,035 LT
Lightship Weight (estimated)	771 LT

Maximum Capacities:

Diesel Fuel, at 95%	35,800 gal.
Fresh Water, at 100%	8,400 gal.

Towing, at 6 knots.....10,000 lbs
Towing, at 4 knots.....20,000 lbs

Speed and Range: The vessel shall be capable of a maximum speed of at least 11 knots and a sustained speed of 10 to 11 knots in calm seas at full load. The vessel shall be capable of a 5,400 nautical mile range at sustained speed in calm water.

The vessel shall have an integrated diesel electric propulsion plant and be capable of continuous speed control to 1/2 rev/minute throughout the entire operating speed range.

Endurance shall be at least 21 days.

Some science operating profiles will require continuous underway survey or towing operations at speeds from 0 knots up to the normal cruising speed. The design shall consider the impacts on engine operation, maintenance and emissions, exhaust gas ingestion, watermaking capability, and other factors when on-station or moving at slow speeds for extended periods of time.

The vessel shall be capable of towing scientific packages with up to 10,000 pounds of towing load at 6 knots and 20,000 pounds of towing load at 4 knots. The vessel shall be capable of performing towing operations continuously during an entire cruise (up to 21 days.)

Berthing Accommodations: Permanent berthing accommodations and toilet/showers shall be provided as follows:

- 6 single staterooms with toilet/shower facilities shared between pairs of single staterooms.
- 11 double staterooms with toilet/shower facilities shared between pairs of double staterooms. One double stateroom shall be an accessible stateroom.

Public Toilets: A public toilet with sink shall be located adjacent to the laboratories and the working deck area. A public toilet with sink shall be provided in the immediate vicinity of the pilothouse.

Lounge: A lounge shall be provided.

Laboratories: A suite of modern, well-equipped laboratories including main lab, hydro/wet lab, and computer lab shall be provided. The main lab and hydro/wet lab shall be located adjacent to each other and the working deck. It is desirable that the computer lab also be located adjacent to the other labs. Labs shall be arranged and designed to minimize their use as passageways.

Aft Control Station: An enclosed aft control station shall be provided for operation of working deck equipment.

ET Shop: An ET shop shall be provided.

Deck Equipment: Cranes, winches, stern frame and other deck equipment shall be installed to permit conducting a variety of oceanographic operations at sea, such as coring, water sampling, equipment implantation, and array and trawl towing. All deck equipment, with the exception of the vessel's heavy crane, shall be demountable.

Working Deck Areas: A stern working area shall be provided with a minimum of 800 sq. ft. of clear space aft of the deck house. In addition, a 40 foot long by 8 foot wide area of clear deck shall be provided along the starboard rail contiguous with the aft working area. The total clear working deck area, including the starboard side shall be a minimum of 1,100 sq. ft.

Working deck areas shall be as clear as possible to accommodate large and heavy temporary equipment. Bulwarks shall be removable and all deck-mounted gear (winches, portable cranes, stern frames, etc.) shall be removable to a flush deck to provide flexible re-configuration.

A clear foredeck area shall be provided to accommodate small, specialized towers, booms and other sampling equipment.

Additional deck areas shall be provided with the means for flexible and effective installation of incubators, vans, workboats and temporary equipment.

All working decks shall be equipped with easily accessible power, fresh and seawater, air, data ports, and voice communication systems. Adequate flow of ambient temperature seawater for incubators shall be available on decks supporting the installation of incubators.

The arrangement shall provide for good visibility from the pilothouse of the working deck areas.

Van Locations: Space shall be provided to carry two UNOLS/ISO standard vans.

On-Deck Incubators and Optical Equipment/Instruments: Design of deck layout and science infrastructure shall include areas and services for deck incubation or optical experiments. These deck areas must receive as much unobstructed sunlight as possible, and continuous flow of near surface seawater at ambient temperatures (< 1°C above ambient) in order to maintain the proper temperature for the experiments. Overboard drains shall be provided to prevent water running across decks.

Provision shall be made for readily installing equipment that is brought onboard occasionally such as portable winches, SeaSoar, MOCNESS, Deep Tow, Magnetometers, specialized ADCPs, slack tether ROVs, AUVs, AAVs, and other systems. Power sources, deck space, mounting locations, data connections, hydraulic power, and compressed air shall be provided to support these installations.

070.4 Operating Environment

The vessel shall be capable of operating in any ocean or waterway worldwide and in the conditions of ice required for Ice Class D0. In addition to the seawater and sea air environment, the vessel and its subsystems shall be capable of functioning in the following environmental conditions:

WINTER:

Minimum Air Temperature:.....0°F
Minimum Seawater Temperature: .....28°F

SUMMER:

Maximum Air Temperature:
Dry Bulb: .....100°F
Wet Bulb: .....86°F
Maximum Seawater Temperature:.....90°F

070.5 Seakeeping and Maneuvering

Seakeeping is the ability to carry out the scientific work of the vessel while maintaining crew comfort and safety, and maintaining equipment operability. Vessel equipment and personnel are considered fully operable if the following criteria are met:

- Limit maximum vertical accelerations to less than 0.15 g (rms).
- Limit maximum lateral accelerations to less than 0.05 g (rms) at lab deck level.
- Limit maximum roll to less than 3 degrees (rms).
- Limit maximum pitch to less than 2 degrees (rms).

It is an important design criterion to maximize the sea-kindliness of this vessel and its ability to work in Sea States 4 and higher. Specifically, it is desirable that the vessel be able to:

- Maintain 9 knots and remain operable at best heading 80% of the time in Sea State 4 (1.25 – 2.5 m wave heights).
- Maintain 7 knots and remain operable at best heading 50% of the time in Sea State 5 (2.5 – 4 m wave heights).
- Maintain 4 knots and remain operable at best heading 25% of the time in Sea State 6 (4 – 6 m wave heights).
- Survive while hove to at Sea State 7 or greater (>6 m wave heights).

Seakeeping calculations shall be performed using mean wave height and most probable modal period characteristic data for each sea state for the Open Ocean North Atlantic as defined in Table D-1 of STANAG 4194.

071 ACCESS (AND MAINTENANCE)

All spaces shall be provided with practical and convenient access.

Vertical ladders shall not be considered a means of escape from public spaces. Dead end passageways shall be avoided where possible. Vestibules shall be provided on the weather ends of passageways.

Passageways shall have a clear width (distance between protuberances) of at least 36 inches. Passageways where lines form shall be a minimum clear width of 54 inches. Access routes shall be kept clear of items that restrict passage or are a source of danger to personnel. Access shall be provided between the vans and the vessel superstructure without requiring personnel to be exposed to the weather. Van access shall be at van ends.

Clear headroom in living, walking and working areas shall be a minimum of 6 feet 9 inches. Headroom in doors, arches, and van accesses shall be at least 6 feet 6 inches.

Door openings shall provide a clear width of 32 inches minimum. Clear openings of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees.

073 NOISE, VIBRATION AND RESILIENT MOUNTINGS

073.1 General

These specifications and drawings call for certain measures to reduce noise levels and vibrations in the vessel, as well as underwater radiated noise, under operating conditions. These include the use of sound isolation mounts under vibrating, reciprocating and rotating machinery, and the details to be used in heating and ventilation ductwork. In addition, acoustical treatment is called for in the engine room and other areas of the vessel.

The Contractor shall contract with an expert consultant in shipboard noise control experienced in working with shipyards and vessel requirements. The noise consultant shall be an active participant in detail design and production engineering, inspection and production QA, and review of change orders that impact noise and vibration.

073.2 Resilient Mounts

Resilient mounts are identified in Section 500 for selected rotating machinery and equipment. All mounts shall be inherently captive in design, or retainers shall be added. All mounts shall be loaded to within 20% of the rated load. The resilient mounts shall not be painted. All mounts under a unit shall be equally loaded relative to each other. Mount materials shall be compatible with their environment, including heat levels. Snubbers shall be used on compressors. Sound shorts shall be eliminated.

Where it is required to place two or more components together connected by shafting, the components shall be installed on a common sub-base with the resilient mountings installed between the sub-base and the vessel structure.

A six degree-of-freedom (6DOF) analysis should be performed by the noise consultant for each type of resiliently mounted equipment to ensure that no natural frequencies coincide with the equipment's operation frequencies.

073.3 Airborne Noise

Airborne noise in vessel compartments and at deck stations shall be in accordance with the limits given in Table 000-1. Spaces not listed shall have a noise category similar to a listed space or be in accordance with NVIC No. 12-82 and IMO Resolution A.468(XII), "Code On Noise Levels On Board Ships." Staterooms shall be sound insulated for privacy.

Airborne noise requirements are applicable during normal vessel operation at sustained speed, during overside handling and towing operations, and during station keeping, while propulsion, bow thruster, auxiliary and scientific-related equipment and machinery are operating simultaneously at rated conditions. Noise level requirements are applicable with all ventilation systems in proper balance and operating at design flow rates. Attention shall also be given to frequently used items, such as galley equipment, that may constitute annoyance problems (such as range hoods), while not actually exceeding specification levels.

Hearing protection signs shall be affixed in compartments and deck areas where airborne noise levels exceed 84 dBA.

Table 000-1. Airborne Noise Acceptance Levels for Vessel Spaces

Space	dBA
Pilothouse	65
Library/Conference Room	65
Staterooms	60
Offices	65
Laboratories	65
Aft Control Station	65
ET Shop	65
Lounge	65
Mess	65
Passageways	65
Hospital	65
Working Decks (Note 1)	70
Galley/Scullery	75
Storerooms	85
HVAC Machinery Spaces	90
Machinery Control Station	75
Engine Room	115
Propulsion Motor Room	110
Bow Thruster Room	110

Note 1: For airborne noise purposes, working decks includes the entire aft working deck, starboard side working deck area, forward working deck area, rescue boat operating station, anchor handling station, winch and deck crane local and remote control locations, and pilothouse top.

073.4 Vibration

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

Hull girders, masts, above-deck structures and the superstructure vibration shall be below the Zone III threshold as defined in SNAME T&R Bulletin No. 2-29A. Longitudinal, torsional and lateral propulsion shafting vibration shall meet the acceptability constraints of Sections 3, 4 and 5 of SNAME Code C-5. During the detail design phase, the noise control consultant will assess if any design changes will impact vibration of the hull girder, masts, cranes, other above deck structures, and the superstructure, However, it is not intended to perform any structural modeling, such as finite element analysis (FEA).

073.5 Sonar Self-Noise

The sonar self-noise levels at the sonar transducer locations shall not exceed the values given in Table 000-2 for all scientific sonar operating conditions.

The Contractor shall incorporate the following design features:

- Bow and underwater hull shape shall minimize bubble generation and prevent bubble sweepdown that degrades sonar performance.
- Sonar transducers shall be arranged and installed to minimize interference associated with local flow noise.
- Sonar transducers shall be arranged and installed in a location that is free from the effects of bubble sweepdown.
- All hull appendages including sonar transducers and their housings shall be cavitation free, aligned with water flow and fair within 0.125 inch over any 24-inch span. Surfaces within 10 feet of sonar transducer locations shall have a smooth finish when painted.
- Within 20 feet of sonar receive transducers, all piping and ducting, except in fuel tanks, shall be supported by resilient hangers per Section 500.1, and air flow in ducting shall not exceed 33 feet/second.
- Piping penetrations for fluid systems shall be located as far as practicable from sonar receive transducers. Structural paths to the sonar from bulkhead penetrations shall be damped to prevent compromising sonar transducer performance.

- The bow thruster inlet and discharge openings shall be designed to be cavitation free and to minimize turbulence at the sonar transducer locations. The design shall prevent the accumulation of air in the thruster.
- Hull openings for main sea suctions and discharges shall be located at least 30 feet from all sonar transducers. Except for the bow thruster openings and uncontaminated seawater system intakes, all sea connectors and underwater shell openings shall be aft of the sonar transducers.
- Orifices and other flow control devices for fluid systems shall be located a minimum of 20 feet from sonar receive transducers.

Table 000-2. Sonar Self-Noise Level Requirements

Equipment	Frequency of Band	Spectrum Noise Level Limit
Multibeam Survey System (MBSS)	70-100 kHz 30kHz	32dB 40dB
Single Beam Survey Systems (SBSS)	12kHz 38kHz 120kHz 200kHz	49dB 40dB 32dB 32dB
Sub-Bottom Profiler (SBP)	2kHz - 8kHz 15kHz - 20kHz	60dB 47dB
Acoustic Doppler Current Profiler (ADCP)	38kHz 75kHz 150kHz	40dB 32dB 32dB
Acoustic Navigation and Tracking System (ANTS)	20kHz – 30kHz	47dB

073.6 Radiated Noise

The RCRV has been designed to meet the underwater noise limit specified in the ICES CRR 209 Report at speeds up through 6 knots. Radiated noise levels are intended to be achieved with all main propulsion and auxiliary machinery operating, all normally operating hotel services such as refrigeration and HVAC systems, and all navigational and scientific instrumentation systems in operation. The following items are not intended to be operated: Bow Thruster, Fire Pump and the Ballast/Fire Pump. The ICES underwater noise limit shall be in the one-third octabe band format from 10 Hertz to 50,000 Hertz, as shown in Figure 000-1.

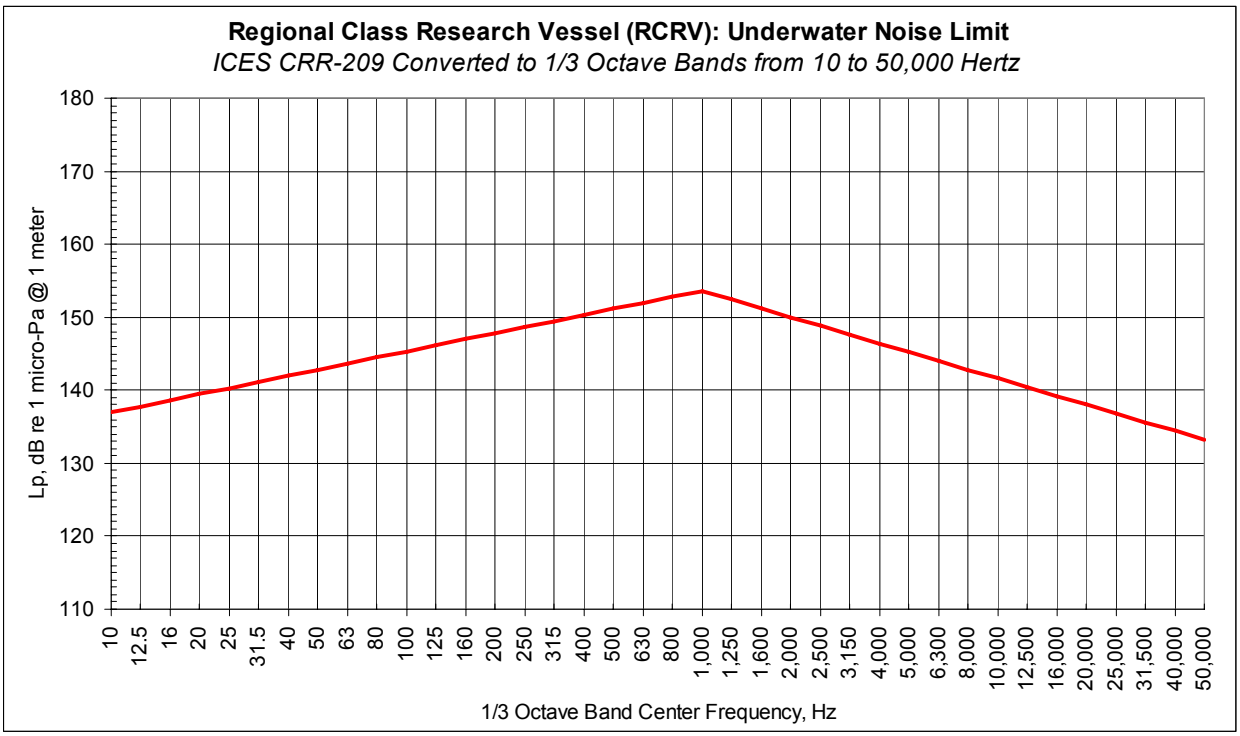

Figure 000-1. ICES Radiated Noise Level Criteria

077 HUMAN ENGINEERING AND SYSTEM SAFETY

077.1 Human Engineering

ASTM F1166 specific criteria shall be applied in the design of compartments, spaces, work and control stations, and facilities. Factors affecting both normal and emergency conditions, such as illumination and environmental conditions, shall be as outlined in ASTM F1337. Vessel systems shall be designed to be operated by a range of the specific user population, bounded between the 5th-percentile female to the 95th-percentile male. Operation, maintenance and repair activities and procedures shall minimize manual handling, and shall be designed to be conducted by this range of individual physical capability.

077.2 System Safety

Safety guards shall be installed over unprotected moving parts of rotating or oscillating equipment and machinery that could pose a hazard to personnel. Guards shall also be installed over moving wire ropes that could be contacted by personnel. Guards for scientific winches shall not enclose the drums or cable lead.

- Unbalanced load capability - alternator suitable for unbalanced load up to 20% of rated current between line-neutral, without exceeding the rated current
- Parallel operation - alternators suitable for parallel operation
- Sustained short circuit current 3 x rated current for 3 sec. at 3-pole terminal short-circuit
- Overload 10% for 1 hr every 12 hrs or 50% for 30 sec
- Harmonic content ≥2 % measured between phases at no load up to nominal load and power factor from 0.1 to 1.0 under symmetrical and linear loads. The winding optimized in order to keep the 5th and 7th harmonics measured between the phases as low as possible
- The alternators thermally suitable for a high content of non-linear loads, 12-/18-/24-pulse converters, up to 90% of rated load
- Electronic voltage regulator with voltage drop device for parallel operation, to be mounted in the main switchboard or delivered in a separate cabinet with auxiliaries and terminals for control and signal cables

Each alternator enclosure shall be protected by a dedicated CO_2 fire extinguishing system, as discussed in Section 555.

235 ELECTRIC PROPULSION SYSTEM

235.1 Main Propulsion Motors

Two main propulsion motors shall be provided and installed. Each motor shall be a Siemens permanent magnet HT-direct motor 1FW4451-1HA rated for 454 BHP (339kW) at 200 RPM.

Each motor shall be isolated from the vessel's structure by resilient (vibration isolator) mounts in accordance with Section 500.

Each propulsion motor shall be asynchronous, alternating current, squirrel cage, 3-phase, double winding, freshwater cooled, outfitted for marine propulsion service. The motors shall be opposite turning but otherwise identical. The motors shall operate from a pulse width modulating (PWM) frequency converter supply.

Each motor shall be totally enclosed and watertight to the bottom of the shaft. The enclosures shall be splash-proof above the bottom of the shaft.

Each propulsion motor enclosure shall be protected by a dedicated CO_2 fire extinguishing system, as discussed in Section 555.

235.2 Propulsion Power Converters

A total of two (2) PWM type, 12-pulse, solid state propulsion frequency converters ("drives"), Siemens 690V Bluedrive Single Propulsion Converter 12-Pulse, shall be

provided and installed to supply power to the two (2) propulsion motors. Computer control of the drive shall provide the necessary motor current to maintain the set speed reference. It shall also limit generator load if propulsion demand exceeds the capacity of the generators operating at the time. Regenerated power associated with quick reversals and emergency stopping shall be absorbed by a braking resistor bank.

AC line and line-to-ground filters shall be provided as required to protect against line voltage spikes, switching surges and electrical noise.

Each propulsion converter unit shall be supplied as a totally enclosed, free standing, water-cooled unit. Instruments and control switches shall be mounted on front hinged doors. Removable panels shall be secured by knurled machine screws made captive in the panel. All doors and panels shall have gaskets to provide EMI shielding.

All bus work shall be copper. The bus bar connections shall be silver plated. All bus work shall be insulated, covered or physically separated to eliminate arc over and arc propagation. All bus work shall be braced for not less than 1.5 times the maximum fault current.

235.3 Propulsion Converter Transformers

Two (2) propulsion converter transformers shall be provided and installed, one for each propulsion sub-system. The transformers shall be three-winding (copper, one primary and two secondary), cast resin, indoor dry-type suitable for location in a ventilated (non-air conditioned) space, remote from the installed motors, with maximum ambient temperature of 115°F. The transformers shall be suitable for use in the marine environment and compatible with the specified drive frequency converter.

235.4 Bow Thruster Motor

The bow thruster motor shall be asynchronous, alternating current, squirrel cage, 3-phase, double winding, Siemens model 1LA8 405-6PM8, 690V, 466kW, 1200 RPM. The motor shall operate from a pulse width modulating (PWM) frequency converter supply. The motor shall be self ventilated air cooled.

The motor insulation shall meet the requirements for Class F materials as a minimum. The windings shall be vacuum pressure impregnated with epoxy resin. The finished windings shall present a smooth surface and shall not permit moisture, oil or dirt to penetrate or damage the insulation.

235.5 Bow Thruster Motor Drive

A PWM type, 12-pulse, solid state propulsion type frequency converter, Siemens 690V Sinamics G150 model 6SL3710-1GH35-8CA, shall be provided and installed to supply power to the bow thruster motor. Computer control of the drive shall provide the necessary motor current to maintain the set speed reference. It shall also limit generator load if demand exceeds the capacity of the generators operating at the time. Regenerated

power associated with quick reversals and emergency stopping shall be absorbed by a braking resistor bank if required to maintain power quality.

AC line and line-to-ground filters shall be provided as required to protect against line voltage spikes, switching surges and electrical noise.

The power converter unit shall be supplied as a totally enclosed, free standing, air-cooled unit. Instruments and control switches shall be mounted on front hinged doors. Removable panels shall be secured by knurled machine screws made captive in the panel. All doors and panels shall have gaskets to provide EMI shielding.

All bus work shall be copper. The bus bar connections shall be silverplated. All bus work shall be insulated, covered or physically separated to eliminate arc over and arc propagation. All bus work shall be braced for not less than 1.5 times the maximum fault current.

235.6 Bow Thruster Converter Transformer

A bow thruster converter transformer shall be provided and installed in the bow thruster room. The transformer shall be three-winding (copper, one primary and two secondary), cast resin, indoor dry-type suitable for location in a ventilated (non-air conditioned) space with maximum ambient temperature of 110°F. The transformers shall be suitable for use in the marine environment and compatible with the specified drive frequency converter.

243 PROPULSION SHAFTING

The main propulsion shafting system shall include shafting, thrust bearing, bearings, stern tube seals, torsional couplings and components to connect the propellers to the main propulsion motors. The propeller shafting shall be designed to allow easy removal through the stern tube without cutting either the shaft or vessel structure.

Propulsion shafting shall be Aquamet 22 with an outside diameter of 6".

A LO-REZ torsional coupling model 27-1/2 RT shall be provided and installed between the propulsion motor and the line shaft.

Shaft locking devices with means to mechanically align and engage shall be provided. Shaft brakes shall be provided if required for DPS requirements.

244 PROPULSION SHAFT BEARINGS AND SEALS

244.1 Thrust Bearings

One hydrodynamic, self-aligning thrust bearing shall be provided on each shaft. The thrust bearing shall have an integral concentric journal bearing. The thrust bearing configuration shall permit ready inspection, maintenance, repair and adjustment of axial clearances.

244.2 Stern Tube & Strut Bearings

The stern tube bearings shall be Kobelco Eagle Friction Free Bearings of the full molded type, 12" long, one per shaft located at the aft end of the stern tube. Each bearing shall be aligned to the manufacturer's specified tolerance using set screws threaded into the stern tube. Once aligned, the void between the bearing and the shaft tube shall be filled with waterproof chockfast type material. Lubrication shall be seawater injected into the stern tube at a port in the forward shaft seal.

Strut bearings shall be Kobelco Eagle Friction Free Bearings, one per shaft, 18" long, one per shaft located in the strut. Each bearing shall be aligned to the manufacturer's specified tolerance using set screws threaded into the strut. Once aligned the void between the bearing and the strut shall be filled with waterproof chockfast type material. Lubrication shall be naturally flowing seawater.

244.3 Stern Tube Seals

Forward stern tube seals shall be Koblelco Eagle type EVK, size 150, water lubricated stern tube seal. An additional spare seal shall be installed onto the shaft to allow quick replacement of a worn seal element.

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

A well shall be provided under the stern tube seal to collect leakage. Means shall be provided to pump out the well.

245 PROPULSORS

245.1 Propellers

The propellers shall be 6'-6" diameter, 5 bladed, wake adapted stainless steel props in accordance with the design documented in the Deliverable DI-010-02 Speed and Power Report.

Propellers shall be manufactured in accordance with ISO Standard 484/1, "Ship-building - Ship Screw Propellers Manufacturing Tolerances - Part 2: Propellers of Diameter between 0.80 and 2.50 Meters inclusive." Blade tolerances shall be in accordance with ISO 484/1 Class S.

Each completed propeller's static balance shall comply with ISO 484/1. The weight of each blade shall not deviate by more than 2% from the mean weight of all blades of the same hand. In addition, the static imbalance of the assembled propeller shall not exceed the value determined by:

$$U = \frac{4000W}{N^2}$$

where: U = maximum residual static unbalance in ounce-inches
W = weight of rotating part in pounds
N = maximum operating RPM of unit

A contoured fairwater cap shall be provided on the forward end of the propeller hub.

A detailed 3-D wake survey in the propeller plane was performed, and the results can be found in the Deliverable DI-010-05, Model Test Report.

256 ENGINE COOLING WATER SYSTEMS

Each diesel generator shall be provided with an independent, closed loop freshwater cooling system.

The jacket water cooling pump shall be provided by the manufacturer, engine-mounted and driven by the engine's power-take-off system.

Each diesel engine shall be provided by the manufacturer with an electric jacket water heater to maintain engine block temperature when the engine is not operating.

Each SSDG freshwater cooling system shall be a manufacturer supplied plate heat exchanger capable of recovering waste engine heat for potable watermaking by the evaporators. The waste heat recovery system shall be fully automatic to the extent that operator assistance is not required to maintain proper diesel generator operating temperatures and recover waste heat when a generator is placed in or taken out of service. See Section 534 for details on the waste heat recovery system.

When the waste heat recovery system is not absorbing all the available heat from the freshwater cooling system(s), the heat shall be rejected to the SSDG seawater cooling system(s) described in Section 524.

259 DIESEL ENGINE EXHAUST

Each engine shall have a separate exhaust piping system between the engine exhaust manifold outlet and the top of the stack. Each engine combustion exhaust system, including the silencer, shall not impose a back pressure on the engine exceeding the recommendations of the respective engine manufacturer.

Table 400-1. Cable Group Separation Distances (inches)

Cable Group Classification		A	B	C	D	E	F	G	H	I	J	K	L
A	**Propulsion Cables**	--	24	24	24	24	24	24	24	24	24	24	24
B	**Power & Lighting**	24	--	2	4	2	4	12	18	18	18	18	24
C	**Power & Lighting Control**	24	2	--	4	2	4	12	18	18	18	18	24
D	**Receiving Antenna Cables**	24	4	4	--	2	2	12	18	18	18	18	24
E	**TV/VHF Antenna Distribution**	24	2	2	2	--	2	12	18	18	18	18	24
F	**Telephone/ Audio Distribution**	24	4	4	2	2	--	12	18	18	18	18	24
G	**Sonar Transducer**	24	12	12	12	12	12	--	18	18	18	18	24
H	**HF Transmitter/ Coupler Cables**	24	18	18	18	18	18	18	--	18	18	18	24
I	**HF Coupler/ Antenna Waveguide Cables**	24	18	18	18	18	18	18	18	--	18	18	24
J	**VHF/UHF Transmitter Cables**	24	18	18	18	18	18	18	18	18	--	18	24
K	**Radar Transceiver Coaxial or Waveguide**	24	18	18	18	18	18	18	18	18	18	--	24
L	**Digital Data Bus**	24	24	24	24	24	24	24	24	24	24	24	--

420 DYNAMIC POSITIONING SYSTEM (DPS) AND AUTOPILOT

420.1 General

A Dynamic Positioning System (DPS), Kongsberg K-Pos DP-11, shall be provided and installed. The DPS primary control shall be located in the pilothouse main console with a secondary control located in the Computer Lab. Two portable operator terminals with joystick (with full head capability), remote controller and video display shall be provided. Terminals shall be designed to be viewable indirect bright sunlight. Remote plug-in jacks for the portable terminal shall be provided at each bridge wing, aft control station, A-frame, and the vicinity of the starboard overside handling device.

Station selection shall be located at the primary control in the pilothouse. Visual indications and voice channels shall be provided at primary and secondary stations to effect and accept control transfer. Full positive control shall be maintained during control transfer. Video display of the DPS screen shall be provided to the scientific information system.

The DPS shall have an industry standard commercial operating system. The DPS application shall be programmed in a standard language code. DPS control shall include color video display monitors and keyboards in the pilothouse main console and the computer lab.

The DPS shall have a menu selectable operating and setup capability and help library. Setup features shall include the following modes: manual, autopilot, and automatic control

with local or remote input of commands. The DPS system shall have operator selectable heading, speed and tracking.

The DPS waypoints and tracks shall be capable of being uploaded from or downloaded to electronic storage media or the vessel's data network. The DPS shall be capable of generating a survey track of multiple waypoints, including parallel courses, cross line courses, lead-in and lead-out line, and turns from 0 degrees to 359 degrees. Color video displays shall have dimming controls and shall indicate the following:

- Operating mode selected: DP mode of Station Keeping or Position Move, Course Tracking or Autopilot
- Source of command information: manual, automatic local or automatic remote
- Commanded position and actual vessel position
- Commanded heading and actual vessel heading
- Commanded track course, actual vessel track course made and present cross track error
- Next track course selected
- Distance along track, distance to end of track waypoint time to end of track waypoint, distance to last waypoint, time to last point
- Commanded speed and actual speed
- Commanded rudder angle and actual rudder angle
- Crab angle
- Tracking status - tracking or not tracking
- Individual generator status and loading
- Individual thruster and propeller shaft status and loading
- Navigation input source
- DP system shall have an ECDIS capability to display electronic navigation charts (ENC) in IHO S-57 format and project vessel's position on chart - DP system shall display on a grid with axes calibrated in latitude and longitude, and scale of the display shall be user-selectable
- Identification of ECDIS chart installed and ready for display
- Radar targets
- Identification of radar screen selected for display
- Vessel heading
- Waypoint locations
- Any additional information needed for operation of the DPS in the various modes

The DPS shall be capable of operating in any mode with any combination of propellers, rudders and bow thruster disabled. Operators shall be capable of enabling or disabling each thruster and propeller. Any thruster disabled by DPS shall revert to manual control automatically.

The DPS shall be designed to operate continuously for long periods (up to full endurance) of on-station or trackline following work. The DPS shall accept inputs from navigation equipment and at least 3 position sensor inputs from devices such as GPS/DGPS, Wide Area Augmentation System/Differential Global Positioning System (WAAS/DGPS), other satellite GPS/DGPS inputs, multiple (2 to 3) course heading inputs, position/motion sensing input from a device such as a AHRS, wind inputs, and Doppler speed log inputs. The DPS shall be capable of interfacing with a vesselwide data network and be capable of providing non-proprietary, industry-standard format output to future installed science systems.

420.2 Manual Mode

In the manual mode, control shall be by dual axis joystick at the pilothouse main console, bridge wings and aft control station. The joystick shall include automatic heading capability. Joystick control response shall be squared curve (instead of linear).

420.3 Autopilot Mode

The autopilot shall automatically control the vessel's heading within 2 degrees of the selected course at speeds from 0.5 knots to maximum. Propeller RPM shall be manually controlled at the propeller controls or the DPS joystick. This system shall allow course corrections without coming out of this mode.

420.4 Automatic Control Mode

The DP system design and operation shall minimize noise, vibration, and adverse effects on the operation of acoustic systems as much as possible. The DPS shall automatically control propeller RPM, steering control surface angle, and bow thruster azimuth angle and RPM to meet the following requirements:

- Position Keeping - The vessel shall be able to maintain station and work in Sea States up through 4 (1.25 – 2.5 m wave heights) at best heading.
- Dynamic Positioning - using the best possible and multiple navigation inputs, shall be possible, in both relative and absolute references in the following conditions:
  - 25-knot wind
  - Sea State 4
  - 2-knot "beam" current

The maximum excursion allowed shall be ±5 meters (equal to navigation accuracy) from a fixed location for operations through Sea State 4 at best heading. The DPS shall sound an alarm when the vessel falls off position beyond a user-selectable limit. The DPS shall

include the ability to move from present position to a selected location in any direction while maintaining vessel's heading and rotate 360 degrees while maintaining position.

The vessel shall follow a trackline over the bottom within ±5 meters at best heading at any speed between 2 and 12 knots with a constant towing load of up to 10,000 pounds in seas up to Sea State 4, a wind speed of 25 knots, and a 2-knot current (perpendicular to trackline). The DPS shall provide the capability of accepting multiple waypoints. Permissible lateral tracking error shall be ±5 meters.

Permissible maximum variation of the vessel's heading from the track course (crab angle) shall be user-selectable up to a limit of ±45 degrees. When following a multiple waypoint trackline that requires a change in course after a waypoint, the DPS shall be capable of changing the vessel's heading automatically to follow the new course of the next track segment. The DPS shall alert the operator that a turn is impending by sounding a local alarm at a fixed time interval before the turn. The DPS shall require an acknowledgment of the alarm before the turn is executed. The DPS shall alert the operator by sounding a local alarm when the vessel falls off track.

Straight track segments shall be maintained without large and/or frequent heading changes. In the automatic mode, the DPS shall be capable of using position information from the vessel's Global Positioning System (GPS) and at least three additional input ports.

421 NON-ELECTRICAL AND NON-ELECTRONIC NAVIGATION AIDS

The following navigations aids shall be provided:

- One compass, magnetic plate installed in the forward pilothouse console.
- Two gyro repeater pelorus stands, located port and starboard in the pilothouse, Sperry Marine Part # 1812783.
- One bracket-mounted, 12-inch diameter, cast bronze fog bell, engraved with the vessel name, located forward of the pilothouse. The clapper shall be provided with a lanyard. The bell shall be a Kahlenberg model P492-02BE.
- Two trim and heel clinometers of the bubble-in-tube type, graduated in degrees. One of each type shall be located in the pilothouse and in the MCS. Clinometers shall be Moeller Instrument Co., Model No. 458.
- Three 6-inch, quartz movement, solid brass, flanged case, screw bezel clocks. One shall be located in the pilothouse, one in the lounge and one in the MCS.
- Two 6-inch, solid brass, flanged case, screw bezel barometers. One shall be installed adjacent to each of the pilothouse and lounge clocks.
- One recording barometer. The barometer shall consist of a R.M. Young Model 61202 barometric pressure sensor, to be located on the mast, and a R.M. Young Model 26800 meteorological display, to be located at the chart table. Data shall be slaved to the scientific information system via RS-232 or RS-485 connection.

- Transducers shall be suitable for continuous operation in a seawater environment. Transducer mounting locations shall be located away from discharges and shall be subject to minimal flow disturbance.
- Transducer installations shall be free of hull interferences and not impede the ability of the vessel to be drydocked.
- Transducer locations shall be free of bubble sweepdown.
- Seachests for scientific electronic systems (SES) shall be provided with faired flush, removable outer covers.

The ADCP transducer seachests and the scientific seachests shall be identical in size and configuration. The ADCP transducer seachests shall be provided with the capability of adding a 1.5 inch thick window on the sea side for instrument protection. The window shall be flush with the hull when installed. The transducer seachests shall be located near midship and near centerline.

Sea chests for equipment in Table 400-2 shall be provided with head tanks and fresh-water system connections as required by the manufacturers.

426 SCIENTIFIC ELECTRONIC SYSTEMS (SES)

The RCRV shall be designed and constructed to readily accept FUTURE INSTALLATION of the scientific electronic systems in Table 400-2. See also Deliverable DI-010-13.

Table 400-2. Scientific Electronic Systems

Equipment	Make and Model – Alternative #1	Make and Model – Alternative #2
Multibeam Survey System (MBSS)	Kongsberg EM302 (1 deg x 1 deg)	Reson 8128 and 8160
Single Beam Survey System (SBSS)	Kongsberg EA 600 (3 transducers – 12, 38, and 120 kHz)	
Sub-Bottom Profiler (SBP)	Array of 16 ORE 137D transducers in 4x4 configuration in an oil-filled chamber approximately 4 ft x 4 ft by 30 inches high	
Acoustic Doppler Current Profiler (ADCP)	RDI Ocean Surveyor (2 transducers – 75 and 150 kHz)	
Test Hydrophones	Harris Acoustic Products Corp., Model HAP-5050	

Where two alternative makes and models of equipment are listed, the vessel shall be capable of accommodating both. The Contractor shall provide all necessary design features and supporting components of the installations including:

- Space and weight reservations in suitable locations for all components of the systems.
- Electrical power in accordance with manufacturers' recommendations.
- Cables shall have appropriate terminations in the vicinity of SES components, with sufficient extra cable provided to make final connections.
- Air conditioning and ventilation systems shall include all heat loads imposed by SES components.
- Seachests shall be provided in accordance with manufacturers' requirements. For SES transducers that are provided with a manufacturer-supplied seachest, space for installation shall be provided. Transducer locations shall not be inside tanks.
- Cable trunks, science wireways, trays, pipes, hangers and penetrations.

In addition, space in the transducer room shall be reserved for future installation of a parametric sub-bottom profiler and an acoustic navigation and tracking system (ANTS).

432 TELEPHONE SYSTEMS

432.1 Sound Powered Telephone System

Sound-powered telephone systems shall be provided and installed as required by the regulations and as outlined below. Sound-powered systems described shall be as provided by Hose-McCann Telephone Company.

432.2 Engineering Circuit (2JV)

An engineering sound-powered telephone system (circuit 2JV) shall be provided and installed to communicate between the following stations/spaces:

- Pilothouse, Main Control Console
- Aft Control Station
- Engine Room
- MCS
- Bow Thruster Room
- Emergency Generator Room
- Steering Gear Room

The sound-powered telephone units in the pilothouse, MCS and machinery spaces shall be Hose-McCann model SW-123J (w/Cat. #16B2 handset cord). Headsets, Hose-McCann model 15AN/4SP, shall be provided for the machinery space stations. Headsets shall be

568 BOW THRUSTER

One (1) Elliott White Gill Model 32T3S-QR bow thruster shall be provided and installed. The bow thruster design shall be optimized for acoustic performance. The bow thruster shall be configured with a minimum 3 RPM 360-degree azimuthing steering control, 860 RPM input speed, fixed pitch impeller, vertically mounted electric motor, and thrust deflector. The bow thruster and support systems shall be rated for 100% continuous duty cycle.

The bow thruster suction and discharge openings shall be faired into the hull to minimize hull resistance and to present a smooth hull surface.

The bow thruster assembly and accessories shall be certified to American Bureau of Shipping Rules for Building and Classing Vessels, ✠AMS, ✠ACCU. The thruster shall be designed to operate under static and dynamic angles of inclination in accordance with ABS rules for classing propulsion and auxiliary machinery.

570 VENTS, FILLS, AND SOUNDS

570.1 General

The chain locker and all tanks, except hydraulic, lube oil and freshwater tanks, shall be sounded. All tanks and compartments fitted with filling, flooding, pumping, or drainage and void spaces through which pressure pipe runs, shall be vented.

570.2 Sounding

Sounding pipes of not less than 1-1/2 inches inside diameter shall be provided for the chain locker and all voids and tanks (except hydraulic, lube oil and freshwater tanks). Each sounding tube shall be located to lead approximately 2 inches above the lowest point in the tank or void, and to then rise vertically straight to its upper terminus, as much as practicable.

Sounding pipes terminating on the main deck or above shall be labeled with the name and number of the tank or compartment they serve and the maximum sounding of the space. Striker plates shall be fitted at the bottom of all sounding pipes to prevent damage to the plating by sounding rods. A tee wrench, or similar, shall be provided and mounted near each grouping of flush deck plates. All deck plates shall use the same size wrench in order to standardize the use of wrenches.

All sounding pipes terminating below the main deck shall be fitted with self-closing gate valves at the upper end and shall be in accessible locations. They shall be labeled with label plates located in a readily readable position on the adjacent structure where practicable; otherwise, the label plates shall be securely attached to the self-closing valve. Sounding pipes shall not terminate in staterooms, or in locked or inaccessible spaces.

570.3 Vent Pipes

Vent piping runs shall slope, whenever possible, to prevent accumulation of moisture in the piping.

Vents for small independent tanks in the machinery spaces shall terminate in the space where they are located and away from machinery.

Potable water tank vents shall terminate 6 feet above the main deck in order to prevent contamination from other fluids. Vent piping shall be of corrosion resistant materials.

The sewage/gray water storage tanks vents and the MSD plant vent shall terminate in the weather above the 03 deck in the stack. Due to the aromatic and somewhat corrosive nature of the effluent in the tank, these vents shall not be terminated in the space where the tanks are located.

A common vent system shall be installed for the fuel tanks. Individual vent line(s) for each of the fuel tanks shall come off the top of the tank and run to weather. Separately, an overflow line shall run from each tank and be connected to a common header leading to the fuel overflow tank(s). The individual tank vent lines and the overflow lines shall be sized such that, in the case of an overfill condition, the fuel will drain to the overflow tank through the overflow piping instead of backing up the vent pipe and spilling on the weather deck. The vents for the overflow tanks shall be terminated in the weather above containment coamings, sized per the regulations.

570.4 Vent Terminals

Vent terminals above the weather deck shall terminate in the atmosphere at least 36 inches above the deck, and with approved gooseneck fittings. Terminals shall be located on the pilothouse side or under the bulwark cap. The number of vent terminals above the weather deck shall be kept to a minimum.

Vent terminals and lines, fill and discharge lines for the fuel oil over flow tanks, lubricating oil tanks, oily water tanks, and waste oil tanks shall terminate in containment stations. Containment coamings shall be sized in accordance with regulations. No vent, fill, or discharge connection from any hazardous system shall be located within 36 inches of any opening into living quarters, or any ventilation system intakes or discharges.

Automatic ball float valves shall, in general, be fitted to all vent pipes from spaces below the main deck unless otherwise approved. Flame screens shall be fitted only where necessary.

573 HANDLING SYSTEMS

573.1 General

Handling equipment shall be marinized and ABS certified. Offshore cranes shall be certified in accordance with the ABS *Guide for Certification of Lifting Appliances*. Plastic

non-skid gratings shall be provided around winches and exterior control locations (except on working deck).

Overside handling gear shall meet the breaking strength requirements of 46 CFR 189.

573.2 Cranes

Main Deck Crane

One (1) knuckle boom crane shall be provided that can reach all working deck areas, and is capable of offloading vans and equipment weighing up to 16,000 pounds to a pier in port. The crane shall be able to deploy buoys and other heavy equipment up to 8,000 pounds and up to 12 feet over the starboard side at sea. The crane shall be an Effer Model 80000-3SL, and shall be provided with a standup control bank at the crane base and a portable, plug-in chestpack control unit.

The crane shall be person-rated for a basket directly attached to the end of the boom for access to the A-frame and other vessel equipment. The crane shall be supplied with a winch in the "horse head" configuration (on top of the boom).

Portable Deck Crane

One (1) portable crane capable of handling weights up to 4,000 pounds, 12 feet beyond the side of the vessel, shall be provided. The crane shall be articulated for work at deck level and at the sea surface. The crane shall be an Effer Model 155M-1S.

The portable crane shall be provided with a base plate compatible with the deck bolt grid system. Three (3) installation locations shall be provided: forward, amidships and aft. The portable crane shall be supplied with local controls and a portable, plug-in chestpack control unit.

This crane shall also be provided with a relocatable crutch as an over-the-side, cable fairlead for vertical work and light towing.

573.3 Oceanographic Winches

Traction/Trawl Winch System

One (1) Markey Type DUTWC-11-48 single storage drum traction system shall be installed in the Winch Room on the vessel. The winch shall have the following characteristics:

- Traction winch safe working load of 20,000 lbs.
- Traction winch maximum line pull of 25,000 lbs.
- Rated performance of 20,000 lbs. line pull at 0 to 200 ft/min.
- Maximum speed performance of 9,722 lbs. at 300 ft/min.
- Storage winch safe working load of 1,500 lbs.

- Storage winch maximum line pull of 1,865 lbs.
- Storage drum capacity of 10,000 meters of 0.562" 3 x 19 wire rope.

The traction drums shall be driven by two variable-frequency AC motors to provide variable speed control. The storage drum shall be driven by a single variable-frequency AC motor. Motors and controllers shall be provided with dynamic braking and sufficient cooling for continuous, full torque capacity stall.

Sheaves in the sizes, number and locations shown on the drawings shall be provided and installed to support running the trawl cable through the A-frame.

CTD Winches

Space, weight and electrical power reservations shall be provided on the exterior deck for two (2) Owner-furnished hydrographic-type winches, each capable of handling 5,000 meters of 0.393 fiber optic cable. The space reservations shall be located to serve the starboard side and the future CTD system. The winches shall be integrated into the handling system, including suitable deck strengthening and winch control and display systems.

Winch Controls

The Aft Control Station and other remote control stations shall include readouts of line speed, tension, line out and station-in-control indication, and control transfer acknowledgments. Large winch status displays of line speed, tension, and line out shall be provided near deployment locations and be viewable from at least 25 feet away to provide status information to personnel on deck. Displays shall be LED or electroluminescent for nighttime viewing. Winch control and power system design shall be integrated with other components of over-the-side handling systems to maximize the safety and protection of equipment in heavy weather operation and to maximize service life of installed wires. Winches shall be provided with slip rings (may be optical) and be connected to the winch wire and the vessel's power and data network. Power for slip rings shall be provided from the scientific conditioned power system as required.

573.4 Over-the-Side/Stern Handling Gear

A-Frame

The vessel shall be provided with a removable stern A-frame that provides a height of 24 feet from the attachment points for blocks to the deck and has a clear width between the legs of at least 15 feet. The inboard and outboard reach shall be a minimum of 12 feet and shall be able to safely launch long towed bodies, 3 meter diameter mooring buoys, and other large packages. Hydraulic cylinder rams shall be retracted when the stern frame is in the stowed position. Stern weight handling appliances shall have a dynamic safe working load of 20,000 pounds and shall meet the breaking strength requirements of the regulations. The A-frame shall be controlled hydraulically as described in Section 556.

573.5 CTD Handling System

A space, weight and electrical power reservation shall be provided on the starboard side for an Owner-furnished CTD handling system, including suitable deck strengthening and interface with winch control and display systems.

573.6 Control Stations

The overside handling equipment, except both cranes shall be controlled locally and in the Aft Control Station.

581 ANCHOR SYSTEMS

A complete anchoring system shall be provided and installed. The anchoring system shall be approved by ABS and ABS Ⓔ certification obtained. The ABS equipment number is 360.

Two anchors shall be stowed against the hull plating (1 per side). Heavy doubler plates shall be provided in way of the shell where the anchors are stowed. Edges of doubler plating shall be chamfered at a slope of at least 1:4.

Dogged steel covers shall be provided for the deck bolsters and chain pipes. Chain pipe covers shall be provided with gaskets.

581.1 Anchor Windlass

Two ABS-approved anchor windlasses, Coastal Marine Equipment CME Model 1V11831-126-00, with one 15" diameter cathead fitted to the shafting, shall be provided and installed. The wildcats shall be properly sized for the anchor chain to be handled. The anchor windlass shall be sized to recover the anchors and chain at a rate of at least 30 feet per minute at a maximum motor speed of 1200 RPM. All electrical components on the windlass shall be rated at least waterproof and shall be provided with internal heaters. The windlass brakes shall be spring set and electric coil release. Local pedestal mounted pushbutton controls shall be provided with ability to hoist, lower and stop the windlass.

581.2 Anchors

Three identical stockless anchors shall be provided, one port and one starboard, connected to the anchor chain. The third anchor is a spare and will not be carried on the vessel. The anchors shall be 2800 lb stockless type.

581.3 Hawse Pipes

The forward end of the hull shall be fitted with hawse pipes with deck and shell bolsters for stockless anchors, one port and one starboard. The bolsters shall be designed for a load no less than the breaking strength of the chain applied at any angle. All surfaces that may come in contact with the chain shall have a radius of seven times the chain wire diameter and shall be hardened.

664.4 Bosun's Storeroom(s) and Bosun's Workshop

The bosun's storeroom(s) and workshop areas shall be outfitted with a steel workbench with vise, line stowage racks, and shelving for other miscellaneous deck gear.

The bosun's workshop shall be provided with a ship service compressed air outlet for use with portable air-driven tools.

665 LABS

665.1 General

The main lab and hydro/wet lab shall be located on the main deck adjacent to each other and adjacent to the main working deck area. Doors into the weather shall have removable sills and coamings to allow rolling equipment and pallets in and out.

Two (20 cubic foot) stand-alone refrigerator/freezer units shall be provided and installed in the main lab.

665.2 Lab Services

Provisions for removable fixtures in the lab spaces designed to secure compressed gas tanks shall be provided.

In exterior bulkheads of labs that adjoin the weather deck, openings shall be cut and fitted with sections of 6-inch standard pipe, with external fiberglass camlock pipe caps, to permit leading cables from the lab to the weather deck. Openings shall be located approximately 6 feet 3 inches above the deck, and shall be spaced at a distance no greater than 10 feet in each lab. Pipe caps shall be fitted with retaining lines to prevent loss.

Cabinetry and Furnishings - Based on lab bulkhead linear footage, cabinetry in the labs shall be not less than the following percentages:

Benchtops, 36 inches high	65 %
Bulkhead (unistrut) mounted wall cabinets	30 %
Bulkhead (unistrut) mounted wall shelving	30 %
Base units with doors	25 %
Base units with drawers	35 %
Benchtops, 29 inches high	30 %

Benchtops shall be 3/4-inch birch plywood finished with polyurethane. One benchtop in the hydro/wet lab shall be covered with stainless steel for trace element analysis work.

Fume Hoods - Two removable, lab grade, laminar flow, Class A fume hoods shall be provided as follows:

- One 47-inch type with acid storage cabinet installed in the main lab.
- One 47-inch type with solvent storage cabinet and stainless steel work surface installed in the hydro/wet lab.

Hoods shall be provided with explosion-proof lighting, as well as connections to an explosion-proof blower located remotely at the discharge terminal. Lab hoods shall be set on their own storage cabinets. Hood linings shall meet NFPA Std. 45 and ASTM E162.

Ventilation - Each fume hood shall have an independent exhaust. Exhaust from fume hoods shall discharge directly to the weather at a distance greater than 15 feet from working areas.

Compressed Air - Standard lab-type outlets for compressed air shall be provided along lab benchtops at not less than 8-foot intervals. Compressed air for lab use shall be provided from the ship service air system, reduced to 100 lb/in^2, dried to a 50°F dew point through after coolers and regenerative silica gel dryers, and oil-separated. A consumption of 4 ft^3/min per outlet and 0.30 use factor (diversity) shall be assumed.

Plumbing - Lab sinks shall be provided in accordance with Table 600-13.

Table 600-13. Workshop Furnishings

Location	Type	Quantity
Main Lab	24x30x16 stainless steel	2 each
Hydro/Wet Lab	24x30x16 stainless steel	1 each

Sinks in the labs shall be provided with hot and cold potable water and shall be removable.

Reach Ranges - Operational controls for lab equipment shall be mounted to allow full access to controls and gages that the scientific party normally would be allowed to use. Where a forward reach is unobstructed, the high forward reach shall be 48 inches maximum and the low forward reach shall be 15 inches minimum above the finish deck surface. Where a high forward reach is over an obstruction, the clear deck space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be 48 inches maximum where the reach depth is 20 inches maximum. Where the reach depth exceeds 20 inches, the high forward reach shall be 44 inches maximum and the reach depth shall be 25 inches maximum. Where a clear deck space allows a parallel approach to an element and the side reach is unobstructed, the high side reach shall be 48 inches maximum and the low side reach shall be 15 inches minimum above the finish deck surface.

665.3 Computer Lab

The computer lab shall be provided with the following furnishings:

Item	Qty
Desk, SPFT	3
Book rack, double	3
Chair, side	3
Deck pad and tie down assy	3
Cabinet, filing, 4-drawer	3
Board, dry erase	1
Trash receptacle	3

665.4 Scientific Van Sites

Space shall be provided on the port side of the after main deck to carry two (2) UNOLS/ISO standard 8 foot x 20 foot portable deck vans for lab, storage or other specialized uses. Connections shall be provided for hot and cold fresh water, uncontaminated seawater, compressed air, drains, ISO twist lock fittings, communications, alarms, data and shipboard monitoring systems.

Connections and other provisions for vans shall be designed around UNOLS standard vans, including the following provision:

- Electrical connections for 20-amps 480 VAC 3-phase, 40 amps 240 VAC 3-phase, 40 - 50 amps 208 VAC three phase, and 120 VAC single phase shall be provided.
- Vans shall be capable of having weather-protected access to vessel interior and be located in wave sheltered spaces. Safe access to and from the vans is the primary consideration.
- Radiation vans shall be capable of installation so that they can be isolated from the interior of the vessel while still allowing safe access for personnel.

670 STOWAGE REQUIREMENTS

Stowage aids shall be provided for portable articles, repair parts, food service equipment, and similar items and in storerooms. Stowage aids shall be designed and installed to retain the stowed material without damage under the maximum dynamic conditions of roll, pitch, list and trim. Bin, rack and shelving compartments with vertical compartment clear openings of 10 inches or more, shall be provided with removable horizontal battens. Front flanges of lower shelves of bins, racks, and shelving shall be stiffened, as necessary, to prevent damage from persons climbing to upper bins or shelves. Stops shall be provided on backs of shelving and bins.

Storerooms, or portions thereof designated for bulk stowage, shall be fitted with fixed battens adjacent to structural boundaries and with removable stowage stanchions. The

ends of the stanchions shall be compatible with fittings on the deck and overhead. Fixed battens shall be fitted on shell plating, framing, or structural bulkheads in bulk stores area, to prevent stores from contacting surfaces on which condensation is likely to occur. Installation of fixed battens shall permit circulation of air and protect insulation, piping, and wire cables from being damaged by stores. Remote operating mechanisms shall be protected from stores interfering with their operation. The ends of the battens shall be closed.

Where cabinets with modular drawer units are required, they must conform to GSA Standard A-A-59470 "Cabinets, Modular Drawer Storage (Naval Shipboard)" with lock-in/lock-out drawers.

671 SPECIAL STOWAGE

The following dedicated special stowage spaces shall be provided.

671.1 Gasoline Storage

A quick-release overboard jettison stowage slide for four outboard motor gasoline fuel tanks and two 55-gallon drums of gasoline shall be provided. The drum arrangement shall permit refilling of the outboard motor gasoline fuel tanks.

In accordance with the regulatory requirements, each rack shall be capable of being released by a mechanical quick release pull cable to dump the gasoline drum over the side of the vessel in case of fire, capable of being released from a distance of 40 feet.

671.2 Sewage Treatment Locker

A locker shall be provided for stowage of packaged sodium hypochlorite for sewage treatment.

671.3 Immersion Suit Stowage

Immersion suit racks shall be provided for all exposure suits.

671.4 Linen Lockers

Linen lockers shall be provided as shown on the plans. Each linen locker shall be outfitted with adjustable shelving arranged to maximize the use of the space. The shelving may be either galvanized steel or fabricated from hardcore joiner linings.

Linen lockers shall be provided with 36-inch deep shelving.

671.5 Hazardous Materials Locker

A removable hazardous materials locker shall be provided in the main lab for ready use storage of scientific chemicals and reagents. The locker shall be rated for flammable

liquids, shall have self-closing doors, shall have a capacity of at least 83 liters, and shall be equipped with adjustable shelving and tiedown points.

The space shall be protected by the fixed CO_2 fire extinguishing system as discussed in Section 555.

671.6 Medical Locker

Lockable stowage cabinets shall be provided in the hospital to store medical items.

671.7 Pyrotechnics Locker

A self contained pyrotechnics locker shall be provided and installed as shown on the plans. The pyrotechnics locker shall be used to store emergency flares and other flammable emergency equipment.

671.8 Damage Control Locker

Damage control locker(s) shall be provided and installed as required to meet the regulations. Each damage control locker shall be provided with all the regulatory body required damage control equipment as outlined in Table 600-14. Damage control lockers shall be outfitted with shelving, hooks, brackets, etc., as necessary to neatly stow the required damage control equipment.

Table 600-14. Emergency Squad Locker Equipment (each squad locker)

Description	Quantity
Self-contained breathing apparatus (SCBA)	Two (2)
Zico Walkaway® bracket for SCBA	Six (6)
Spare SCBA air bottles (fully charged)	Four (4)
Spare face pieces for the SCBAs, sizes S, M and L	Two (2) each size
Flame safety lamp	One (1)
Fire axe	One (1)
CO_2 extinguisher, 15 pound	One (1)
Dry chemical extinguisher, 15 pound	One (1)
Flashlight, three (3) cell, explosion-proof	Two (2)
Spare flashlight batteries	Six (6)
Lifeline, 50 foot	Two (2)
Fireman's bunker pants	Eight (8)
Fireman's bunker coats	Eight (8)
Helmet	Four (4)
Helmet flash hood	Four (4)
Boots, pair – various sizes	Eight (8)
Suspenders	Four (4)
Gloves, rubber	Eight (8)
Gloves, leather	Eight (8)

672 STOREROOMS

Dry and ship stores shall be provided as shown on the plans and as described below.

672.1 Dry Stores

The dry storeroom shall be provided on the main deck as shown on the plans. The dry storeroom shall be fitted out with galvanized steel shelving for storing dry galley stores.

672.2 Aft Bosun Stores

An aft bosun storeroom shall be provided adjacent to the aft working deck as shown on the plans. Shelves, pipe, jackrods, portable metal battens and hooks for blocks and tackles shall be provided. A workbench, with a combination bench and pipe vise shall be provided. Storage for mooring lines shall be provided.

672.3 Fwd Bosun Stores

A forward bosun storeroom shall be provided for storage of tools and mooring lines.

672.4 Deck Gear Stores

Two deck gear storerooms shall be provided, one forward and one aft, as shown on the plans. Fittings shall be provided for the stowage of washdown gear for weather decks. Swab and broom racks shall be installed. A service sink shall be provided in each deck gear locker

672.5 Cleaning Gear Stores

Cleaning gear storerooms shall be located on every accommodation deck level, as shown on the plans, and provided with a deep service sink, louvered door, shelving, swab and broom rack and vacuum cleaner stowage.

672.6 Repair Parts Stores

A repair parts storeroom shall be provided, as shown on the plans, with modular drawer-type stowage cabinets.

672.7 Scientific Stores

A scientific storeroom shall be provided and configured to provide top and bottom support at the intersections of a two foot grid, and over the entire storage area, for Unistrut portable stowage stanchion system. Vertical stowage stanchions or elements shall be provided to fill one-half of the resulting support sites.

672.8 Hazardous Materials Stores

Two approximately equal sized storerooms for bulk stowage of scientific chemicals, reagents, chemically treated scientific samples and paint shall be provided as shown on the

plans. One storeroom shall be located adjacent to the main lab and one adjacent to the hydro/wet lab. The storerooms shall be equipped with adjustable shelving and tiedown points, and shall have the capability to maintain the space temperature between 13°C and 26°C. High and low space temperature alarms shall be provided at the main control console and in the pilothouse. The storerooms shall be protected by fixed CO_2 fire extinguishing systems as described in Section 555.