# TECHNICAL REQUIREMENTS FOR A

# PENINSULA SUPPLY AND RESEARCH VESSEL (PSRV)

# FOR THE NATIONAL SCIENCE FOUNDATION

# U.S. ANTARCTIC PROGRAM

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# 1. INTRODUCTION

## 1.1 Purpose

These requirements provide a basis for the Charter and operation of a general purpose, multidisciplinary oceanographic supply and research vessel with icebreaking capabilities. It is the intent that the Contractor shall deliver and operate this ship complete in all respects for the service intended. This implies that the ship shall be fully equipped and fitted out and operated in accordance with the best commercial practice and applicable laws.

## 1.2 Area of Operation

The primary mission area of the ship is the Antarctic Peninsula and the waters adjacent to the Peninsula and the southern sectors of Atlantic and Pacific coasts of South America, although operations throughout the antarctic ocean and adjacent seas may be expected. During the duration of the charter the vessel can be expected to remain in the southern latitudes. Regular visits to Palmer Station will be made throughout the year.

## 1.3 Concept of Operation

As with many oceanographic research vessels, this ship must be capable of independent operation for 75 days. The minimum range of the vessel must be 12,000 nm in calm water at 12 kts. The principal base of operation will be the southern latitudes to minimize transit time to the primary mission areas. The ship will operate from such ports as Punta Arenas, Chile or Ushuaia, Argentina for operation in the Antarctic Peninsula including Palmer Station and the Weddell Sea. Occasionally, the ship may be required to operate out of other ports such as Hobart, Australia or Port Lyttleton, New Zealand for trips to the Ross Sea. Because logistics bases are remote for a ship operating in this area, reliability and maintainability of equipment are of prime importance. All systems must use up-to-date, but proven, equipment and material.

Equal to the scientific research support function of the vessel, the additional primary mission to provide the main supply support for cargo, personnel and fuel to Palmer Station in the Antarctic Peninsula is of equal importance. Considerations in the design, outfit and operation of the vessel must take into account both of these equally important functions, along with safety and the other operational requirements stated in this solicitation.

1.4 Relationship Between NSF and Charterer

The Charterer has a contract with the National Science Foundation (NSF) for the operation and maintenance of the United States facilities in Antarctica. One of the tasks that the Charterer performs is management of research vessels operated by subcontractors. In this regard, Charterer is now seeking an organization to provide and operate a combination supply and research vessel with icebreaking capabilities.

1.5 Vessel Mission Summary

A representative annual operations summary for the ship is shown below. This summary is shown only to provide the bidder with an overview of the types of operations in which the vessel may be employed. This summary is not intended to indicate, in any way, limits to the operation of the vessel within the context of this Requirement, as the actual ship operation may vary significantly over the life of the charter, and any such variation will in no way imply or permit a change to any other portion of the charter agreement, including the day rate.

| Activity | Speed (knots) | Days |
|---|---|---|
| Ice Docked | 0 | 24 |
| Stationkeeping | 0 | 66 |
| Dredging & Trawling | 1-3 | 43 |
| Towing Instruments | 6 | 27 |
| Icebreaking | 3 | 12 |
| Operating in Pack Ice | 2-8 | 57 |
| Open Water Transit | 8-12+ | 86 |
| Total Ops away from Port | | 315 |

1.6 Ship Size Estimate

It is desirable that the length overall (LOA) be approximately 220 ft (67 m) to facilitate turning in the tight passages and basins where the ship will operate. The draft of the ship shall not exceed 19 ft (5.8 m), as this would preclude entry into Hero Inlet, docking and cargo operations at Palmer Station. There are no beam or displacement limitations on the ship.

1.7 Acceptance Test and Trials

The ship shall be subject to dock and underway trials to show that the technical requirements can be met. A discussion of tests and trials requirements, including procedures and data to be taken, is provided in Exhibit B. The trials will be

performed by Bidder under the supervision of, and subject to acceptance by, Charterer personnel and their representatives.

1.8 Technical Evaluation of Responses

The technical requirements contained in this document represent the criteria for performance, equipment, safety, and operation of the research vessel sought through this Request for Proposal. The technical aspect of evaluation of responses to this Request will be based upon the extent to which each response meets each of the technical requirements. For a proposal to be considered for evaluation as a response to this RFP, the requirements of the following sections are minimum and must be met in full:

| | |
|---|---|
| 2.3 Air Temperature | 5.1 General |
| 3.1 Icebreaking Capability | 5.2 Ice-Strengthening |
| 3.8 Stability, Compartmentation and Limiting Drafts | 5.3A Main Propulsion Machinery |
| | 5.3B Cold Weather Starting |
| 3.9 Endurance and Range | 5.3D Fuel |
| 4.2 Winches | |

Proposals should include calculations and/or text to demonstrate compliance and understanding with the requirements. As an example, calculations and/or data should be included with the proposal on: endurance, hull strength, intact and damage stability, and other subjects as appropriate.

Calculations, simulations, model tests or full scale tests for existing vessels in open water must be provided to demonstrate the performance of the vessel including low noise conditions (low propeller cavitation) at slow speed towing conditions.

Operational capability in ice should be shown in the proposal. This can be achieved by comparing the calculated resistance of the vessel, as a function of speed in 1 ft of level ice, to the propeller thrust to overcome that resistance.

Solely repeating the technical requirements, as stated in this Request for Proposal, will be considered as nonresponsive. The use of standard U.S. units or metric units (Systeme International d'Unites (SI)) is acceptable.

## 2. ENVIRONMENTAL REQUIREMENTS

2.1 Ice Conditions

The ship will operate in annual ice from the ice edge up to and including the consolidated pack and fast ice. The ship is expected to routinely operate in partial coverage of first-year ice floes. Glacial ice and therefore glacial ice

fragments also exists in the operating area, and care will be exercised to detect and avoid this type of ice. Icebreaking capability in annual ice is specified in Section 3.1, Icebreaking Capability.

2.2 Sea State

Data on sea states in the primary area of operation are shown below. Ship performance in those sea states is specified in Section 3, Operational Performance Requirements.

| Sea State | Percentage of Time Exceeded | Significant Wave Heigh (ft) | Associated Wind Speed (knots) | Average Modal Perio (sec) |
|---|---|---|---|---|
| 4 | 66 | 6 | 20 | 8.0 |
| 5 | 37 | 10 | 25 | 9.5 |
| 6 | 18 | 16 | 38 | 12.0 |
| 7 | 4 | 25 | 50 | 15.0 |

2.3 Air Temperature

Ship operations during the Antarctic winter can be expected to encounter very cold temperatures. The ship should be capable of operation in a minimum expected winter air temperature of -22°F (-30°C). The combination of low air temperatures and sea spray could lead to rapid deck and superstructure icing. The ship should be capable of operation in a warmer air temperature of about 90°F (32°C), based on the need for the ship to periodically transit to the lower latitudes.

2.4 Wind Velocity

Very high winds occur in Antarctica. The ship should be capable of enduring a maximum sustained wind speed of 100 kts.

2.5 Sea Water Temperature

Sea water temperatures can be expected to range from a high of 85°F (29°C) to a low of 28°F (-2°C). The ship should be capable of operation in this range of water temperatures.

2.6 Precipitation

Precipitation in the form of rain, freezing rain, sleet, and snow can be expected. The ship layout and equipment should consider all of these conditions with the intent of minimizing their accumulation aboard the ship, minimizing their potential adverse effect on ship operations, and providing for their removal.

2.7 Fog and Reduced Visibility

Reduced visibility will occur during ship operations. The ship should have the navigational capability to operate in a safe manner during these conditions.

2.8 Topside Icing

The combination of cold sea water and air temperatures with high sea states in the primary operating area will cause severe topside icing at times. Spray icing rates of 1/2 inch (13mm) per hour can be expected in extreme events. The extreme icing event has been estimated to be a 24 hour exposure at this icing rate. This extreme event results in the following ice accumulations and loads on the main deck forward of the superstructure.

| Accumulation (inches) | Location | Load (lbs/sq ft) |
|---|---|---|
| 12.0 | Horizontal Surfaces | 43.6 |
| 9.6 | Vertical Surfaces | 34.8 |

| | | |
|---|---|---|
| 10.8 | Exposed Gear | 39.4 |
| 10.8 Radius | Rigging and Stays | 111.1 lb/ft |

These loads should be reduced linearly with height such that all loads are zero at 100 ft above the Design Waterline (DWL). Icing is assumed not to occur on the shell plating or area below the main deck (uppermost watertight deck). Icing loads should also be reduced linearly with distance aft along the ship. Icing loads should be constant with length over the foredeck and start to reduce aft of the forward end of the superstructure, resulting in zero load at the stern of the vessel. The ship should be capable of surviving such an icing event. Stability in this icing condition is addressed in Section 3.8.

Given the severity of the icing loads, it is desirable to have clean decks and superstructure, free of all but essential fittings and equipment, to minimize ice accretion.

## 3. OPERATIONAL PERFORMANCE REQUIREMENTS

### 3.1 Icebreaking Capability

The ship must be able to operate independently, year-round, through thin first-year ice conditions of:

| | | |
|---|---|---|
| Level ice thickness | | 1 ft (0.3 m) with continuous forward progress |
| Ice Strength | flexural | 100 psi (0.7 MPa) |
| | compressive | 575 psi (4.0 MPa) |

The ship must also be able to transit compact pack ice of 3 ft (0.9 m) thickness and 100% ice concentration in the ramming mode of operation.

### 3.2 Trimming

The ship should have sufficient ballast tankage in the ends of the ship to change the trim by 3 ft (0.9 m) at both the bow and stern.

### 3.3 Open Water Powering

The ship is required to make a calm water speed of 12 kt at 60% of maximum continuous service rating of the diesel engines. Model tests or recent full-scale measurements should be submitted to verify this performance.

### 3.4 Seakeeping

The ship should be able to maintain ship motions that do not exceed the values given below in sea state 5 (10 ft significant wave height) and short-crested seas (cosine squared spreading function) on any heading at speeds up to 8 kts. Wind

is colinear with the seas as described in Section 2.2 and a steady current of 2 knots is at 45 degrees.

| | |
|---|---|
| Significant Pitch | 5 Degrees |
| Significant Roll | 8 Degrees |

Accelerations

| | |
|---|---|
| 1) on the Bridge Wings | 0.2 g's Athwartship |
| | 0.4 g's Vertical |
| 2) on Main Deck on | |
| Centerline at After Perpendicular | 0.2 g's Athwartship |
| | 0.4 g's Vertical |

| | |
|---|---|
| Slamming | 10 occurrences per hour |

Deck Wetness

| | |
|---|---|
| 1) at After Perpendicular | 5 occurrences per hour |
| 2) at 5 percent aft of | |
| Forward Perpendicular | 5 occurrences per hour |

3.5 Stationkeeping

The ship must be able to maneuver and keep station within a 300 ft, or 3 percent of the water depth, diameter circle in seas up to 10 ft significant wave height, with mean winds of 30 kts and 2 kts of steady current. The wind and waves directions are colinear and the current direction is at 45 degrees to them. Ship heading can be selected to give best stationkeeping ability.

3.6 Trackeeping

The ship shall be capable of remaining within plus or minus 500 ft or 5 percent of the water depth, whichever is greater, of any specified straight trackline and shall be capable of maintaining its mean heading for all forward speeds between 15 degrees of its mean heading for all forward speeds between 1 and 6 knots, in sea state 5 (long-crested seas of 10 ft significant wave height, 25 kt mean wind speed and 2 kt steady current), where the wind and waves are colinear and have an arbitrary heading relative to the trackline and the current direction is at 45 degrees from the wind/wave direction.

3.7 Night Operation

Ship operations are based on year-round science. Long periods of darkness can be anticipated during the winter months due to the extreme latitudes of operation.

The ship must provide adequate lighting on all working decks as well as lighting of the ice or water surface adjacent to and astern of the ship.

3.8 Stability, Compartmentation, and Limiting Drafts

The ship must meet the US Coast Guard requirements of Subchapter U for Oceanographic Research Vessels (CFR Title 46, Parts 188 to 196). Additionally, the ship must meet the intact stability requirements of Subchapter U with the icing load described in Section 2.8.

3.9 Endurance and Range

The ship must be capable of an endurance of 75 days. The minimum range of the vessel must be 12,000 nm calm water transit at 12 kt. The corresponding fuel tankage should be equal to the fuel consumed by the propulsion diesel(s) to achieve a 12 kt calm water speed and the associated fuel consumed by the auxiliary machinery in service during that time. There should be a 10 percent margin of usable fuel left onboard upon returning to port. The total computed volume of fuel should be 95% of the required tank volume. The ship must be able to fill the required tank volume with fuel, load a full complement of scientists, stores, scientific containers and scientific cargo and still meet her loadline requirements.

3.10 Service Life

A service life of 15 years is required from commencement of the charter.

3.11 Vibration

The ship and its equipment should be free of excessive vibration during open water and icebreaking operation. Open water vibration criteria are as follows. Vibration should not exceed the levels given in the latest revision of the "ISO Habitability Recommendations" for spaces occupied by the crew or scientific personnel. Hull girder vibration should result in velocities less than ± 0.37 in/sec vertically and ± 0.22 in/sec longitudinally or athwartship. Major substructures of the ship not inhabited by the crew should limit vibration to ± 0.1 g providing this level of vibration is not harmful to equipment mounted in the substructure including its supporting structure and mountings. Local structural elements should have vibration levels less than ±0.25 g, be free of vibration induced structural damage, and generate noise levels less than 90 dbA unless Sections 3.12 or 3.13 are more restrictive. Shipboard equipment, as mounted, should be able to meet environmental vibration levels of ±0.25 g. Vibration levels and balancing of rotating machinery should meet accepted standards for good commercial practice. Vibration characteristics of the main propulsion machinery should be in accordance with a recognized vibration standard.

3.12 Airborne Noise

The ship should be capable of keeping compartment noise levels within guidelines of the Society of Naval Architects and Marine Engineers Technical Research Bulletin 2-25, "Ship Vibration and Noise Guidelines." This bulletin specifies noise levels as follows:

| Location on Vessel | A-Weighted Noise Level (dbA) |
|---|---|
| Officers Cabins | 60 |
| Pantry, Mess, Dayroom | 65 |
| Wheelhouse (Doors Open) | 65 |
| Wheelhouse (Doors Closed) | 60 |
| Radio Room | 60 |
| Machinery Space Duty Station (8 hr/day) | 85-90 |
| Machinery Space Enclosed Control Station | 75 |
| Workshops and Storerooms | 85 |
| Galley | 75 |
| Laboratory Spaces | 65 |

Ear protection or similar protective devices are strongly recommended in all areas where the noise level exceeds 85 dbA. All doors accessing spaces where noise exceeds 85 dbA should be marked with signs recommending that ear protection devices be worn in this space.

3.13 Underwater Noise

Noise generated by the ship should not interfere with the operation of the installed sonars. Noise levels should also be adequately low so as to not interfere with the operation of research single and multi-channel seismic, and narrow beam deep ocean echo sounding systems that are or may be installed in the vessel. Operating frequency ranges are identified in Section 4.8. Operationally quiet noise levels should be achieved over the entire range of ship speeds from 0 to 10 knots and wave conditions up to sea state 4.

## 4. SCIENCE REQUIREMENTS

### 4.1 Deck Working Area

A fantail working deck area of approximately 1000 sq ft is required with a contiguous working area along the starboard side about 25 ft long and 12 ft wide. This area should be capable of withstanding local deck loads of 750 lb/sq ft. Flush deck threaded holdowns (internally threaded 1 inch UNC) should be provided throughout the working deck area on 2 ft centers. Holddowns should be supplied with stainless steel (s/s) threaded plugs for each and approximately 40 s/s hex head and 40 s/s eye bolts. The work areas should be approximately 8 ft above the working draft to make them as dry as possible while still allowing over-the-side work. A portion of the bulwark in this area should be removable to facilitate loading heavy or bulky objects.

The ship should also have a clear area on the foredeck near the bow for erection of specialized towers and booms that reach forward of the bow wave for gathering uncontaminated environmental samples. This area should also have similar flush deck threaded holddowns on 2 ft centers.

All working decks should be provided with 110 and 220 V AC, 60 Hz. power, sea water supply, hydraulic service as supplied to the ship's cranes, A-Frames and deck machinery. There should be at least two service points from this system, on the aft deck available for Charterer's equipment.

### 4.2 Winches

Space, weight , clearances, and services must be provided for at least three government furnished oceanographic winches to be permanently installed aboard the vessel. These winches consist of the following:

1 Markey DUSH 4 with independent hydraulic power pack
1 Markey DUSH 5 with independent hydraulic power pack
1 Markey DESH 6 with MG set

For space and weight considerations assume that each winch will have 10,000 m of wire per drum. Location of these winches shall allow for efficient and safe operation. Detailed drawings and specifications for these winches are in Exhibit C. The Bidder is to provide routine maintenance and repair of these winches. The cost of spare parts inventory is to the Charterer's account.

### 4.3 Cranes

Several types of shipboard marine cranes are required. Cranes should be provided to load and unload the inflatable boats. One of these cranes should serve to load and unload containers and heavy equipment to the after working deck and cargo hold (up to 24 LT). Cranes should be provided to reach all working deck areas, the cargo hold, and all locations where vans will be stored.

### 4.4 Over-the-Side Handling

The ship should be fitted with an A-frame to work off the stern of at least a 20 ft vertical clearance. The A-frame should reach at least 15 ft beyond the transom and have a safe working load of 10 LT.

Additionally, an articulated crane should be positioned near the starboard side of the transom servicing the after work area for lifting equipment aboard from the sea and for supporting fairlead sheaves for cables. This crane should be able to support 5 LT at a 10 ft (3 m) reach.

There should be an A-frame or telescoping boom on the starboard quarter of the ship with a safe working load of 5 LT. This boom should reach beyond the side of the ship 15 ft and have a 15 ft clearance above the working deck. Bulwarks should be removable in the way of this boom.

All winch systems should be positioned to work safely with, and fairlead to, the over-the-side equipment.

## 4.5 Laboratories

Approximately 1400 sq ft of dedicated laboratory space is required as follows: a dry lab of 300 sq ft, a hydro lab of 300 sq ft located as nearly as possible contiguous to the working deck area; a wet lab of 400 sq ft, located contiguous to the working deck area; and an electronics/computer lab and associated user space of 400 sq ft. Labs should be located as close as possible to each other, and none should serve as a general passageway. There should be convenient access between all laboratory spaces, working deck areas and scientific storage spaces.

One of the labs must be able to receive a 15 ft long core from the working deck. One emergency shower should be fitted in the dry lab
and the wet lab to provide personnel wash down in the event of accidental contact with a hazardous substance. A deck drain should be located under each shower. The wet lab, the dry lab and the hydro lab should have provisions for the installation of fume hoods (one sink per lab, vented overboard) and acid resistant sinks and drains (one each per lab with hot and cold fresh water; and one additional sink in each of the wet and hydro labs with uncontaminated sea water supply).

Labs and lab equipment should be built of materials that cannot become contaminated and are easily cleaned. Furnishings, heating, ventilation, air conditioning, doors, hatches, cable runs, and fittings should all be built for maximizing lab cleanliness. Laboratory lighting shall be adequate and to research facility standards.

Cabinetry should be constructed to provide for flexibility through the use of unistruts and deck boltdowns. Since the ship will be engaged in basic research in all branches of oceanography, its equipment and the investigations it

undertakes will change frequently. The ship should be built to facilitate attaching temporary equipment easily and quickly. Thus, the mission of the ship can be rapidly changed between successive cruises. Equipment mounted in the labs and on the working decks should be installed such that it can be easily removed, rearranged, or reinstalled.

An enclosed Aquarium room, contiguous to, and accessible from, the working deck, must be provided. This space shall be capable of housing six aquarium tanks 2 ft wide, 4 ft high, and 4 ft long each, with 2 ft wide walk ways between tanks. The space must be fitted to drain Charterer supplied tanks overboard, be supplied with 110 and 220 VAC, 60 Hz. power and uncontaminated seawater at a flow rate of 10 gpm. The space must be heated to maintain temperature above freezing.

4.6 Scientific Vans Storage

The ship should be capable of accommodating up to four standard 8 by 8 by 20 ft containers which may be configured for laboratory, berthing, storage or other specialized use, within sheltered space in the vessel. Provisions should be made to easily supply power (110 and 220 VAC, 60 Hz), fresh water, and sea water.

Additionally, the ship should be capable of stowing at least five more standard containers on the superstructure or deck at separate locations aft of the forward superstructure. Sea water and 110 and 220 VAC, 60 Hz. power should be available at each location.

4.7 Inflatables

The ship must provide storage for two 20 ft inflatable (semi-rigid) boats (Zodiac or equal) with appropriately sized and redundant outboard motors and spare parts, located so as to allow easy launch and recovery of the boats.

4.8 Acoustical Systems

The ship will be required to carry several acoustical systems in the course of its science operations. These include equipment in the frequency ranges as follows:

| | |
|---|---|
| Seismic Recording | 4 to 500 Hz |
| Echo Sounding and Acoustic Navigation | 3 to 200 kHz |
| Doppler Current Profiling | 75 to 300 kHz |

Weight allowances, transducer spaces; acoustic windows, and services must be provided for two government furnished precision depth recording systems to be permanently installed aboard the vessel. These are 3.5 and 12 kHz discrete signal frequency systems capable of recording precision bottom and sub-bottom topography at water depths below the keel to at least 4000 meters. See Exhibit C for details.

The ship should also be provided with a commercial dual-axis Doppler speed log having display and RS232 output.

4.9 Ship Command and Control during Science Operations

The ship must provide good visibility of all working deck areas from the ship control stations on the bridge or bridge wings. This requirement can be met by closed circuit television with monitors at the bridge control station. The functions, communications, and layout of the ship control station should maximize coordination of ship control and scientific operations.

4.10 Uncontaminated Sea Water Service

An uncontaminated sea water supply is required in most laboratory spaces. The uncontaminated sea water main supply to the laboratory spaces should be 2 inch IPS as a minimum. Piping, valves, and fittings must be pvc or material lined with inert enamel or teflon. Stainless steel piping and fixtures will not be acceptable for this system. Two separate sea chests for uncontaminated sea water, one forward of all discharges and one aft near the centerline of the ship, are desirable. The aft sea chest will be used during operations in ice and should be located to minimize ice clogging. The sea chests should be of adequate size to install additional intakes for future needs. These sea chests should not be heated and must be as contamination free as possible.

4.11 Compressed Air Service

A ship service compressed air system is required to supply laboratory spaces, working deck areas and standard maintenance areas. The air supply should be filtered and free of oil and moisture. Oiling for use with power tools will be accomplished in each space as required.

4.12 Scientific Electrical Power Requirements

Each lab should have a separate electrical circuit to provide continuous power of at least 40 VA/sq ft of laboratory space. Voltages should be both 110 and 220 V AC at 60 Hz. The total estimated power demand for the lab spaces is 35 kVA at any given time. Electrical circuits providing 100 VAC, 60 Hz power should be available in each scientific stateroom and on the bridge. The electronics/computer lab is required to have uninterruptible and conditioned power supply.

4.13 Habitability for the Scientific Party

A minimum of two single staterooms (Party Manager and NSF Representative) should be provided with private shower and toilet facilities. Twelve two person staterooms should be provided for other scientists. Two, six person vans with sleeping accommodations may also be installed aboard the vessel by Charterer.

Toilet and sanitary spaces should be provided appropriate to the total number of scientific persons (38) aboard.

All doors from staterooms and toilet and sanitary spaces must be fitted with kickout panels for emergency egress. Separate male and female toilet and shower facilities are to be provided.

The two single staterooms should be sized to accommodate additional office furniture. Each of the single staterooms should contain a desk, a two drawer file cabinet, arm chairs, and a tackboard. These office areas in the single cabins should be configured separately from, or partitioned from, the berthing space in the cabin.

All berthing spaces should be easily cleanable, well lighted, and provide a berth, drawers, hanging space, lockers and a book shelf for each person, and a desk and chair in each room. Berths should not be obstructed by pipes, ducts or other obstructions, and fitted with privacy curtains of flame retardant materials in multiple person spaces. Bunk lights should be provided. All drawers and doors should be latched to prevent opening in a seaway. Portable furniture should contain a fastening mechanism for securing in a seaway.

Sanitary spaces with a sink, toilet, and associated hardware should be provided near the messroom, the laboratories and adjoining the deck changing room.

Staterooms and toilet facilities must be provided with 110 VAC, 60 Hz electrical power.

4.14 Scientific Storage

Approximately 10,000 cu ft of scientific storage is required in an internal storage or with suitable shelving, racks and tie downs. There should be good access to the weather deck and scientific spaces for easy loading and use.

4.15 Multi-channel Seismic Compressed Air System

The ship shall be configured to support multi-channel seismic operations. These operations will be based upon deploying up to four 400 cubic inch water guns working at 8 second repetition rates at 2000-3000 psi. Equipment to support these operations shall be installed by Charterer in accordance with the technical requirements. Space, weight and services must be provided aboard the ship for two government furnished 300 scfm air compressors. Detailed drawings and specifications for these compressors are in Technical Attachment 1.

The Bidder is to provide routine maintenance and repair of these compressors. The cost of spare parts inventory is to the Charterer's account.

4.16 Overboard Discharge

It is desirable that all overboard discharges should be on the port side of the vessel and the starboard side designated the clean side such that contamination of scientific samples is minimized.

4.17 Wireways

Wireways must be provided to all science and van areas, working decks and winch locations; and should have bulkhead pass-throughs to provide for ease in stringing science related cable without removing end fittings.

## 5. ADDITIONAL SHIP REQUIREMENTS

5.1 General

The ship must be: classed by a U.S. recognized classification society with appropriate ice classification experience, consistent with the mission of the ship, certified by the U.S. Coast Guard and maintained in Certificated condition, U.S. registered, and manned by personnel with appropriate licenses, documents and experience for unrestricted oceans and high latitude ocean service, and operated in conformance with all applicable laws.

5.2 Ice-Strengthening

The vessel is to be suitably ice classed by a recognized classification society to meet the operational performance requirements in Section 3.1.

5.3 Propulsion Plant

5.3A Main Propulsion Machinery

The ship is required to have a minimum of two propulsion diesel engines. The reduction in propulsive power caused by the loss of any single main propulsion engine must not exceed fifty percent of the total installed power.

The use of single or twin propeller systems with or without nozzles is acceptable. The propulsion plant must be capable of: (1) adequately absorbing shocks due to propeller-ice impacts, (2) adequately absorbing or generating propeller torque during ice impacts and/or ice milling to preclude stalling of the prime movers and (3) responding to load transients during ice blockage of the propeller nozzles, if installed. The propulsion machinery must be capable of being controlled from the machinery control room, the pilot house, the starboard bridge wing, and the aloft conning station.

5.3B Cold Weather Starting

Provision should be made for the possible cold weather starting of the prime movers. Specifically, during certain operations, only hotel services may be required while ice docked. After a period of time, the temperature of the lubricating oil may drop to a point where engine starting becomes difficult. Consideration should be given to having a lube oil heater or methods to heat lubricating oil in equipment and components.

5.3C Noise and Vibration Isolation

The propulsion engines, ship service generators, and associated auxiliary equipment should be mounted in a manner that their operation does not result in structural vibration and noise generation such that it interferes with the operation of all hull mounted and towed electronic transmitting and receiving equipment.

5.3D Fuel

Since fuel supplies are limited in Antarctica, it is necessary to require that the main propulsion and auxiliary machinery have the capability of operating on commercial marine diesel fuel. Power levels to meet operational requirements should be achievable using this type of fuel. It is desireable for the vessel to have an installed fuel monitoring and management system to optimize fuel efficiency.

5.3E Ship Control and Positioning System

For stationkeeping, it is desirable to have an integrated console where the operator can control all main propulsion and maneuvering systems, preferably in a single joystick. Control consoles should be located on the bridge, on the starboard bridge wing, and in the aloft conning station. Master control should reside in the console on the bridge. Positioning will be determined by a Global Positioning System (GPS) receiver and/or bottom transponders. The GPS receiver should be provided with the ship. Equipment to constantly display actual position relative to a target station, or actual course relative to a track line is not required. This equipment may be added at a later date.

Special automatic positioning or track-keeping control equipment is not required. An auto piloting system with performance as described in Section 3.6 is required, however.

5.3F Sea Chests

During ice transiting and ice breaking operations, snow, small ice pieces, and entrained air may accumulate in the sea chest. This accumulation may be of such a magnitude to cause overheating of the diesel engines and unscheduled shut-downs. To preclude clogging of the sea chests with snow and ice slush, it is recommended that the sea chests should be located deep in the ship, be of adequate size, and be provided with baffles, large vent pipes to eliminate air, and be provided with means of heating. A thermostatically controlled valve should regulate the recirculating flow based on water temperature in the sea chest.

These features should not be used in the scientific sea chest for uncontaminated sea water.

5.4 Navigation and Communications

5.4A Internal Communications

The ship should have an internal communications system that provides high quality voice communications among all the scientific spaces, the lounge/conference room, the messroom, the working deck areas, and the bridge. It is desirable that this system be integrated with the normal ship's internal communication system which services all staterooms. There should be a "talk back", hands free communication system between working decks and the bridge.

5.4B External Communications

The ship should have standard commercial marine quality INMARSAT, VHF, and fully synthesized (1.2 to 30 MHz.) HF communication equipment suitable for transmitting and receiving from shore stations, other ships, boats and aircraft by voice communications. Facsimile communications to send and receive high resolution graphics and hard copy text on regular intervals is also required. The ship should also have a weather fax.

5.4C Navigation Systems

The ship must be provided with a complete suite, with appropriate redundancy, of standard marine navigation and safety equipment such as collision avoidance radars, satellite navigators, shallow water fathometers, dual gyro compasses suitable for high latitude operation, barograph, anemometers and thermometers. A GPS receiver must also be provided with appropriate interfaces to other navigation systems as required.

5.4D Surface Search Radar

One 10 cm and one 3 cm surface surveillance radar and associated collision avoidance system must be provided.

5.4E Aloft Conning Station

An aloft conning station is required with instrumentation and controls to fully operate the ship from this position. The aloft conning station should be enclosed from the weather, heated and sized to accommodate the operator and one observer, with internal access from the superstructure. The purpose of the conning station is to allow for better visibility and navigation in ice.

5.5 Auxiliary Systems

5.5A Auxiliary Machinery

Ships service generators must be of sufficient number and size to provide power consistent with the mission of the ship. Electric power must be 220 and 110 V AC, 60 Hz, for all laboratories, scientific accommodations, vans, and at other select locations such as the bridge. These other locations allow scientists to power portable electrical equipment, instrumentation, and computers. The ship

will be calling at ports where shoreside power is not available, therefore one ship service generator must be capable of handling the in-port electrical load for the ship and for scientific needs.

5.5B Heating, Ventilation and Air Conditioning

The HVAC system should be able to maintain internal ship spaces between 65$^{o}$ (heating) and 78$^{o}$ F (air-conditioning) at 50 percent relative humidity. Nine to eleven air changes per hour are required in laboratory spaces.

5.5C Evaporators

Two identical evaporators must be provided, each having a capability of producing 3600 gal(13.7 $m^{3)}$ or 13.5 LT(13.7 MT) of fresh water per day. A minimum of two days fresh water storage must be provided.

5.5D Waste Management System

An incinerator must be provided that is suitable for burning paper, wood products, and other burnables. The unit to be sized consistent with the size of the complement and refuse generated in the course of performing oceanographic research. Incineration by electric or fuel is acceptable, recognizing the incineration unit must be capable of using the type of onboard fuel. In addition to the incinerator, a trash compactor of suitable size must be provided for the compaction of glass, metal containers, plastics, and other materials that will accrue from the galley and ship operations.

Provisions must made throughout the ship for the segregation of trash into combustible and compactable. This may take the form of separate trash containers in laboratories, galley, and other spaces to eliminate or reduce the need to sort the trash.

Any human waste, garbage, or other effluents must be treated in compliance with the requirements of U.S. law, MARPOL, the Law of the Sea, IMCO, and the Antarctic Conservation Act. Holding tanks should be provided such that all waste discharge from the ship can be stopped for a period of five hours during critical science operations.

The Bidder will be required to comply with additional U.S. Antarctic Program (USAP) environmental protection policies which may come into effect during the course of the Charter. Costs associated with implementing new policies during the Charter period will be reimbursed.

5.6 Outfit and Furnishings

5.6A Messing Facilities

A single messroom for all personnel is desired with cafeteria style service. The messroom should be adequately sized for the entire complement of crew and scientific personnel.

5.6B Refrigeration and Dry Stores

Storage facilities for refrigerated and dry stores must be consistent with the size of the crew and scientific complement for 75 days at sea.

5.6C Laundry Facilities

Laundry facilities must be consistent with the size of the crew and scientific complement for 75 days at sea.

5.6D Exercise Room

An exercise room of approximately 10 ft by 10 ft (3 m by 3 m) is required for use by all personnel. The room should be outfitted with the usual set of gym equipment such as a stationary bicycle, weight equipment and a rowing machine. Adjacent to exercise room, shower and sauna facilities shall be provided.

5.6E Lounge/Conference Room

A common lounge/conference room must be provided for officers, crew and scientists. The space should be suitable for about twenty people and should be provided with several card tables, arm chairs, sofas, end tables with lamps, magazine rack, bulletin board, waste paper baskets, and entertainment equipment. Entertainment equipment must include 25 inch (635 mm) (minimum size) color television, a video cassette recorder (American VHS format), and stereo equipment.

5.6F Heated Pilothouse Windows

At a minimum, every other window in the pilot house must be heated to prevent icing.

5.6 G Gasoline Drum Storage Rack

A gasoline drum storage rack must be provided for the storage of six U.S. standard fifty five gal. gasoline drums. The rack must have the capacity for the rapid release of all drums at a remote location in case of fire.

5.6H Floodlights

Floodlights must be provided and mounted on brackets that can be temporarily swung outboard and rigidly locked in position to illuminate the water and ice surface directly adjacent to the ship. In additional, bow headlights and two powerful searchlights mounted above the bridge are required to assist in navigation during hours of darkness.

5.6I Repair Parts and Storage

Repair parts should be provided onboard for all mechanical, electrical, and electronic equipment and components in accordance with manufacturers recommendations for one year of operation. Supply parts inventories onboard should be consistent with the mission of the ship which is logistically remote. Storage space should be provided that can maintain spare parts in good working order.

5.6J Deck Coverings

All exterior decks must be covered with a durable non-skid coating. This coating should survive one full year of ship operation.

5.6K Deck Changing Room

A room should be provided on the main deck aft to provide for the changing of interior to exterior clothing and vice versa. This space is intended to accommodate wet, dirty, and cold weather articles to minimize the transmission of dirt and water throughout the vessel. Access should be provided directly to the weather deck and to an interior passageway.

5.7 Special Storage Requirements

5.7A General Cargo Storage

Below deck storage is required for about 10,000 cu ft of general cargo which could include standard 8 by 8 by 20 ft containers. The cargo hatch should be sized to conveniently handle these containers.

5.7B Pyrotechnics Storage

The ship should be provide a pyrotechnics locker of approximately 8 by 10 ft and be accessible from the deck on which the locker is located. The access door to this space should be lockable.

5.7C Hazardous Materials Storage

A locker for hazardous materials storage must be provided, at least 6 ft by 6 ft, with full deck height, fitted with fire suppression and fire safety lighting and electrical fixtures, and shelving. The locker must have a lockable door, opening onto a working deck.

5.7D Weather Deck Storage

In addition to the container storage requirement previously specified, there must be at least 500 sq ft of weather deck area available for breakbulk storage, within service range of the ship's 24 LT crane.

5.7E Fuels and Hydrocarbon Storage

It is desireable to have all fuels and other hydrocarbon materials stored in tanks or other containers separated from, not adjacent to, the hull of the ship.