Scientific Mission Requirements for Large High-endurance, General-purpose Oceanographic Research Ship

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General: The ship is to serve as a large general-purpose, multi-discipline oceanographic research ship. The primary requirement is for a high endurance vessel capable of worldwide cruising (except in close pack ice) and able to provide both overside and laboratory work to proceed in greater capacity and in higher sea states than is now available. Other general requirements are larger scientific parties, reliability, flexibility, cleanliness, vibration and noise free, and an overall upgrading of quality for doing science and engineering at sea.

Selected vessels may be designed for additional or enhanced capabilities in a particular field, such as Multichannel Seismics Profiling or Ice Worthiness. Any added performance requirement, however, shall not reduce or supplant the general-purpose performance requirements.

Size: The size ultimately is determined by the requirements. It seems likely that these will result in a vessel larger than present academic ships. However, the LOA should not exceed 300 ft.

Endurance: Sixty days; providing the ability to transit to the most remote area and work 3-4 weeks on station. 15, 000 mile range at cruising speed.

Accomo-dations: 30-35 scientific personnel in two-person staterooms. Expandable to 40 through the use of vans. Science library lounge with conference capability. Science office.

Speed: 15 knots cruising; sustainable through sea state 4. Speed control $\pm$ 0.1 knot in 0-6 range; and $\pm$ 0.2 knot in range 6-15 knots.

Seakeeping: Maintain science operations in following speeds and sea states:

15 knots cruising through sea state 4
13 knots cruising through sea state 5
8 knots cruising through sea state 6
6 knots cruising through sea state 7

Station Keeping: Allow normal station and deck work in sea states through SS 5 and limited work through SS 7.

Maneuverability that would assure a relative positioning at best heading in 35 knot winds and SS 5 and 2 kt current $\pm$ 150 ft maximum excursion from a point or trackline, and maintain $\pm$ 5 degree heading.

Maintain a precision trackline while towing at speeds as low as 0.5 kts with a heading deviation up to 45º from the prescribed trackline using GPS or bottom navigation as reference. (See navigation and positioning.) Speed control along track should be maintained ± 0.1 knot (averaged over one-minute intervals).

Trackline requirements should be met 95% of time considering range of specified sea states.

Ice Strengthening: ABS Ice Classification 1A. Able to transit loose pack. Not intended for icebreaking or close pack work. Protection against encounters with growlers and other glacial ice difficult to detect.

Deck Working Area: Spacious fantail area – 3,000 sq ft minimum with contiguous work area along one side 12 x 50 ft minimum. Provide for deck loading up to 1, 500 lbs/ sq ft and an and an aggregate total of 100 tons.

Oversize holddowns on 2-ft centers. Highly flexible to accommodate large and heavy equipment. Removable bulwarks. Dry working deck but not greater than 7-10 ft above waterline.

Usable clear foredeck area to accommodate specialized towers and booms extending beyond bow wave.

All working decks accessible for power, water, air, and data and voice communication ports.

Cranes: A suite of modern cranes to handle heavier and larger equipment than at present: (1) to reach all working deck areas and offload vans and heavy equipment up to 20,000 lbs; (2) articulated to work close to deck and water surface; (3) to handle overside loads up to 5,000 lbs, 30 ft from side and up to 10,000 lbs closer to side; (4) overside cranes to have servo controls and motion compensation; (5) usable as overside cable fairleads at sea.

Ship to be capable of carrying portable cranes for specialized purposes such as deploying and towing side scanning sonars, photo and video devices, remotely operated vehicles (ROV's), and paravaned MCS air gun arrays.

Winches: New generation of oceanographic winch systems providing fine control (0.5m.min); constant tensioning and constant parameter. Wire monitoring systems with inputs to laboratory panels and shipboard recording systems. Local and remote controls.

Permanently installed general-purpose winches include:
- two winches capable of handling 30,000 ft of wire rope or electromechanical cables having diameters from 1/4" to 3/8".

- A winch complex capable of handling 40,000 ft of 9/16" trawling or coring wire and 30,000 ft of 0.68" electromechanical cable (up to 10 KVA power transmission and fiber optics). This could be two separate winches or one winch with two storage drums.

Additional special purpose winches may be installed temporarily at various locations along working decks. Winch sizes may range up to 40 tons (140 sq ft) and have power demands up to 300 hp. (See also Multichannel Seismics).

Portable shelters available to winch work areas for instrument adjustments and repairs. Winch control station(s) located for optimum operator visibility with reliable communications to laboratories and ship control stations.

Overside Handling: Various frames and other handling gear and more versatile than present to accommodate wire, cable and free launched arrays. Matched to work with winch and crane locations but able to be relocated as necessary.

Stern A-frame to have 20-ft minimum horizontal and 30-ft vertical clearance; 15-ft inboard and outboard reaches; safe working load up to 60 tons.

Able to handle, deploy and retrieve very long, large-diameter piston corer up to 50 m length, 15 tons weight and 60 ton pullout tension. Variable configurations ranging from a flush deck to a waterline platform.

Provision to carry additional overside handling rigs along working decks from bow to stern. (See also Multichannel Seismics)

Control station(s) to give operator protection and operations monitoring and be located to provide maximum visibility of overside work.

Towing: Capable of towing large scientific packages up to 10,000 lbs tension at 6-knots and 25, 000 lbs at 2.5 knots in sea state 5, 35-knot wind, and 3-knot current.

Laboratories: Approximately 4, 000 sq ft of laboratory space including: Main Lab area (2,000 sq ft) flexible for frequent subdivision providing smaller specialized labs; Hydro Lab (300 sq ft) and Wet Lab (400 sq ft) both located contiguous to sampling areas; Bio-Chem Analytical Lab (300 sq ft); Electronics/Computer Lab and associated users space (600 sq ft); Darkroom (150 sq ft); climate-controlled chamber (100 sq ft), and freezer (100 sq ft).

Labs should be located so than none serve as general passageways. Access between labs should be convenient. Labs, offices and storage to be served by a man-rated elevator having clear inside dimensions of approximately 3 ft by 4 ft.

Labs to be fabricated using uncontaminated and "clean" materials and constructed to be maintained as such. Furnishings, HVAC, doors, hatches, cable runs, and fittings to be planned for maximum lab cleanliness.

Fume hoods to be installed permanently in Wet Lab and Analytical Lab. Main Lab shall have provision to temporary installation of fume hoods.

Cabinetry shall be high-grade laboratory quality including flexibility through the use of unistruts and deck boltdowns.

Heating, ventilation, and air conditioning (HVAC) appropriate to laboratories, vans, and other science spaces being served. Laboratories shall maintain temperature 70-75º F, 50% relative humidity, and 9-11 air changes per hour. Filtered air provided to Analytical Lab. Each lab area to have a separate electrical circuit on a clean but with continuous delivery capability of at least 40-volt amperes per square foot of lab deck area. Labs to be furnished with 110 v and 220 v AC. Total estimated laboratory power demand is 100 KVA.

Uncontaminated sea water supply to most laboratories, vans, and several key deck areas. Compressed air supply to be clean and oil-free.

Vans: To carry four standardized 8 ft by 20 ft portable vans which may be laboratory, berthing, storage, or other specialized use. Hookup provision for power, HVAC, fresh water uncontaminated sea water, compressed air, drains, communications, data and shipboard monitoring systems. Van access direct to ship interior.

Ship should be capable of loading and offloading vans using own cranes.

Workboats: At least one and preferably two 16-ft inflatable (or semi-rigid) boats located for ease of launching and recovery.

A scientific work boat 25 – 30 ft LOA specially fitted out for supplemental operation at sea including collecting, instrumentation, and wide-angle signal measurement. 12-hour endurance including both manned accommodations and automated operation. "Clean" construction. To be carried as a one of four-van options above.

Science Storage: Total of 20,000 cubic ft of scientific storage accessible to labs by elevator and weatherdeck hatch(es). Half to include suitable shelving, racks, and tie downs; remainder open hold.

Acoustical Systems: Ship to be as acoustically quiet as practicable in the choice of all shipboard systems and their location and installation. Design target of operationally quiet noise levels at 12 knots cruising in sea state 5 at the following frequency ranges:

- 4 hz – 500 hz seismic
- 3 kHz – 500 kHz echo sounding and acoustic navigation
- 75 kHz – 300 kHz Doppler Current Profiling

Ship to have 12 kHz, 3.5 kHz echo sounding systems and provision for additional systems.

Phased array, very wide multibeam precision echo sounding system (equivalent to "Sea Beam").

Transducers appropriate to dynamic positioning system.

Transducer Wells (20") one located forward and two athwartships. Large pressurized sea chest (4ft x 8 ft) to be located at optimum acoustic location for at-sea installation and servicing of transducers and transponders.

Multichannel Seismics: All vessels shall have the capability to carry out multichannel seismic profiling (MCS) surveys using large sound sources (airguns) and longstreamers (3-6 km).

Selected vessels shall have compressors capable of generating 2000 SCFM of air at 2500 psi permanently installed. The compressors and associated high-pressure plumbing should be installed in or adjoining below-deck machinery spaces.

Refer to the appendix on special characteristics of equipment and capabilities for geological and geophysical investigations.

Navigation/ Positioning: Global Positioning System (GPS) with appropriate interfaces to data systems and ship control processors:

Short baseline acoustic navigation system.

Selected vessels should be equipped with "dynamic positioning" capability to maintain the ship on station or on a trackline to the stationkeeping specifications under automatic control and appropriate navigational reference.

Internal Communi-cations: Internal communication system providing high-quality voice communications throughout all science spaces and working areas.

Data transmission, monitoring and recording system available throughout science spaces including vans and key working areas.

Closed-circuit television monitoring and recording of all working areas including subsurface performance of equipment and its handling.

Monitors for all ship control, environmental parameters, science and overside equipment performance to be available in all, or most, science spaces.

External Communi-cations: Reliable voice channels for continuous communications to shore stations (including home laboratories), other ships, boats and aircraft. This includes satellite, VHF and UHF.

Facsimile communications to transmit high-speed graphics and hard-copy text on regular schedules.

High-speed data communications (56K Baud) links to shore labs and other ships on a continuous basis.

Satellite Monitoring: Carry transponding and receiving equipment including antenna to interrogate and receive satellite readouts of environmental remote sensing.

Ship Control: Chief requirement is maximum visibility of deck work areas during science operations and especially during deployment and retrieval of equipment. This would envision a bridge-pilot house very nearly amidships and with unobstructed stern visibility.

The functions, communications, and layout of the ship control station should be carefully designed to enhance the interaction of ship and science operations. For example, ship course, speed, attitude, and positioning will often be integrated with scientific operations requiring control to be exercised from a laboratory area.

Sea State		*Height*	
	Description	*Feet*	*Meters*
0	Calm-glassy	0	0
1	Calm-rippled	0 to 0.5	0 to 0.1
2	Smooth-wavelets.....	0.5 to 1.5	0.1 to 0.5
3	Slight	1.5 to 4	0.5 to1.25
4	Moderate	4 to 8	1.25 to 2.5
5	Rough	8 to 13	2.5 to 4
6	Very rough	12 to 20	4 to 6
7	High	20 to 30	6 to 9
8	Very high	30 to 45	9 to 14
9	Phenomenal	Over 45	Over 14