

Scientific Mission Requirements for Large High-performance, General-purpose Oceanographic Research Ship, Small Waterplane Area Twin Hull (SWATH)

November 1989

General: The ship is to serve as a large general-purpose research ship. The overriding required characteristic is that the ship provide the most stable environment possible in order to allow both overside and laboratory work to proceed in greater capacity and in higher sea states than is now possible. 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.

Size: The size ultimately is determined by the requirements.

Endurance: Fifty days; providing the ability to transit 24 days at cruising speed and 24 days station work (see station keeping and towing); 10,000 mile total range.

Accommodations: 30 scientific personnel in two-person staterooms. Expandable to 40 under reduced endurance conditions, through the use of vans. Science library-lounge with conference capability. Science office.

Speed: 13 knots cruising; sustainable in sea state 6. Speed control ± 0.1 knot in 0-6 knot range; and ± 0.2 knot in range 6-15 knots.

Maintain science operations in following speeds and sea states:

15 knots cruising through sea state 6
10 knots cruising through sea state 7

Seakeeping: To provide exceptionally stable seakeeping capabilities. Design targets for at-rest condition in the following sea states are:

| | Sea State (Sig. Wave Height) | |
|---------------|------------------------------|--------------|
| | SS-4 (6.9 ft) | SS-5 (12 ft) |
| Pitch (ampl) | 2.0 degrees | 3.0 degrees |
| Roll (ampl) | 2.5 degrees | 4.0 degrees |
| Heave (ampl) | 1.7 ft | 3.0 ft |
| Vert. Accel. | 0.06 g | 0.09 g |
| Horiz. Accel. | 0.06 g | 0.11 g |

Station Keeping: Allow normal station and deck work through SS 6 and limited work through SS 7.

Maneuverability that would assure relative positioning at best heading in 30- knot winds and SS 5 and 1 1/2-kt current ± 150 ft maximum excursion from a point or trackline, and maintain ± 5 degree heading.

Maintain a precision trackline while towing at speeds as low as 0.5 kts with a heading deviation up to 45° 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 sea states specified.

Ice Strengthening:

None. Not intended for icebreaking or work in pack ice.

Deck Working Area:

Spacious; 4,000 sq ft minimum with work areas along all sides; bow and stern; and center well. Provide for deck loading up to 1,500 lbs/sq ft and an aggregate total of 100 tons.

Oversize holddowns on 2-ft centers. Highly flexible to accommodate large and heavy equipment. Removable bulwarks and/or railings.

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

Centerwell:

Approximately 15 ft x 30 ft centerwell accessible from working deck and interior deck.

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 capable of carrying portable cranes for specialized purposes.

Winches:

New generation of oceanographic winch systems providing fine control (0.5 m/rnin); constant tensioning and constant parameter. Wire monitoring systems with inputs to laboratory panels and shipboard recording system. 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 to 300 hp.

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 to accommodate wire cable and free launched arrays. Matched to work with winch and crane locations but able to be relocated as necessary .

Stem A-frame to have 20-ft minimum horizontal and 30-ft vertical clearance; 15-ft inboard and outboard reaches.

Provision to carry additional overside handling rigs along working decks from bow to stern.

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.

Laboratories:

Approximately 3,000 sq ft of laboratory space including: Main lab area (1,500 sq ft) flexible for frequent subdivision providing smaller specialized labs; Hydro lab (200 sq ft) and Wet lab (300 sq ft) both located contiguous to sampling areas; Bio-Chem Analytical lab (200 sq ft); Electronics/Computer lab and associated users space (500 sq ft); Darkroom (100 sq ft); climate controlled chamber (100 sq ft), and freezer (100 sq ft).

Labs should be located so that 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 for 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 of 70-75° 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 bus 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: | <p>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.</p> <p>Provision to carry up to four additional portable non-standard vans (600 sq ft total) on superstructure and working decks. Supporting connections at several locations around ship including foredeck.</p> <p>Ship should be capable of loading and offloading vans using own cranes.</p> |
| Workboats: | <p>At least one and preferably two 16-ft inflatable (or semi-rigid) boats located for ease of launching and recovery.</p> <p>A scientific work boat 25-30 ft LOA specially fitted out for supplemental operations at sea including collecting, instrumentation, and wide angle signal measurements. 12-hour endurance including both manned accommodations and automated operation. "Clean" construction. To be carried as a one of four-van options above.</p> |
| Science storage: | <p>Total of 15,000 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.</p> |
| Acoustical Systems: | <p>Ship to be as acoustically quiet as practicable in the choice of all shipboard systems and their location and installation. Design target is operationally quiet noise levels at 12 knots cruising in sea state 5 at the following frequency ranges:</p> <ul style="list-style-type: none"> • 4 hz -500 hz seismic • 3 kHz -50 kHz echo sounding and acoustic navigation • 75 kHz -300 kHz Doppler Current profiling <p>Ship to have 12 kHz, 3.5 kHz echo sounding systems and provision for additional systems.</p> <p>Phased array, multibeam precision echo sounding system (equivalent to "Sea Beam")</p> <p>Transducers appropriate to dynamic positioning system.</p> <p>Transducer wells (20") located forward and aft. Large pressurized sea chest (4 ft x 8 ft) to be located at optimum acoustic location for at-sea installation and servicing of transducers and transponders.</p> |
| Multichannel Seismics: | <p>All vessels shall have the capability to carry out multichannel seismic profiling (MCS) surveys using large sound sources (airguns) and long streamers (3-6 km).</p> |
| Navigation/ Positioning | <p>Global Positioning System (GPS) with appropriate interfaces to data systems and ship control processors for automatic computer steering and speed control.</p> |

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, board, 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 (56 K 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 with unobstructed stem 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, altitude, and positioning will often be integrated with scientific operations requiring control to be exercised from a laboratory area.

| <i>Sea State</i> | <i>Description</i> | <i>Height</i> | |
|------------------|-----------------------|------------------|---------------|
| | | <i>Feet</i> | <i>Meters</i> |
| 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 to 1.25 |
| 4----- | Moderate | 4 to 8 | 1.25 to 2.5 |
| 5----- | Rough | 8 to 13 | 2.5 to 4 |
| 6----- | Very rough | 13 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 |

