UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

# Science Mission Requirements for New Oceanographic Ships

**June 1986**

Prepared as Part of an
Overall Fleet Planning Study

UNOLS Fleet Replacement Committee
Woods Hole Oceanographic Institution
Woods Hole, Mass. 02543

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## Scientific Mission Requirements

The need to plan for new, more capable research ships to conduct scientific programs at sea has become a matter of urgency. Numerous studies have amply demonstrated that by the 1990's most ships will be obsolete in terms of capability to keep up with the growing requirements of modern seagoing oceanographic programs. Large high performance overside handling arrangements and modern state-of-the art shipboard laboratories will be needed to meet major ongoing ocean programs. In addition, a high quality working environment is essential in order to attract competent seagoing personnel.

The UNOLS Fleet Replacement Committee is preparing a plan for the replacement of the existing UNOLS Fleet. It will address the projected "fleet" for the 1995-2000 time frame. In addition to the recommended numbers and mix of vessels, the plan includes a compilation of science requirements and conceptual designs for each type or class of vessel envisioned.

The beginning point for any facility planning is an orderly statement of the mission requirements. In the case of research vessels, it is the science requirements which define the type of ship along with the size, speed, endurance arrangements and overall capability. Habitability, safety, and cost are important aspects and can have a significant impact on ship design, but these are either mandatory or statutory and usually are defined elsewhere. Science requirements shown here are for each class of ship according to its size or type. It is a fundamental precept that all UNOLS ships should possess "general purpose" capabilities, that is, be able to undertake research in any of the science disciplines with an effectiveness commensurate with the requirements stated herein for its size class. In addition, a number of ships are recommended to include an "option" or enhanced capability for work in a specialized field or discipline. Where this is recommended, such as in geology and geophysics, the additional requirements are defined separately.

The following sets of science requirements have been developed by working groups of practicing, seagoing scientists. As much as possible they have been, and continue to be, reviewed and revised throughout the community. The final design, construction and outfitting of future new ships will be based on the contents of these requirements. It is important that all seagoing science persons give serious attention to their content.

## SUMMARY COMPARISON OF SCIENCE REQUIREMENTS FOR LARGE SHIPS

| | HIGH ENDURANCE R/V (Monohull) | SWATH R/V | MEDIUM ENDURANCE R/V (Monohull) |
|---|---|---|---|
| SIZE RANGE | Class I (250-300 ft) | Class II (200-250 ft) | |
| ENDURANCE | Sixty Days: 30 days cruising; 30 days working. 15,000 miles total range at cruising | Fifty Days: 25 days cruising; 25 days working. 12,000 miles total range at cruising | |
| CRUISING SPEED | 15 knots | | 14 knots |
| SEAKEEPING | 15 knots through SS 4<br>13 knots through SS 5<br>8 knots through SS 6 | 15 knots through SS 6<br>10 knots through SS 7 | 14 knots through SS 4<br>12 knots through SS 5<br>8 knots through SS 6 |
| STATION KEEPING | Dynamic Positioning at best heading: Wind Vel. 35 knots; Sea State 5; 3 knot current; ± 5° head; ± 150 ft maximum excursion | | |
| PRECISION TRACKLINE | Maintain a precision trackline, including towing, at speeds as slow as 2 knots with maximum 45° heading deviation from the trackline in wind speed 35 knots; Sea State 5; 3 knot current. Speed control along track to be ± 0.1 knot; maximum lateral excursion 150 ft | | |
| TOWING | Capable of towing large scientific packages up to 10,000 lbs tension at 6 knots, and 25,000 lbs tension at 2.5 knots into a sea state 5 and 3 knot current | | |
| SCIENCE ACCOMMODATIONS | 30-35 scientific personnel in two person staterooms. Expandable to 40 in portable berthing vans. | | 20-25 scientific personnel in two person staterooms. Expandable to 30 in portable berthing vans |
| DECK WORK AREA | 3,000 sq ft with contiguous 12 x 50 ft area along side 100 tons disposable load | 4,000 sq ft with 15 x 30 ft centerwell 100 tons disposable load | 2,000 sq ft with contiguous 12 x 40 ft area along side 90 tons disposable load |
| LABORATORY AREA | 4,000 sq. ft. plus 4 portable vans with inside access | | 3,000 sq ft plus 2 portable vans with inside access |
| SCIENCE STORAGE | 30,000 cu. ft. | | 15,000 cu. ft. |
| ICE STRENGTHENING | ABS Class IB except ABS Class IAA when specified as ice capable | None | ABS Class IC |
| ACOUSTICAL SYSTEMS | All ships to carry precision echo sounding ("SEA BEAM"); 3.5 kHz and 12 kHz echo sounding; Doppler current profiling; bottom positioning to 6,000 m depth. Design underway - target is echo sounding at Sea State 4 | | |
| MULTI-CHANNEL SEISMICS | Selected vessels to carry seismic air compressors for 4,000 scfm at 2,500 psi; and a large array MCS system | Selected vessels to carry seismic air compressors for 3,000 scfm at 2,000 psi; and a large array MCS system | |

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## Wind and Sea Scale for Fully Arisen Sea

| Sea state | Description | Wind | | | | Sea | | | | | | | | | Sea state |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Beaufort wind force | Description | Range, knots | Wind velocity, knots† | Wave height, ft: Average | Wave height, ft: Significant | Wave height, ft: Average 1/10 highest | Significant range of periods, sec | $I_{max}$, period of maximum energy of spectrum | $\bar{T}$ average period | $\bar{l}$ average wavelength | Minimum fetch, nmi | Minimum duration, hr | |
| 0 | Sea like a mirror. | 0 | Calm | Less than 1 | 0 | 0 | 0 | 0 | | | | | | | 0 |
| | Ripples with the appearance of scales are formed, but without foam crests. | 1 | Light airs | 1–3 | 2 | 0.05 | 0.08 | 0.10 | Up to 1.2 sec | 0.7 | 0.5 | 10 in. | 5 | 18 min | |
| 1 | Small wavelets, still short but more pronounced; crests have a glassy appearance, but do not break. | 2 | Light breeze | 4–6 | 5 | 0.18 | 0.29 | 0.37 | 0.4–2.8 | 2.0 | 1.4 | 6.7 ft | 8 | 39 min | 1 |
| | Large wavelets, crests begin to break. Foam of glassy appearance. Perhaps scattered white horses. | 3 | Gentle breeze | 7–10 | 8.5 | 0.6 | 1.0 | 1.2 | 0.8–5.0 | 3.4 | 2.4 | 20 | 9.8 | 1.7 hr | |
| 2 | | | | | 10 | 0.88 | 1.4 | 1.8 | 1.0–6.0 | 4 | 2.9 | 27 | 10 | 2.4 | 2 |
| | | | | | 12 | 1.4 | 2.2 | 2.8 | 1.0–7.0 | 4.8 | 3.4 | 40 | 18 | 3.8 | |
| 3 | Small waves, becoming larger; fairly frequent white horses. | 4 | Moderate breeze | 11–16 | 13.5 | 1.8 | 2.9 | 3.7 | 1.4–7.6 | 5.4 | 3.9 | 52 | 24 | 4.8 | 3 |
| | | | | | 14 | 2.0 | 3.3 | 4.2 | 1.5–7.8 | 5.6 | 4.0 | 59 | 28 | 5.2 | |
| | | | | | 16 | 2.9 | 4.6 | 5.8 | 2.0–8.8 | 6.5 | 4.6 | 71 | 40 | 6.6 | |
| 4 | Moderate waves, taking a more pronounced long form; many white horses are formed (chance of some spray). | 5 | Fresh breeze | 17–21 | 18 | 3.8 | 6.1 | 7.8 | 2.5–10.0 | 7.2 | 5.1 | 90 | 55 | 8.3 | 4 |
| | | | | | 19 | 4.3 | 6.9 | 8.7 | 2.8–10.6 | 7.7 | 5.4 | 99 | 65 | 9.2 | |
| 5 | | | | | 20 | 5.0 | 8.0 | 10 | 3.0–11.1 | 8.1 | 5.7 | 111 | 75 | 10 | 5 |
| | | | | | 22 | 6.4 | 10 | 13 | 3.4–12.2 | 8.9 | 6.3 | 134 | 100 | 12 | |
| | Large waves begin to form; the white foam crests are more extensive everywhere (probably some spray). | 6 | Strong breeze | 22–27 | 24 | 7.9 | 12 | 16 | 3.7–13.5 | 9.7 | 6.8 | 160 | 130 | 14 | |
| | | | | | 24.5 | 8.2 | 13 | 17 | 3.8–13.6 | 9.9 | 7.0 | 164 | 140 | 15 | |
| 6 | | | | | 26 | 9.6 | 15 | 20 | 4.0–14.5 | 10.5 | 7.4 | 188 | 180 | 17 | 6 |
| | Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind (spindrift begins to be seen). | 7 | Moderate gale | 28–33 | 28 | 11 | 18 | 23 | 4.5–15.5 | 11.3 | 7.9 | 212 | 230 | 20 | |
| | | | | | 30 | 14 | 22 | 28 | 4.7–16.7 | 12.1 | 8.6 | 250 | 280 | 23 | |
| 7 | | | | | 30.5 | 14 | 23 | 29 | 4.8–17.0 | 12.4 | 8.7 | 258 | 290 | 24 | 7 |
| | | | | | 32 | 16 | 26 | 33 | 5.0–17.5 | 12.9 | 9.1 | 285 | 340 | 27 | |
| | Moderately high waves of greater length; edges of crests break into spindrift. The foam is blown in well-marked streaks along the direction of the wind. Spray affects visibility. | 8 | Fresh gale | 34–40 | 34 | 19 | 30 | 38 | 5.5–18.5 | 13.6 | 9.7 | 322 | 420 | 30 | |
| | | | | | 36 | 21 | 35 | 44 | 5.8–19.7 | 10.3 | 10.3 | 363 | 500 | 34 | |
| | | | | | 37 | 23 | 37 | 46.7 | 6–20.5 | 14.9 | 10.5 | 376 | 530 | 37 | |
| | | | | | 38 | 25 | 40 | 50 | 6.2–20.8 | 15.4 | 10.7 | 392 | 600 | 38 | |
| 8 | | | | | 40 | 28 | 45 | 58 | 6.5–21.7 | 16.1 | 11.4 | 444 | 710 | 42 | 8 |
| | High waves. Dense streaks of foam along the direction of the wind. Sea begins to roll. Visibility affected. | 9 | Strong gale | 41–47 | 42 | 31 | 50 | 64 | 7–23 | 17.0 | 12.0 | 492 | 830 | 47 | |
| | | | | | 44 | 36 | 58 | 73 | 7–24.2 | 17.7 | 12.5 | 534 | 960 | 52 | |
| | | | | | 46 | 40 | 64 | 81 | 7–25 | 18.6 | 13.1 | 590 | 1110 | 57 | |
| | Very high waves with long overhanging crests. The resulting foam is in great patches and is blown in dense white streaks along the direction of the wind. On the whole, the surface of the sea takes a white appearance. The rolling of the sea becomes heavy and shock-like. Visibility is affected. | 10 | Whole gale* | 48–55 | 48 | 44 | 71 | 90 | 7.5–26 | 19.4 | 13.8 | 650 | 1250 | 63 | |
| | | | | | 50 | 49 | 78 | 99 | 7.5–27 | 20.2 | 14.3 | 700 | 1420 | 69 | |
| | | | | | 51.5 | 52 | 83 | 106 | 8–28.2 | 20.8 | 14.7 | 736 | 1560 | 73 | |
| | | | | | 52 | 54 | 87 | 110 | 8–28.5 | 21.0 | 14.8 | 750 | 1610 | 75 | |
| | | | | | 54 | 59 | 95 | 121 | 8–29.5 | 21.8 | 15.4 | 810 | 1800 | 81 | |
| 9 | Exceptionally high waves (small and medium-sized ships might for a long time be lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected. | 11 | Storm* | 56–63 | 56 | 64 | 103 | 130 | 8.5–31 | 22.6 | 16.3 | 910 | 2100 | 88 | 9 |
| | | | | | 59.5 | 73 | 116 | 148 | 10–32 | 24 | 17.0 | 985 | 2500 | 101 | |
| | Air filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected. | 12 | Hurricane* | 64–71 | >64 | >80‡ | >128‡ | >164‡ | 10–(35) | (26) | (18) | ~ | ~ | ~ | |

* For hurricane winds (and often whole gale and storm winds) required durations and fetches are rarely attained. Seas are therefore not fully arisen.

† A heavy box around this value means that the values tabulated are at the center of the Beaufort range.

‡ For such high winds, the seas are confused. The wave crests blow off, and the water and the air mix.

SOURCE: W. A. McEwen and A. H. Lewis, "Encyclopedia of Nautical Knowledge," p. 483, Cornell Maritime Press, Cambridge, Md., 1953. "Manual of Seamanship," pp. 717–718, vol. II, Admiralty, London, H.M. Stationery Office, 1952. Pierson, Neumann, James, "Practical Methods for Observing and Forecasting Ocean Waves," New York University College of Engineering, 1953.

# UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

June 1986

## SCIENTIFIC MISSION REQUIREMENTS FOR LARGE HIGH ENDURANCE GENERAL PURPOSE OCEANOGRAPHIC RESEARCH SHIP

**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 feet.

**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.

**Accommodations:** 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 plus/minus 0.1 knot in 0-6 knot range; and plus/minus 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: | Maintain station and work in Sea States through 5; limited work in SS 7. |
| | Dynamic positioning both relative and absolute at best heading in 35 knot wind, Sea State 5, and 3-knot current in depths to 6,000 m using GPS and/or bottom transponders. Plus/minus 5 degree heading; plus/minus 150 ft. max. excursion. |
| | Maintain a precision trackline (including towing) at speeds as slow as 2 knots with 45° maximum heading deviation from the trackline under controlled conditions (GPS and/or acoustic navigation in depths to 6,000 m; in 35-knot wind; and 3-knot current. Speed control along track is to be within ± 0.1 knots with 150 ft. maximum lateral excursion from the trackline. |
| 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 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 (0.5 m/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 fibreoptics). 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 h.p. (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 tons 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 knots 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 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 constsructed 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 degrees 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: 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.

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.

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 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.

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 is operationally quiet noise levels at 12 knots cruising in Sea State 5 at the following frequency ranges:

- 4 hz - 500 hz seismic
- 3 kHz - 50 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 (4 ft. x 8 ft.) to be located at optimum acoustic location for at-sea installa-tion and servicing of transducers and transponders.

Multi-Channel Seismics:

All vessels shall have the capability to carry out multichannel seismic profiling (MCS) surveys using large source arrays and long streamers.

Selected vessels shall carry on MCS system equivalent to current exploration industry standards. This includes:

- Permanently installed large air compressors to provide 4,000 scfm at 2,500 psi pressure. Very long, multichannel hydrophone streamers up to 7,500 m.
- Multiple air gun and water gun source sub-arrays up to 20 meter length each with 15 guns in each sub-array.
- After deck arangements for streamer winches, and rail guide systems and booms for deploying and towing each of the air gun sub-arrays.
- Hydrophone streamer flotation oil filling and storage facility located near the streamer winch.
- A large shop located near the source array handling area for servicing air and water guns.

Other vessels to temporarily install and carry large array MCS system comprising two large capacity air compressors; streamer reel (10-ft. high, 15-ft. wide, 20-ton weight); rigging and booms to tow arrays with 100-meter separation; and up to four vans (600 sq. ft.) well aft in close proximity to towed arrays. Compressors may be permanently installed.

| | |
|---|---|
| Navigation/ Positioning: | Global Positioning System (GPS) with appropriate interfaces to data systems and ship control processors. |
| | Short baseline acoustic navigation system. |
| | Dynamic Positioning System with both absolute and relative positioning parameters. |
| 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. |
| Exterior Communi- ations: | 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 | Description | Height | |
|---|---|---|---|
| | | Feet | Meters |
| 0 ----- | Calm-glassy | 0 | 0. |
| 1 ----- | Calm-rippled | 0 to ⅓ | 0 to 0.1. |
| 2 ----- | Smooth-wavelets | ⅓ to 1¾ | 0.1 to 0.5. |
| 3 ----- | Slight | 1¾ 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. |

# UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

June 1986

## SCIENTIFIC MISSION REQUIREMENTS FOR MEDIUM ENDURANCE GENERAL PURPOSE OCEANOGRAPHIC RESEARCH SHIP

**General:** The ship is to serve as a medium to large general purpose research ship. The primary requirement is a maximum capability commensurate with ship size to support science and engneering operations at sea in terms of overside equipment handling, laboratory qualities, and a clean vibration free and stable environment for precision measurements.

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

**Size:** The size ultimately is determined by the requirements. However, it is intended that this is a class ship to be a direct replacement of the current large university research ships such as the AGOR-3 Class (210 ft. LOA).

**Endurance:** Fifty days; providing the ability to transit 24 days at cruising speed and 24 days station work (see stationkeeping and towing); 12,000 mile range at cruising speed.

**Accommo-ations.** 20 - 25 scientific personnel in two-person staterooms. Expandable to 30 through the use of vans. Science library-lounge with conference capability. Science office.

**Speed:** 14 knots cruising; sustainable through Sea State 4. Speed control plus/minus 0.1 knot in 0-6 knot range; and plus/minus 0.2 knot in range 6-14 knots.

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

14 knots cruising through Sea State 4
12 knots cruising through Sea State 5
8 knots cruising through Sea State 6
6 knots cruising through Sea State 7

| | |
|---|---|
| Station Keeping: | Maintain station and work in Sea States up through 5; limited in SS 6. |
| | Dynamic positioning both relative and absolute at best heading in 35 knot wind, Sea State 5, and 3-knot current in depths to 6,000 m using GPS and/or bottom transponders. Plus/minus 5 degrees heading; plus/minus 150 ft. maximum excursion. |
| | Maintain precision trackline (including towing) at speeds as slow as 2 knots with 45 degrees maximum heading deviation from the trackline. Under controlled conditions (GPS and/or acoustic navigation in depths to 6,000 m; in 35-knot wind; and 3-knot current. Speed control along track is to be within ± 0.1 knots with 150 feet maximum lateral excursions for the trackline. |
| Ice Strengthening: | ABS Classification 1C. Able to transit very loose pack. Not intended for icebreaking or close pack work. |
| Deck Working Area: | Spacious fantail area - 2,000 sq. ft. minimum with contiguous waist work area along one side 12 x 40 ft. minimum. Provide for deck loading up to 1,200 lbs./sq. ft. and an aggregate total of 90 tons. |
| | Oversize holddowns on 2-ft. centers. Highly flexible to accommodate large and heavy equipment. Removable bulwarks. Dry working deck but not greater than 6 - 8 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 sur-face; (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 (0.5 m/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 fibreoptics). 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 h.p. (See also "Multichannel Seismics")

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. Stern A-frame to have 15-ft. minimum horizontal and 25-ft. vertical clearance; 12-ft. inboard and outboard reaches; safe working loads up to 40 tons.

Able to handle, deploy and retrieve very long, large diameter piston corer up to 50 m. length, 15 tons weight and 60 tons pullout tension.

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 lb. tension at 6 knots, and 25,000 lbs. at 2.5 knots in Sea State 5; 35 knots wind; and 3 knot current.

Laboratories:

Approximately 3,000 sq. ft. of laboratory space including: Main Lab area (1,400 sq. ft.) flexible for frequent subdivision providing smaller specialized labs; Hydro lab (300 sq. ft.) and Wet lab (300 sq. ft.) both located contiguous to sampling areas; Bio-Chem Analytical lab (300 sq. ft.); Electronics/ Computer lab and associated users space (500 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 to be fabricated using uncontaminated and "clean" materials and constsructed 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 degrees 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 75 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 two 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.

Provision to carry up to three additional portable non-standard vans (500 sq. ft. total) on superstructure and working decks. Supporting connections at several locations around ship including foredeck.

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 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 two-van options above.

Science Storage: Total of 15,000 cubic ft. of scientific storage accessible to labs by interior 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 is operationally quiet noise levels at 12 knots cruising in Sea State 5 at the following frequency ranges:

- 4 hz - 500 hz seismic
- 3 kHz - 50 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, multibeam precision echo sounding system. (Equivalent to "Sea Beam")

Transducers appropriate to dynamic positioning system.

Transducer wells (20") one located forward and one 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.

| | |
|---|---|
| Multi-Channel Seismics | All vessels shall have the capability to carry out multichannel seismic profiling (MCS) surveys using large source arrays and long streamers.<br><br>Selected vessels shall have the capability to carry out multichannel seismic profiling (MCS) surveys using large source arrays and long streamers. This includes:<br><br>• Permanently installed large air compressors to provide 3,000 scfm at 2,500 psi pressure<br><br>• Carry large array MCS system comprising streamer reel (10-ft. high, 15-ft. wide, 20-ton weight); rigging and booms to tow arrays with 100-meter separation; and up to two vans (500 sq. ft.) well aft in close proximity to towed arrays. |
| Navigation/ Positioning: | Global Positioning System (GPS) with appropriate interfaces to data systems and ship control processors.<br><br>Dynamic Positioning System with both absolute and relative positioning parameters. |
| Internal Communi-cations: | Internal communication system providing high quality voice communications throughout all science spaces and working areas.<br><br>Data transmission, monitoring, and recording system available throughout science spaces including vans and key working areas.<br><br>Closed circuit television monitoring and recording of all working areas including subsurface performance of equipment and its handling.<br><br>Monitors for all ship control, environmental parameters, science and overside equipment performance to be available in all, or most, science spaces. |
| Exterior 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.<br><br>Facsimile communications to transmit high speed graphics and hard copy text on regular schedules.<br><br>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 read-outs 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 | Description | Height | |
|---|---|---|---|
| | | Feet | Meters |
| 0 ----- | Calm-glassy | 0 | 0. |
| 1 ----- | Calm-rippled | 0 to ¼ | 0 to 0.1. |
| 2 ----- | Smooth-wavelets | ¼ to 1½ | 0.1 to 0.5. |
| 3 ----- | Slight | 1½ 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. |

# UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

## SCIENTIFIC MISSION REQUIREMENTS FOR LARGE HIGH PERFORMANCE GENERAL PURPOSE OCEANOGRAPHIC RESEARCH SHIP "SMALL WATERPLANE AREA TWIN HULL (SWATH) TYPE"

June 1986

**General:** The ship is to serve as a large general purpose research ship. The most 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 21 days at cruising speed and 24 days station work (see stationkeeping and towing); 12,000 mile total range.

**Accommodations:** 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 in Sea State 6. Speed con- trol plus/minus 0.1 knot in 0-6 knot range; and plus/minus 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: | Maintain station and work in Sea States through 6; limited work in SS 7.<br><br>Dynamic positioning both relative and absolute in 35 knot wind, Sea State 5, and 3-knot current in depths to 6,000 m using GPS and bottom transponders. Plus/minus 5 degrees heading; plus/minus 150 ft. max. excursion.<br><br>Maintain a precision trackline (including towing) at speeds as slow as 2 knots with maximum heading deviation from the trackline of less than 45 degrees under controlled conditions (GPS and/or acoustic navigation in depths to 6,000 m) in 35-knot wind; and 3-knot current. Speed control along track is to be within ± 0.1 knots with maximum lateral excursions for the trackline of less than 150 feet. |
| Ice Strenthening: | 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.<br><br>Oversize holddowns on 2-ft. centers. Highly flexible to accommodate large and heavy equipment. Removable bulwarks and/or railings.<br><br>All working decks accessible for power, water, air, and data and voice communication ports. |
| Centerwell: | Approximately 15' x 30' center well 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 sur-face; (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.<br><br>Ship capable of carrying portable cranes for specialized purposes. |

Winches:

New generation of oceanographic winch systems providing fine control (0.5 m/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 fibre-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 h.p.

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.

Stern 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 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 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 constsructed 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 degrees 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:

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.

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.

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 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.

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 is operationally quiet noise levels at 12 knots cruising in Sea State 5 at the following frequency ranges:

- 4 hz - 500 hz seismic
- 3 kHz - 50 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, multibeam precision echo sounding system (Sea Beam).

Transducers appropriate to dynamic positioning system.

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.

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| Multi-Channel Seismics: | Temporarily install and carry large array MCS system comprising two large capacity air compressors; streamer reel (10-ft. high, 15-ft. wide, 20-ton weight); rigging and booms to tow arrays with 100-meter separation; and up to four vans (600 sq. ft.) well aft in close proximity to towed arrays. |
| Navigation/ Positioning: | Global Positioning System (GPS) with appropriate interfaces to data systems and ship control processors. |
| | Short baseline acoustic navigation system. |
| | Dynamic Positioning System with both absolute and relative positioning parameters. |
| Internal Communications: | 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. |
| Exterior Communications: | 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 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, altitude, and positioning will often be integrated with scientific operations requiring control to be exercised from a laboratory area.

| Sea State | Description | Height | |
|---|---|---|---|
| | | Feet | Meters |
| 0 ----- | Calm-glassy | 0 | 0. |
| 1 ----- | Calm-rippled | 0 to ½ | 0 to 0.1. |
| 2 ----- | Smooth-wavelets | ½ to 1½ | 0.1 to 0.5. |
| 3 ----- | Slight | 1½ 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. |

# UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

June 1986

## SCIENTIFIC MISSION REQUIREMENTS FOR AN INTERMEDIATE SIZE, GENERAL PURPOSE OCEANOGRAPHIC RESEARCH SHIP

**General:** The ship is to serve as a general purpose research ship. The primary requirement is a maximum capability commensurate with ship size to support science and engineering operations in all oceans in terms of improved over-side equipment handling, station keeping, towing, and to provide a stable laboratory environment for precison measurements. Other general requirements are for large scientific parties and greater flexibility in use of laboratory/deck spaces than is now available aboard intermediate size ships.

**Size:** The size ultimately is determined by the requirements. However, it is intended that this is to be a class ship to replace the current university research ships having such capabilities as the OCEANUS class (177 ft. LOA; 33 ft. BEAM; 1015 tons DISP).

**Endurance:** Thirty days; providing the ability to transit 15 days at cruising speed and 15 days station work (see station-keeping and towing); 8,000 mile total range.

**Accomodations:** 15-20 scientific personnel in two-person staterooms. Expandable to 25 through the use of vans. Science Library-Lounge with conference room capability. Science office.

**Speed:** 14 knots cruising; 12 knots sustainable through Sea State 4. Maximum speed 15 knots. Speed control plus/minus 0.1 knot in 0-6 knot range; and plus/-minus 0.2 knot in range 6-14 knots.

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

12 knots cruising through Sea State 4
10 knots cruising through Sea State 5
6 knots cruising through Sea State 6

**Station-Keeping:** Maintain station and work in Sea State up through 5. Dynamic positioning both relative and absolute in 35 knot wind, Sea State 5, and 3-knot current in depths to 6,000 m using GPS and bottom transponders; maximum excursion plus or minus 150 ft.

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| Ice Strengthening | Ability to transit loose pack (3/10 cover Class 1c). Not intended for icebreaking or close pack work. |
| Deck Working Area: | Spacious stern working area a 1,500 sq. ft. minimum with contiguous waist work area along one side 8 x 80 ft. minimum to allow piston coring. Provide for deck loading up to 1,200 lbs/sq. ft. and an aggregate total of 60 tons.<br><br>Heavy duty holddowns on 2-ft centers. Highly flexible to accomodate large and heavy equipment. Removable bulwarks. Dry working deck but not greater than 6-8 ft. above waterline.<br><br>Usable clear foredeck area to accommodate specialized towers and booms extending beyond bow wave.<br><br>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 and motion compensation; (5) usable as overside cable fairleads for towing at sea.<br><br>Ship capable of carrying portable cranes for specialized purposes. |
| Winches: | New generation of oceanographic winch systems providing fine control (0.5 m/min); constant tensioning and constant parameter. Wire monitoring systems with inputs to laboratory panels and shipboard recording systems. Local and remote controls.<br><br>Permanently installed general purpose winches include:<br><br>- Two hydrographic-type winches capable of handling 30,000 ft. of wire rope or electromechanical cable having diameters from 1/4" to 3/8".<br><br>- A heavy winch comlex capable of handling 40,000 ft. of 9/16" wire/ synthetic fibre rope; or 30,000 ft. of 0.68" electromechanical cable (up to 10 KVA power transmission) or fiberoptics cable. This is envisioned as one winch with multiple storage drums which could be interchanged. |

Additional special purpose winches may be installed temporarily at various locations along working decks. Winch sizes may range up to 30 tons (140 sq. ft.) and have power demands to 300 h.p.

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 accomodate wire, cable and free launched arrays. Maximum hoist capacity 30,000 lbs. Matched to work with winch and crane locations but able to be relocated as necessary.

Stern A-frame to have 15-ft minimum horizontal 25-ft. vertical clearance; 12-ft. inboard and outboard reaches.

Capability for articulated stern ramp, providing variable configuration ranging from a flush deck to a waterline platform.

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

Control stations(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 lb. horizontal tension at 6 knots, and 25,000 lbs. at 2.5 knots.

Labora-Tories: Approximately 2000 sq. ft. of laboratory space including: Main lab area (1000 sq. ft.) flexible for frequent subdivision providing smaller specialized labs; Hydro lab (200 sq. ft.) and Wet lab (200 sq. ft.) both located contiguous to sampling areas; Electronics/Computer lab and associated users space (300 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 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 degrees 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 75 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 two (2) standardized 8 ft. by 20 ft. portable deck vans which may be laboratory, berthing, storage, or other specialized use. Hookup provison for power, HVAC, fresh water uncontaminated sea water, compressed air, drains, communications, data and shipboard monitoring systems. Vans should have direct access to ship interior but located in wave sheltered spaces.

Capability to carry up to two (2) additional portable non-standard vans (500 sq. ft. total) on superstructure and working decks. Supporting connections at several locations around ship including foredeck.

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

Workboats: At least one (1) 16-ft. inflatable (or semi-rigid) boat located for ease of launching and recovery.

Capability to carry and deploy scientific work boat 25-30 ft. LOA, specially fitted out for supplemental operations at sea including data/sample collecting, instrumentation, and wide angle seismic measurements. Boat to have 12-hour endurance including both manned and automated operation. "Clean" construction. To be accomodated as one of the two-vans option above.

Science Storage: Total of 10,000 cubic ft of scientific storage accessible to labs by interior and weatherdeck hatch(es) and elevators. Half to include suitable shelving, racks, and tie downs; remainder open hold.

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| Acoustical Systems: | Ship to be as acoustically quiet as praticable in the choice of all shipboard systems and their location and installation. Design target is underway, conventional and Sea Beam SWATH echo sounding in Sea Stae 4 and acoustical dynamic positioning through Sea State 5. |
| | Ship to have conventional 1 kHz, 3.5 kHz echo sounding systems and provision for additional systems, including: |
| | - Phased array, multibeam SWATH sonar system (Sea Beam) for guiding seafloor sampling/photography for and deep tow geophysical profiling studies; and for limited bathymetric charting. |
| | - Forward-looking submarine search-type sonar for mid-water trawl net guidance. |
| | - Hull-mounted transducers appropriate for dynamic positioning using seafloor transponders. |
| | - Transducer wells one located forward and one aft. Large pressurized sea chest (3 ft. x 6 ft.) to be located at optimum acoustic location for at-sea installation and servicing of transducers and transponders. |
| Multichannel Seismics (MCS): | Temporarily install and carry on stern working deck an MCS system comprising two large capacity high pressure air compressor (total weight 20 ton total weight); rigging and booms to tow air gun source and streamer arrays; and up to two vans (500 sq. ft.) well aft in close proximity to towed arrays. |
| Navigation/ Communications: | Global Positioning System (GPS) with appropriate interfaces to data systems and ship control processors for automatic computer steering and speed control. |
| | Dynamic Positioning Systems with both absolute and relative positioning parameters using both GPS and seafloor acoustic navigation transponders. |
| Internal Communications: | 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 working areas.

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

Exterior Communications: Reliable voice channel 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.

Highspeed data communications (via satellite) 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 data.

Ship: Control: Chief requirements 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 with television monitors as well as direct, unobstructed stern visibility. Portable hand-held control units could also be used at various after deck locations during overside equipment handling.

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 by computer from a laboratory or working deck area. Also a collision avoidance system should be provided to help insure safe, remote computer controlled operations in traffic congested waters.

| Sea State | Description | Height | |
|---|---|---|---|
| | | Feet | Meters |
| 0 ----- | Calm-glassy | 0 | 0. |
| 1 ----- | Calm-rippled | 0 to ¼ | 0 to 0.1. |
| 2 ----- | Smooth-wavelets | ¼ to 1½ | 0.1 to 0.5. |
| 3 ----- | Slight | 1½ 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. |

# UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

June 1986

## SCIENTIFIC REQUIREMENTS FOR A SMALL SIZE GENERAL PURPOSE SWATH OCEANOGRAPHIC RESEARCH VESSEL

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| General: | The general aim of this study is to design a SWATH vessel with the same overall capabilities of an intermediate class monohull. Although smaller, the SWATH vessel will provide a more stable platform in higher sea states, have a higher cruising speed (15 knots), and use less fuel. On the other hand, the SWATH will be weight-limited; its payload will be only 50 LT including winches, cranes, frames, etc., but not fuel. |
| Size: | The size is determined by the requirements for a 15 knot cruising speed and a 4,000 mile range. Initial studies indicate that the displacement will be on the order of 400 LT, the continuous power will be 1620 horse power, the size of the "box" will be approximately 110 feet long by 55 feet wide. If the main engines are in the hulls, 6,000 square feet will be available for apportionment into living space, laboratory space, auxiliary engine space, center sampling well space, etc. The bridge and possibly some living space will be located above the main deck "box". |
| Endurance: | At least 21 days and not to exceed 30 days. |
| Accommodations: | 12-16 scientific personnel in two-person staterooms. Science library-lounge with conference capability. |
| Speed: | 15 knots cruising; sustainable in Sea State 5. Fine speed control throughout this range especially between 0-6 knots. |
| Station Keeping: | Maintain station and work through Sea State 5; limited work in SS 6. |
| Ice Strengthening: | None. |
| Deck Working Area: | Spacious work area - 3,000 sq. ft. minimum with contiguous waist work area along one side 12 x 50 ft. minimum. Provide for deck loading up to 1,200 lbs./sq. ft. in selected areas and an aggregate total of 50 tons. A 15 x 25 ft. centerwell to be provided. |

Holddowns on 2-ft. centers. Highly flexible to accommodate large but not necesarily heavy equipment. A deck at the bottom of the centerwell to be 10 ft. or less above waterline.

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

Cranes: A modern crane to handle heavy and large equipment capable of reaching working deck areas and offload vans and heavy equipment up to 8,000 lbs. Crane to have servo controls and motion compensation and be usable as oveside cable fairleads at sea.

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

Removable general purpose winches will include:

- Hydrowinch with interchangeable drums capable of handling 30,000 ft. of wire rope, Kevlar synthetic line or electromechanical cables having diameters from 3/16" to 5/16" (Markey DESS-3 or equivalent) weight with wire 5 tons.

- A winch capable of handling 20,000 ft. of 1/2" trawling or coring wire or 20,000 ft. or 0.68" electromechanical cable (up to 10 KVA power transmission and fiberoptics).

- Capable of loading and using portable winches such as a double drum winch with 15,000 ft. of 9/16" trawling wire on each drum for large mid-water net towing.

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.

NOTE: Because of weight considerations, the ship could carry 2 small winches or one large winch, but not all 3 together.

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 15-ft. minimum horizontal and 20-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.

Laboratories: Approximately 1,400 sq. ft. of laboratory space including: Main Lab area (700 sq. ft.) flexible for subdivision providing smaller specialized labs; Wet Lab (300 sq. ft.) both located contiguous to sampling area; plus Electronics/Computer Lab and associated users space (400 sq. ft.); and freezer (80 sq.ft.).

Labs should be located so that none serve as general passageways. Access between labs should be convenient.

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 hood to be installed permanently in Wet 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 degrees F; 50% relative humidity and 9 - 11 air changes per hour. 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 200 v AC. Total estimated laboratory power demand is 40 KVA. Uncontaminated sea water supply to most laboratories, vans, and several key deck areas. Compressed air supply to be clean and oil free.

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| Vans: | To carry two standardized 8 ft. by 20 ft. portable vans which may be laboratory, berthing, storage, or other specialized use. Hookup provision for power, fresh water, uncontaminated sea water, compressed air, drains, communications, data and shipboard monitoring systems. Van access direct to ship interior.<br><br>Ship should be capable of loading and offloading vans using own cranes. |
| Workboats: | One 16-ft. inflatable (or semi-rigid) boat located for ease of lauching and recovery. |
| Science Storage: | Little science storage space will be provided. Equipment to be used on various legs will have to be shipped in standard vans via commercial carriers. |
| Acoustical System: | Ship to be as acoustically quiet as practicable in the choice of all shipboard systems and their location and installation.<br><br>Ship to have 12 kHz, 3.5 kHz echo sounding systems and provision for additional systems. |
| Multi-Channel Seismics | None. |
| Navigation/ Positioning: | Global Positioning System (GPS) with appropriate interfaces to data systems and ship control processors.<br><br>Short baseline acoustic navigation system. |
| Internal Communications: | Internal communication system providing high quality voice communications throughout all science spaces and working areas.<br><br>Data transmission, monitoring, and recording system available throughout science space including vans and key working area.<br><br>Closed circuit television monitoring and recording of all working areas including subsurface performance of equipment and its handling.<br><br>Monitors for all ship control, environmental parameters, science and overside equipment performance to be available in all, or most, science spaces. |

Exterior Communications: 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 links to shore labs and other ships on a continuous basis.

Capability to receive realtime or near realtime satellite imagery.

Ship Control: Chief requirement is maximum visibility of deck work areas during science operations and especially during deployment and retrievel of equipment.

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.

Other: Ship to have acrylic dome at the bow of one lower hull and underwater view ports in the lower struts.

| Sea State | Description | Height | |
|---|---|---|---|
| | | Feet | Meters |
| 0 ----- | Calm-glassy | 0 | 0. |
| 1 ----- | Calm-rippled | 0 to ½ | 0 to 0.1. |
| 2 ----- | Smooth-wavelets | ½ to 1½ | 0.1 to 0.5. |
| 3 ----- | Slight | 1½ 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. |