Parameter	Capability or Characteristic - 2003 Ocean Class SMRs	Capability or Characteristic - 1989 Large High-Endurance	New Global Values	Committee Member Comment
Main Subject Headings are hyperlinked to Online SMR document				
Size and Cost				
Length	55-70 meters (180 to 230 feet)	LOA not to exceed 300 feet	FOFC Plan = 70 - 90	
Cost	$50 million, total program cost in 2001 $'s	Not specified	$70 million in 2001 $s, total	
Draft	Consider ports to operate from (~18 - 19 ft)	Not specified		
Accommodations and habitability				
Accommodations	20 to 25 non-crew personnel - Crew and Technicians in single staterooms to the maximum extent possible. Non-crew in 2 person	30 - 35 in 2 person rooms expandable to 40 with vans	FOFC plan = 30 - 35	
Habitability	Attention to details that ensure effective work and living spaces.	Science library lounge with conference capability. Science		
Operational characteristics				
Endurance	40 days (20 transit and 20 station) 30+ days for underway survey or towing cruises at 4 - 12 knots.	60 days (18 transit 42 on station)	FOFC plan = 50 Days	
Range	Up to 20,000 km (10,800 nautical miles) at optimal transit speeds. Minimum of 14,815 km (8,000 nm) required	15,000 nautical mile range at cruising speed (27,778 km)	FOFC plan = 25,000 km (13,500 nm)	
Speed	12 knots sustainable through sea state 4. 14 - 15 kts maximum at sea trial in calm seas. Optimum cruising speed of at least 12 kts desirable.	15 knots cruising sustainable through SS 4		
Speed Control	Speed control in sea state 4 or less should be ±0.1 kts in 0 - 6 kt range and ±0.2 kts in the 6 - 14 kt range	Speed control +/- 0.1 kt in 0-6 range ; and +/- 0.2 kt in range 6-15 kt		

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Sea keeping	Fully operable in sea state 4. Maximize ability to work in sea states 5 (2.5 to 4 m wave heights) and higher. 75% operability in PNW and NA during winter. At sea state 5: maintain 9 knots, maintain on station ops 80% of time (CTD ops 90%, Moorings 75%, Coring 50%, ROV and similar 50%). At sea state 6, maintain 7 knots and 50% operability. At sea state 7 and	Maintian science operations in following speeds and sea states: 15 kt cruising through SS 4 13 knots cruising through sea state 5 8 knots cruising through sea state 6 6 knots cruising through sea state 7		
SK - Vertical	SS5 - less than 0.15 g (rms)	not specified		
SK - Lateral accelerations	SS5 - less than 0.05 g (rms) at deck level	not specified		
SK - Maximum roll	SS5 - less than 3 degrees (rms)	not specified		
SK - Maximum pitch	SS5 - less than 2 degrees (rms)	not specified		
SK - Deck wetness	Not specified, criteria used by JJMA - get # of deck wetting events	not specified		
Station keeping	Dynamic positioning ± 20 meters relative to a fixed position in 35 knot wind, sea state 5, and 2 knot current at best heading. ± 5 meters through SS4 at best heading. DP system design to minimize adverse affects on the operation of acoustic systems as much as possible.	Allow normal station and deck work in sea states through SS 5 and limited work through SS 7. At best heading in 35 kt wind, SS 5 and 2 kt current maintain within 50 meters of fixed position		

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Track line following	Maintain a track line within ± 5 meters of intended track and with a heading deviation (crab angle) of less than 45 degrees with 30 knots of wind, up to sea state 5 (2.5 - 4 m wave heights), and 2 knots of current. No large and/or frequent heading changes.	Maintain a precision track line 95% of time within 50 meters while towing at speeds as low as 0.5 kt with heading deviation up to 45 0 from prescribed trackline using GPS or bottom nav as reference. Speed control should be maintained =/- 0.1 kt		

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Ship control	The chief requirement for ship control is maximum visibility of deck work areas and alongside during science operations and especially during deployment and retrieval of equipment. This should be accomplished with a direct view to the maximum extent possible and enhanced with closed circuit television systems. Portable hand-held control units or alternate control stations could also be used at various locations that enhance visibility and communications with the working deck during over the side 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 should be integrated with scientific information systems. Voice communication systems between the bridge, labs, working decks, and machinery spaces should	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.		

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Ice strengthening	It is desirable that two vessels (one in Atlantic & one in Pacific) in this class have the capability to operate in the presence of 6/10 coverage of first year ice and should be designed to meet the criteria for the appropriate ice classification.	ABS Ice Class IA. 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.		
Over-the-side and weight handling				
Over-the side equipment	The design of weight handling appliances to safely and effectively deploy, recover, and sometimes tow a wide variety of scientific equipment should be considered at the earliest stages of the design cycle so that they are integrated in the earliest layout of spaces. The entire suite of over the side handling equipment including winches, wires, cranes, frames, booms, and other appliances should be considered as an integrated system and perhaps engineered and designed by a single contractor/manufacturer. Designs for over the side appliances and equipment should include innovative thinking and consider ideas that will reduce the amount of human intervention necessary for launch and recovery of equipment, both on	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”.		

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Winches	Winches should provide fine control (0.1 m/min under full load); maximum winch speeds should be at least 100 meters/min. Two hydrographic-type winches capable of handling up to 10,000 meters of wire rope, electromechanical or fiber-optic cables having diameters from 1/4" to 1/2" should normally be installed. Winches should be readily adaptable to new wire designs with sizes within a range appropriate to the overall size of the winch. A heavy winch complex capable of handling 12,000 meters of 9/16" wire/synthetic wire rope and/or 10,000 meters of 0.68" electromechanical cable (up to 10 KVA power transmission) or fiber optics cable should be permanently	- 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		

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	A crane that can reach all working deck areas and that is capable of offloading vans and equipment weighing up to 20,000 lbs to a pier or vehicle in port is desirable. This will generally mean being able to reach approximately 20 feet beyond one side of the ship (usually starboard) with the design weight. At least one crane should be able to deploy buoys and other heavy equipment weighing up to 10,000 lbs up to 12 feet over the starboard side at sea in sea state 4. One or two smaller cranes, articulated for work with weights up to 4,000 lbs at deck level and at the sea surface, with installation locations forward, amidships, and aft should be provided.	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,		

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Frames	The Stern Frame should be designed for a dynamic safe working load of 30,000 lb through its full range of motion, and it must structurally engineered to handle 1.5 times the breaking strength of cables up to one inch, such as the tether for large ROV systems (up to 120,000 lbs breaking strength). The stern A-frame should have a 15-ft minimum horizontal and 25-ft vertical clearance from the attachment point for the block to the deck. At least a 12-ft inboard and outboard reach is required. Side weight handling appliances or frames should be designed to handle the loads for piston coring (e.g. 9/16 inch 3 x 19 wire) and have a safe working load of at least 20,000 lbs. Multiple locations and/or multiple devices should be provided that will facilitate deploying coring equipment, equipment from either side, and from the bow area. Portable weight handling appliances should be located to work with winch and crane locations, but be able to be relocated as necessary. The design of frames and other weight handling equipment should allow removal to flush deck.	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)		

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Towing	The ship should be capable of towing large scientific packages up to 10,000 lbs tension at 6 knots, and 25,000 lbs at 4 knots. Winch control should allow for fine control (± 0.1 meters/min) at full load and all speeds. Winches should be capable of sustaining 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.		
Science working spaces				
Working deck	Stern working area - 1,500 sq ft minimum aft of deck houses open as possible. Contiguous waist work area along one side that provides a minimum of 80 ft clear deck area. Minimum 8 foot width. Room for one van to be considered here. Total amount of clear working area available on the main deck aft	Spacious fantail area – 3,000 sq ft minimum with contiguous work area along one side 12 X 50 ft minimum		
	Deck loading should meet the current ABS rules (i.e. designed for a 12 foot head or 767 lbs/sq ft) and provide a minimum aggregate total of 60 tons on the main working deck. Point loading for some specific large items (such as vans and winches) should be evaluated in the deck design since these may	Provide for deck loading up to 1, 500 lbs/ sq ft and an aggregate total of 100 tons		
	All working areas should provide 1”-8NC (SAE National Coarse Thread) threaded inserts on two-foot centers with a tolerance of ± 1/16” on center. OTHER GENERAL REQUIREMENTS INCLUDED BEYOND	Oversize holddowns on 2-ft centers. Highly flexible to accommodate large and heavy equipment. Removable bulwarks. Dry working deck but not more than 7 - 10 feet above		

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	A clear foredeck area should be capable of accommodating small, specialized towers, booms, and other sampling equipment as much as possible. Providing tie down sockets, power, water, and data connections will facilitate flexible	Usable clear foredeck area to accommodate specialized towers and booms extending beyond bow wave		
	Additional deck areas should be provided with the means for flexible and effective installation of incubators, vans, workboats, and temporary equipment. (See relevant SMRs below for details) All working decks should be equipped with easily accessible power, fresh and seawater, air, data ports, and voice communication systems. Adequate flow of ambient temperature seawater for incubators should be available on decks supporting the installation of incubators. All working decks need to be covered by direct visibility and/or	All working decks accessible for power, water, air, and data and voice communication ports		

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Laboratories	The majority of the lab space should be located in one or two large lab(s) that can be reconfigured, partitioned, and adapted to various uses to allow for maximum flexibility. This flexibility is an important design criterion. Total lab space should be approximately	Approximately 4, 000 sq ft of laboratory space including: Main Lab area (2,000 sq ft) flexible for frequent subdivision providing smaller specialized labs		
	Main (dry) lab area (1,000 sq ft) designed to be flexible for frequent subdivision;	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		
	Separate wet lab/hydro lab (400 sq ft) located contiguous to sampling areas;	Darkroom (150 sq ft); climate-controlled chamber (100 sq ft), and freezer (100 sq ft).		
	An electronics/computer lab (300 sq ft);	Labs should be located so than none serve as general passageways. Access between		
	A separate electronics repair shop/work space for resident technicians;	Labs, offices and storage to be served by a man-rated elevator having clear inside dimensions of approximately 3 ft by 4 ft.		
	High bay/hanger space for multiple purposes adjacent to the aft main deck;	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		

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	Climate controlled work space or chamber (approx.100 sq ft) & Refrigerator/Freezer space (100sf)	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		
	SMR's contain separate sections for Lab layout & construction, electrical, water and air requirements with a lot of detail. Electrical: 75-100 amps 110 VAC single phase, 50 amps 208/230 VAC 3 phase readily available, 480 VAC 3-phase available. Clean bus with 40 volt amps per square foot of lab. 1/2 bolt downs on 2 foot centers. 7.5 to 8 ft of headroom. At least two sink locations in wet lab, four in main lab. Two locations for fume hoods in main lab, one in wet lab. Adequate supply of 18 mega-ohm water. 100psi ship's service air.	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.		

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Vans	Carry two standardized 8 ft by 20 ft portable deck vans and the capability to carry up to two additional portable, possibly non-standard size, vans (500 sq ft total); Electrical and other ships services to vans specified.	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		
Storage	Approximately 5,000 cubic feet of storage space that could also be used as shop or workspace when needed would be desirable.	Total of 20,000 cubic ft of scientific storage accessible to labs by elevator and weatherdeck hatch(es). Half to include suitable shelving, racks,		
Science load	Variable science load should be 200 LT (desirable), 100 LT minimum. 5% service life allowance for growth in light ship weight.			
Workboats	At least one 16-ft or larger inflatable boat located for ease of launching and recovery. Capability to carry science workboat 25-30 ft LOA. Workboats may have to be in addition to required rescue boats.	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		

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Masts	Main mast and second lightweight and removable mast capable of supporting science packages weighing between 30 & 100lbs.			
On deck incubations	Location with unobstructed sunlight and access to reliable 50 gals/min flow of water at ambient near surface seawater tempurature (<1 degree C above ambient).			
Marine mammal & bird observations	Area for two to three observers with a combined 180 degree obstruction free view forward of the beam.			
Science and shipboard systems				
Navigation	Best available navigation (real-time kinematics, differential, P-code, and 3-axis GPS) capability shall be provided with appropriate interfaces to data systems and ship control processors for geo-referencing of all data, dynamic positioning, and automatic computer steering and speed control. Back-ups and redundant systems should be provided to ensure continuous coverage. Best available electronic charting (e.g., ECDIS) and bridge management system shall be provided.	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.		

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Data network and onboard computing	A modern and expandable data network should be integrated into the design for all spaces on the research vessel including labs, deck areas, instrument mounting spaces, bridge, machinery spaces, common areas, and staterooms. Wireless networks should be available in laboratories. Connecting cables/wiring should be installed to	Data transmission, monitoring and recording system available throughout science spaces including vans and key working areas.		
Real time acquisition	A well designed “system” for real time collection of data from permanently installed sensors and equipment as well as provision for temporarily installed sensors and equipment that allows for archiving, display, distribution, and application of this data for a variety of scientific and ship board purposes should be designed and specified by a group of knowledgeable science users and			

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Comms – internal	Internal communication system providing high quality voice communications throughout all science spaces, working, and berthing areas should be provided. Point to point and all-call capabilities are required such as 21mc and 1mc systems. A sound powered phone emergency system should be included. All staterooms should have phones for internal communications. Alarm and information panels should be installed in key workspaces, common areas, and all staterooms. The alarm system and information panels should connect to vans seamlessly. The ability to install closed circuit television monitoring and recording of working areas should be provided to improve operations and safety. The ability to install monitors (flat screen) for all ship control, environmental parameters, science and over the side equipment performance should be available in	Internal communication system providing high-quality voice communications throughout all science spaces and 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		

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Comms – external	Reliable voice channels for continuous communications to shore stations (including home laboratories), other ships, boats, and aircraft should be provided. This includes satellite, cellular, VHF, HF, and UHF (best available and required by regulations). Voice and data communications should be provided through the best available systems (currently cellular (near shore) and satellite based systems). Plans should include high-speed data (best current capability) communication links to shore labs and other ships on a continuous basis; data transmission systems should be connected to internal networks and phone systems to provide accountable calling, network (internet), and email access. Transmission of video, photographs, and large data sets, as well as	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.		

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Underway data collection & sampling	The infrastructure and space for continuous underway sampling and data collection for as many ocean and atmospheric parameters as possible should be included in all design phases and construction details. This would include, but not be limited to surface (or near surface) seawater temperature, salinity, fluorescence, chemical, and biological measurements. Provisions for adequate continuous flow of seawater in all underway conditions to all permanently installed and temporary sensors should be included. System design including proper location for equipment, pump materials and design, de-bubblers, screening, intakes, and plumbing materials that ensure accurate measurements should be made based on current advice from science experts. Provisions for sampling clean, uncontaminated, and ambient			

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Acoustic systems	Each ship should be as acoustically quiet as is feasible. Special consideration should be given to machinery noise isolation, including heating and ventilation. Propeller(s) are to be designed for minimal cavitation, and hull form should attempt to minimize bubble sweep down. Installed systems should be based on the currently best available systems and should include the following types of systems: - 12 kHz single beam deep-sea echo sounder that meets the (IHO) standards for accuracy. - Sub-bottom profiler operating in the 2 to 8 kHz frequency range with an array suitable for use with a 10 kW transmitter. Allocate transducer space for a parametric sub-bottom profiler. - A multi-beam swath mapping sonar system capable of one degree or better resolution at full ocean depth. The system should be capable of obtaining reasonable data at depths as shallow as 50 meters. - ADCP system with transducer wells for more than one frequency (i.e. 38, 75 or 150 kHz); hull mounted	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.		

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Multichannel Seismics	Included as a portable towed system in Project science system installation.	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		
Satellite Monitoring	Included as part of communications/masts sections	Carry transponding and receiving equipment including antenna to interrogate and receive satellite readouts of environmental remote sensing.		

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Visiting science systems	Provisions are required for installing equipment that is brought on board occasionally such as SeaSoar, MOCNESS, MR1, Deep Tow, towed sonars, portable seismic reflection systems, gravimeters, and specialized ADCPs. Taught and slack tether ROVs, AUVs, remotely piloted aircraft, and other systems should also be readily accommodated. The types of equipment will need to be defined during concept and preliminary design cycles, and as much flexibility as possible should be designed. Generally providing power sources, deck space, mounting locations, and data connections will accommodate most needs, however, in some cases it may be necessary to provide fuel, hydraulic power or other services. Provision for multiple simultaneous connections should be possible for 480V 3-phase, 208 – 230V 3-phase and single phase, and 110V single phase with up to 50 amps service			

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Discharges	All liquid discharges from sinks, deck drains, sewage treatment systems, cooling systems, ballast pumps, fire fighting pumps, and other shipboard or science systems should be on the port side, with tanks capable of holding normal discharges for a minimum of 24 hours. Design should allow for zero discharges on the starboard side, including deck drains, when required during normal operations. A well thought out waste management plan should be developed during the design phases so that these vessels can prevent, control, or minimize all discharge of			
Construction, operation & maintenance				
Maintainability	Starting with the earliest elements of the design cycle, the ability to maintain, repair, and overhaul these vessels, and the installed machinery and systems efficiently and effectively with a small crew should be a high priority. Specifications for equipment should require all equipment vendors to provide parts lists, manuals, and maintenance procedures in electronic form for integration with a Computerized Maintenance Management System			

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Operability	Design should ensure that the vessel could be effectively and safely operated in support of science by a well trained, but relatively small crew complement. The regional conditions, available ports, and shore side services should be considered during the design process. The impact of draft, sail area, layout, and other features of the design on the ability to operate the vessel during normal science operations should be evaluated by experienced operators, technicians,			
Life cycle costs	A thorough evaluation of construction costs, outfitting costs, annual operating costs, and long-term maintenance costs should be conducted during the design cycle in order to determine the impact of design features on the total life cycle costs. Economy of operation has been a big benefit of the smaller classes of research vessels, and this aspect should be retained as much			
Regulatory issues	The impact of USCG and international regulations on the design and outfitting of these vessels should be carefully			