Ocean Class Science Mission Requirements (SMR) - Table of Requirements, Values, and Priorities

SMR ID	*Category*	*SMR_Element*	*Requirement*	*Target Objective*	*Minimum Threshold Value*	*Priority*	*ARRV*	*Ocean Class AGOR*	*OC AGOR Performance Spec (Attach J-1) cross reference*
01.01	Accommodations	Berths_non_crew	# Of berths - non crew	30 non-crew berths which includes berths for the Marine Technicians	20 Science berths plus 2 Marine Technicians for a total of 22 non-crew berths	Critical	24 science berths plus 2 Marine Technicians	20 science berths	070c p. 16
01.02	Accommodations	Staterooms_non_ crew	# Of staterooms - non crew	Four single staterooms with the remainder as double staterooms. The use of larger capacity staterooms can be considered especially if total berths can be increased.	2 single berths for technicians, 10 double staterooms	Very Important	12 double staterooms, including one ADA accessible, for scientists, 1 double for marine technicians.	10 double SR, 1 with dedicated TS, 1 ADA with dedicated TS and 8 with shared TS	070c p. 16
01.03	Accommodations	Crew_per_Stateroom	# Of crew per stateroom	1 - all crew	1 - officers, 2 - all others	Very Important	14 single, 2 double	2 single SR with dedicated TS for CO and Chief Eng. 6 single SR with shared TS and 6 double SR with shared TS. 14 crew berths	070c p 15 & 16
01.04	Accommodations	Toilet_Shower	# Of persons per toilet & shower facilities	2 for 25% of accommodations, 4 for remainder.	No more than 4	Important	Scientists: 3 rooms with 2-persons per WC/shower, 10 with 4-persons per WC/shower. Crew: 4 rooms with private WC/shower, 8 rooms with 2 persons per WC/shower, 2 rooms with 3 per WC/shower	4 max, 2 with 1, 8 with 2 and 14 with 4. 3 public Toilets	070c p 15 & 16
02.01	Habitability	HVAC_Temperatures	HVAC - Temperature ranges and environmental conditions	Same as minimum with wider range of environmental conditions and/or additional capacity for heating and cooling.	Maintain temperatures in normally occupied spaces (A/C Spaces) of at least 70 degrees F in the heating season and 75 degrees or lower in the cooling season. Other spaces can have relaxed requirements based on the use of the space. Use SNAME Technical and Research Bulletin No. 4-16 for guidance. Environmental conditions range from a minimum air temperature of 0 degrees F and seawater temperature of 28 degrees F in winter and a maximum dry bulb air temperature of 95 degrees F (82 degrees F wet bulb) and seawater temperature of 90 degrees F.	Very Important	Cooling season (ambient 90F air, 90F water): 70F Cooling season (ambient -25F air, 28F water): 70F	S070d Defines environmental conditions under which the ship systems will need to operate. 0°F - 95°F air temperature and 28°F - 90°F seawater temperature; S512 HVAC Design specs;	070d p 17 & 18 and Table 070-1; 512 p 68 - 71
02.02	Habitability	HVAC_Relative_ Humidity	HVAC - Relative Humidity percentages	Same as minimum	Laboratories require a non-condensing environment and shall have a relative humidity of 50% relative or lower. Other A/C spaces shall have a relative humidity of 55% or lower.	Very Important	50%RH	HVAC Design Specs	512 p 68 - 71
02.03	Habitability	HVAC_Air_Changes	HVAC - rate of air changes	Same as minimum	4 minute rate of change of air in air conditioned areas and 6 minute rate of change in ventilated spaces	Very Important		HVAC Design Specs	512 p 68 - 71

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02.04	Habitability	Noise_Levels	Noise Levels	Same as minimum	Airborne noise in ship compartments and at deck stations shall be specified such that the weighted sound pressure levels are 60 dB or lower in staterooms and lounges, 65 dB or less in other occupied spaces and passageways, 70 to 75 dB or less on working decks, bridgewings and the Main Control Station and no more than 110 dB in Machinery spaces. Spaces not listed shall have a noise level limit similar to a listed space with similar function or be in accordance with NVIC No. 12-82 and IMO Resolution A.468(XII), "Code on Noise Levels On Board Ships." Staterooms shall be sound insulated for privacy. Airborne noise specifications should be developed using an experienced shipboard noise consultant.	Critical	Not to exceed levels (dBA): Machinery rooms 110, workshops 75, passageways 65, labs 65, Galley 75, mess 65, library 60, staterooms 60, bridge 65, open deck aft 75, open deck fwd 70, Baltic room 85	Noise levels specified	073 pp 21 - 24; Table 073-1
02.05	Habitability	Vibration	Vibration	Same as minimum	The ship and all ship components shall be free from excessive vibration. Vibration is excessive when it results in damage or danger of damage to ship structure, machinery, equipment or systems, or when it interferes with the proper operation of the ship and all ship components. Vibration is also considered excessive when it interferes with personnel safety, comfort or proficiency, or with scientific operations. In particular vibration should be at a minimum in areas where microscope work or other sensitive scientific equipment is in operation. The following criteria should be used: Vibration in normally occupied spaces shall be limited to a maximum allowable velocity of 160 mils/sec (4 mm/sec) in maximum repetitive amplitude terms for a frequency range of 1 to 100 Hz in accordance with revisions to ISO 6954 recommended by SNAME T&R Bulletin 2-29. The vibration of the masts and other structures supporting vibration-sensitive equipment shall be limited to that level acceptable to the manufacturers of mast-mounted equipment, or ±0.1g over the frequency range of 1 to 100 Hz, whichever is less. The vibratory response of the propulsion system over its entire power range and speed range through 115 percent of maximum shaft RPM shall be limited according to manufacturer's recommendations and so as not to harm installed machinery.	Very Important	Normally occupied spaces: max 4mm/s max repetitive amplitude in range 1-100 Hz. In masts and structures no more than ±0.1g in range 1-100 Hz.	Vibration criteria	073 pp 21 - 24
02.06	Habitability	Light_Levels	Light Levels minimums and specifications	Same as minimum	Lighting levels shall generally exceed by 30% the values given in IESNA RP-12-97, Marine Lighting, Table 3. Laboratories shall have 100 foot-candles of light, staging bays and working decks shall have 70 foot-candles of light. In the laboratories, individual lights or groups of lights shall have independent switches to allow them to be controlled separately to provide varying light levels. Navigation spaces shall be equipped with red illumination in addition to the normal lighting.	Very Important	Main deck labs 120 FC, lighting set up in banks for control. Upper lab 50 FC	331 & 332 provide lighting specifications for decks, laboratories and other spaces. 100 ft-candles with ability to darken zones no larger than 100 sf in labs	331 p 50; 332b p 51

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02.07	Habitability	ADA_Design_ Features	Application of ADA Design Features	Implement as many of the ADA Guidelines as possible within the budget and size constraints for the vessel. ADA Guidelines for UNOLS Vessels_Final_Feb08.pdf	Implement ADA Guidelines that do not impact size of vessel. ADA Guidelines for UNOLS Vessels_Final_Feb08.pdf	Very Important	Personnel elevator access at Main deck and above, one ADA-accessible stateroom, wide passageways, ADA restroom on main deck, wide, no-sill door between main lab and baltic room, low sills and wide passageways throughout, ADA accomodation in mess.	S434 entertainment system; S493 Video and Audio network to all spaces.	434 p 60; 493 p 61 - 62
02.08	Habitability	Enhanced_ Habitability	Design for Enhanced Habitability to improve productivity and well being of personnel	Same as Minimum with a target of maximizing design features that enhance habitability and productivity.	The productivity of all personnel sailing in these vessels can be enhanced by providing comfortable, aesthetically pleasing spaces, and by including, to the extent possible, areas for off-hour activities other than staterooms and workspaces such as a library, lounge, or conference room with tables, good lighting, video capability, etc. Equipment and appropriate space for exercise should be provided. Human engineering principals should be applied in the design of workspaces. As an example, the distance from the deck to the underside of the finished overhead should be 7.5 to 8 feet. Headroom space and room for the installation of tall equipment should be maximized while balancing the need for cable trays, adequately sized ventilation ducts, lighting, etc.	Critical	Science office and Library/lounge, Exercise room, Spa room. Clear ceiling height on Main deck: 7.0ft. 01 level and above: 6.75ft. Structural deck-to-deck 10ft.	S640 - accomdation space specifications emphasizing habitablitiy;	640 p 103
03.01	Operational Characteristics	Endurance	Endurance in days for normal operations including transit, station work and underway surveys	45 days with full complement	40 days with full complement	Critical	45 days	40 days	070a p13, 070c p 15
03.02	Operational Characteristics	Range	Range at optimal cruising speed with normal reserve fuel capacity	10,800 nm (20,000 km) at optimal cruising speed	9,600 nm (17,700 km) at optimal cruising speed.	Critical	9400 nmi @ 12 knots, 18000 nmi @ 10 kts; 95% of fuel capacity	10,000 nm	070c p 15
03.03	Operational Characteristics	Speed	Speed in knots in calm seas at 80% of maximum continuous rating (MCR) and minimum sustainable speed in sea state four (SS4).	11 knots sustainable through sea state four. Cruising speed 12.5 kts at 80% maximum continuous rating (MCR) in Calm Seas (SS1)	10 knots sustainable through sea state four. Cruising speed of 12 kts at 80% maximum continuous rating (MCR) in Calm Seas (SS1)	Very Important	14.2 kts calm water, 12.3 kts SS5, 2 kts in 2ft level ice	11 knots at 80% MCR	070c p 15
03.04	Operational Characteristics	Draft_Navigational	Maximum Navigational Draft in feet	Same as Minimum	17 ft or less navigational draft with retractable appendages fully retracted. [includes service life allowance]	Very Important	18'-9"	17 ft maximum with retracted appendages.	070c p15

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04.01	Sea-keeping	Motion_Criteria	Maximum ship motions allowable if ship equipment and personnel are to be considered fully operable	Same as Minimum	• Vertical accelerations less than 0.15 g (RMS) at Main Deck amidships at deck edge. • Lateral accelerations less than 0.05 g (RMS) at Main Deck amidships at deck edge. • Roll less than 3 degrees (RMS) • Pitch less than 2 degrees (RMS)	Critical		S 070e - vert acc <0.15 g RMS, lateral acc <0.05 g RMS, roll < 3° RMS, pitch < 2° RMS; S565 Roll Stabilization Tank;	070e p18; 565 p 81
04.02	Sea-keeping	Fully_Operational	Maintains speeds from 0 to 9 knots and meets motion criteria 100% of the time using maximum wave height and the most probable modal period characteristic data for the Open Ocean North Atlantic as defined in Table D-1 of STANAG 4194	In sea state five (2.5 - 4 m wave heights)	In sea state four (1.25 - 2.5m wave heights)	Very Important		SS4	070e p18
04.03	Sea-keeping	80% Operability	Maintain speeds from 0 to 9 knots and have an operability index of at least 0.80 in sea state five (2.5 - 4 m wave heights) using the mean wave height and the most probable modal period characteristic data for the Open Ocean North Atlantic as defined in Table D-1 of STANAG 4194	In sea state six (4 - 6 m wave heights)	In sea state five (2.5 - 4 m wave heights)	Very Important		SS5 desirable	070e p18
04.04	Sea-keeping	50% Operability	Maintain speeds from 0 to 7 knots and have an operability index of at least 0.50 using the mean wave height and the most probable modal period characteristic data for the Open Ocean North Atlantic as defined in Table D-1 of STANAG 4194	In sea state seven (6 - 9 m wave heights)	In sea state six (4 - 6 m wave heights)	Very Important		SS6 desirable	070e p18

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04.05	Sea-keeping	Safely_Hove_to	Ability to safely hove to and ride out bad weather	Sea State Seven plus	Sea State Seven plus	Critical			
05.01	Station Keeping	Maintain_Position_ Heading_SS5	Maintain position at best heading in SS5, 35 knot wind, 2 knot current	± 2 meters from a fixed location at sea states up to SS5 OR ± 5 meters at higher wind, current, and sea state	± 5 meters from a fixed location	Critical		± 5 m in SS5 with 35 kts wind and 2 kt beam current.	420d-a p 55 - 56
06.01	Track Line Following	Track_Line_ Following	Follow a defined straight track segment in SS5, 30 knots of wind, and 2 knots beam current at speeds of 2 knots or greater	Same as minimum with higher wind, wave or current conditions	± 5 meters from intended track with less than 45° heading deviation.	Very Important		± 5 meters in SS% with 35 kts wind and a 2 kt beam current at speeds ranging from 2 kts to full speed. Crab angle less than 45°	420d-b p 56
07.01	Ship Control	Ship_Control	Design Requirements for Ship Control and visibility from control stations	Same as Minimum	Design for maximum direct visibility of deck working areas during deployment and retrieval of equipment. Functions, communications, and layout of ship control must allow the close interaction of ship and science operations. Cameras can be used where necessary for maximizing visibility of operations.	Critical		S663 Pilot House design critieria, calls for good visibility of stern, starboard side working decks and water surface at starboards side deployment locations.	663 p 111

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08.01	Ice Strengthening	Ice_Strengthening	Ice strengthening criteria	One additional vessel designed to meet the criteria for IACS Polar Class PC5 if demand exists and funding is available.	One vessel in this class (Alaska Region) is designed to meet the criteria for IACS Polar Class PC5: Year-round operation in medium first-year ice, which may include old ice inclusions. All other vessels shall be designed and constructed as Ice Class D0 in accordance with ABS Rules for Steel Vessels Under 90 meters (295 feet) in length.	Important	PC5	S070b Ice Classification D0	070b p14
09.01	Over-the-side Handling	Stern_Frame	Stern Frame Dimensions and Capacities	Structural Design IAW 46 CFR 189.35-9 for use with cables having a breaking strength = 120,000 lbs. Able to move 30,000 lbs through full range of motion. Minimum horizontal clearance = 20 ft up to 15 ft above the deck. Minimum vertical clearance between deck and attachment point = 27 ft. Minimum inboard and outboard reach = 12 ft. Rotation period from stop to stop shall be no more than 35 seconds. Winches and Over-the-Side Handling systems shall be designed and provided as an integrated system. Refer to UNOLS Load Handling System Functional Requirements for further detail.	Structural Design IAW 46 CFR 189.35-9 for use with cables having a breaking strength = 120,000 lbs. Able to move 15,000 lbs through full range of motion. Minimum horizontal clearance = 20 ft up to 15 above the deck. Minimum vertical clearance between deck and attachment point = 27 ft. Minimum inboard and outboard reach = 12 ft. Rotation period from stop to stop shall be no more than 35 seconds. Winches and Over-the-Side Handling systems shall be designed and provided as an integrated system. Refer to UNOLS Load Handling System Functional Requirements for further detail.	Critical	Dynamic SWL 30,000lbs, designed for 120,000lb BS cables. 20ft clear width, 25 ft. deck to block attachment point. Two-stage deployment aft, safety position forward to 48" above deck.	S573a - General requirements; S73d Stern Frame requirements - 15,000 dynamic SWL, 46CFR189 loads for 120,000 lb BS cable, 10 ft wide opening up 15 ft, 27 ft to sheave attachment point, 12 ft inboard and outboard reach; 573e controls	573a p 81; 573e p 85

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09.02	Over-the-side Handling	Side_Weight_Handling	Side Weight Handling Appliance Dimensions and Capacities	Structural Design IAW 46 CFR 189.35-9 for use with cables having a breaking strength = 45,000 lbs. Able to move 20,000 lbs through full range of motion. Minimum horizontal clearance = 10 ft. Minimum vertical clearance between deck and attachment point = 18 ft. Minimum inboard and outboard reach = 12 ft. Design does not have to be a typical frame, but any system that can reliably, safely, and effectively allow the launch and recovery of science packages over-the-side including supporting the deployed system while being lowered or towed. "Hands free" deployment with control of the package to the water and with motion compensation while deployed should be included whenever possible. Winches and Over-the-Side Handling systems shall be designed and provided as an integrated system. Refer to UNOLS Load Handling System Functional Requirements for further detail.	Structural Design IAW 46 CFR 189.35-9 for use with cables having a breaking strength = 45,000 lbs. Able to move 10,000 lbs through full range of motion. Minimum horizontal clearance = 10 ft. Minimum vertical clearance between deck and attachment point = 18 ft. Minimum inboard and outboard reach = 10 ft. Design does not have to be a typical frame, but any system that can reliably, safely, and effectively allow the launch and recovery of science packages over-the-side including supporting the deployed system while being lowered or towed. "Hands free" deployment with control of the package to the water and with motion compensation while deployed should be included whenever possible. Winches and Over-the-Side Handling systems shall be designed and provided as an integrated system. Refer to UNOLS Load Handling System Functional Requirements for further detail.	Very Important	Side boom to meet requirements of NSF/NAVY Load Handling Systems Workshop.	S573a - General requirements; 573d Stbd side handling device with 10,000 dynamic SWL, designed to 50,000 lb breaking strength; 573e controls	573a p 81; 573e p 85
10.01	Winches & Wire	Hydrographic_ Winches	Hydrographic Winches capacities and capabilities.	Same as minimum	Two winches with 10,000 meter capacity for wire rope, E-M cable and F-O cables from 1/4" to 1/2" diameter. Two or more mounting locations. Winches should have speed control to 0.1 meters/min throughout the speed range up to 1.5 m/sec. Monitoring system shall support the most stringent requirements of the UNOLS Research Vessel Safety Standards - Appendix A (i.e. refresh rate of at least 10 Hz). Winches and Over-the-Side Handling systems shall be designed and provided as an integrated system. If a CTD Handling system is provided with an integrated winch, it can be counted as one of the hydrographic winches. Refer to UNOLS Load Handling System Functional Requirements for further detail.	Very Important	10,000m capacity	S573a - General requirements; S573c winch requirements - two hydrographic wincheds capable of handling 0.393 f/o cable at 90 m/m, winch monitoring specs at 10 Hz frequency; 573e controls	573a p 81; 573c p 83

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10.02	Winches & Wire	Heavy_Duty_Winch_ Complex	Heavy Duty Winch Complex capacities	Same as minimum	Traction winch system with two drums with the capacity to hold 12,000 meters of 9/16" wire rope or 10,000 meters of 5/8" wire rope AND 10,000 meters of either 0.680" E-M cable or 0.681" F-O cable. Fine speed control to 0.1 meters/min up to 1.5 m/sec maximum speed. The winch and sheaves must be capable of handling F-O cable and storage drums should be fitted with an integral cooling system to keep cables cool during high power transmission. Monitoring system shall support the most stringent requirements of the UNOLS Research Vessel Safety Standards - Appendix A (i.e. refresh rate of at least 10 Hz). Winches and Over-the-Side Handling systems shall be designed and provided as an integrated system. Refer to UNOLS Load Handling System Functional Requirements for further detail.	Very Important	Dual-drum traction winch complex, 10,000m capacity	S573a - General requirements; S573c winch requirements traction winch with two drums, 45 m/m at full load up to 90 m/m at light load. 12,000 meters of 9/16 and 10,000 of 0.680 with two constant tension storage drums, winch monitoring specs at 10 Hz freque	573a p 81; 573e p 85
10.03	Winches & Wire	Cranes	Crane requirements and capabilities	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. 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.	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 smaller crane, 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.	Very Important	Two stern cranes for instrument deployment and self-loading	S573a - General requirements; S573b Crane Requirements - fixed crane with 20,000 load at 20 ft beyond stbd side in port and 10,000 lb at 12 ft beyond stbd side in SS4.. Portable articulated crane capable of 4,000 lbs at sea surface 12 ft beyond stbd side	573a p 81; 573b p 82
10.04	Winches & Wire	Towing	Towing capabilities - bollard pull	Same as minimum	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. Winches should be capable of sustaining towing operations continuously for days at a time.	Very Important	Bollard pull 108,000 lbf	10,000 lbs @ 6 kts and 25,000 lbs @ 4 kts, continuously for 40 days.	070c p 15
11.01	Science Working Spaces	Working_Deck_Total	Working deck - Total clear working area requirements	2,600 sq ft total	Total amount of clear working area available on the main deck aft should be at least 2,000 sq ft.	Very Important	Working Deck total 3690 sq.ft.	2,100 sf; 100c defines deck structural load requirments; 100e defines deck bolts and ISO van fittings.	070c p 17; 100c p 29; 100e p 30
11.02	Science Working Spaces	Aft_Deck_Area	Aft Deck Area - Amount of deck space aft of the deck houses assumed to be the full width of the ship.	1,800 sq ft aft of deck houses	1,500 sq ft minimum aft of deck houses as open as possible.	Very Important	Aft Deck 2900 ft. sq. clear of all overhangs	1,600 sf aft of deck house	070c p 17

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11.03	Science Working Spaces	Side_Deck_Area	Side Deck Area - contiguous area along the starboard side for operations such as coring.	Contiguous waist work area along one side that provides a minimum of 80 ft x 10 ft clear deck area that is in addition to aft deck area requirements	Contiguous waist work area along one side that provides a minimum of 80 ft x 10 ft clear deck area some of which can be counted towards the aft deck area.	Very Important	Max clear waist 81 ft.	80 ft x 10 ft	070c p 17
11.04	Science Working Spaces	Vans	Vans - number of vans to be carried.	Space to carry two ISO standard 8 foot x 20 foot portable deck vans and the capability to carry up to two additional portable, possibly non-standard size, vans that is in addition to the working deck space requirements. There should be the ability to mount two vans next to each other on the main deck and the ability to connect the vans to the Main Lab.	Space for two ISO standard 8 foot x 20 foot portable deck vans that is in addition to the working deck space requirements.	Critical	Two side-by-side locations with built-in tiedowns. Space and service for one additional van. No van docking.	S070c - two ISO 20 ft standard vans on stern working deck, space not part of working deck space; S665d Van Site requirements	070c p 17; 665d p 116

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11.05	Science Working Spaces	Laboratories	Laboratories - requirements for laboratory type and size	Total lab space should be approximately 2,100 sq ft including: The Main Lab shall be 1000 square feet minimum. The Wet Lab shall be 400 square feet minimum and shall have direct access to the starboard side Working Deck sampling areas. The Wet Lab shall have direct access to the Staging Bay. The Computer Lab shall be 300 square feet minimum. This space shall be dry and separated as much as possible from sources of electronic noise. A Staging Bay shall be 300 square feet minimum and rectangular shaped and shall have direct access to the aft and starboard side Working Deck areas and the Wet Lab. A Scientific Refrigerator/Freezer Chamber of 100 square feet minimum shall be provided adjacent to the Main and Wet Labs. The chamber shall be capable of maintaining temperatures from -15 degrees C to 10 degrees C at a precision of +/- 0.5 degrees C. Laboratories shall be as flexible as possible with the capability to be reconfigured, and adapted to various uses. This flexibility is an important design criterion.	Total lab space should be approximately 1,850 sq ft including: The Main Lab shall be 900 square feet minimum. The Wet Lab shall be 350 square feet minimum and shall have direct access to the starboard side Working Deck sampling areas. The Wet Lab shall have direct access to the Staging Bay. The Computer Lab shall be 250 square feet minimum. This space shall be dry and separated as much as possible from sources of electronic noise. A Staging Bay shall be 250 square feet minimum and rectangular shaped and shall have direct access to the aft and starboard side Working Deck areas and the Wet Lab. A Scientific Refrigerator/Freezer Chamber of 100 square feet minimum shall be provided adjacent to the Main and Wet Labs. The chamber shall be capable of maintaining temperatures from -15 degrees C to 10 degrees C at a precision of +/- 0.5 degrees C. Laboratories shall be as flexible as possible with the capability to be reconfigured, and adapted to various uses. This flexibility is an important design criterion.	Critical	Total lab space: 2010 sq.ft., Dry lab: 1000 sq.ft., Wet lab: 500 sq.ft., Computer-Electronics Lab 310 sq.ft. Additional spaces: Baltic Room/Hangar 490 sq.ft., Science Office 95 sq.ft., climate control chamber 70 sq. ft, Science freezer 55 sq. ft., electronics workshop 320 sq. ft.	S573f - Trolly lift system for the hanger space; S665 Laboratory specifications: a - number, size and type: Main Lab 950 sf, Wet Lab 360 sf, Computer Lab 270 sf, Staging Bay 250 sf, Scientific refer/freezer 100 sf; b - layout and construction; c - labor	573f p 86; 665 p 113
11.06	Science Working Spaces	Storage	Storage for science gear	Approximately 5,000 cubic feet of storage space that could also be used as shop or workspace when needed would be important.	4,000 cubic feet	Very Important	Science storerooms total approx 7000 cu.ft.	S672 Science Storeroom with 4,000 cu. ft.	672 p 118 - 119
11.07	Science Working Spaces	Science_Load	Science load capacity with growth allowance.	Variable science load should be 250 LT with a 5% service life allowance.	Variable science load should be at least 150 LT with a 5% service life allowance.	Critical	100 LT	Science load of 150 LT listed in table.	096 p 28 and Table 096-1

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11.08	Science Working Spaces	Workboats	Workboats - type and number of boats for science operations.	One 19 ft or larger foam collar or semi-rigid or other equivalent workboat with integral fuel tank and minimum twin 40 hp four stroke engines should be provided and located for ease of launch and recovery. This boat is in addition to the required SOLAS/USCG approved Rescue Boat. Capability to carry and launch at least one additional scientific work boat 16 ft or larger.	One 19 ft or larger foam collar or semi-rigid or other equivalent workboat with integral fuel tank and minimum twin 40 hp four stroke engines should be provided and located for ease of launch and recovery. This boat is in addition to the required SOLAS/USCG approved Rescue Boat.	Very Important	one solid hull "ice boat" with house, one RHIB	S583 - One 19 ft boat with twin 40 hp 4-stroke engines.	583 p 87
11.09	Science Working Spaces	Masts	Masts - requirements for support of science instrumentation.	Same as minimum	The main mast shall be provided with yardarms capable of supporting five scientific packages each weighing 100 pounds and measuring 2 feet wide by 2 feet long by 3 feet high. A second lightweight and removable mast shall be provided on the foredeck. The secondary mast shall be located as far forward on the bow as possible in a region where airflow is as little disturbed as possible by the ship's structure. The secondary mast shall be designed for easy servicing of installed scientific packages and instruments. The secondary mast shall be provided with yardarms capable of supporting 5 scientific packages weighing 25 lbs. each and measuring 1 foot wide by 1 foot long by 2 feet high. The secondary mast shall be of adequate height and stiffness to properly support the scientific packages in a region of undisturbed airflow. The secondary mast shall be provided with means (ex. hand-winch) for raising and lowering to allow servicing of installed sensors in one hour or less. The cranes or oceanographic winches shall	Very Important	Main mast designed to accommodate science packages. Jackstaff designed to accommodate science packages. Portable mast still under consideration	Main mast with provisions for five 100 lb (2x2x3ft) science packages. Operational requirements as well. Second lightweight removable mast as far forward on the bow as possible with as little air disturbance as possible. Capable of supporting five scien	170 p 31 - 32
11.10	Science Working Spaces	On_Deck_ Incubations	On-Deck Incubation space and support requirements.	Same as minimum with a target of identifying more clear space up to at least 300 sq ft that could be used to support on deck incubators and optical experiments. These areas should have access to power, services, and 50 gals/min of water at a temperature within 1° C of ambient seawater temperature.	Design of deck layout should include at least 200 sq ft of clear deck space that receive as much unobstructed sunlight as possible for deck incubators and optical experiments. These areas should have access to power, services, and 50 gals/min of water at a temperature within 1° C of ambient seawater temperature.	Very Important	Incubator location top of house	S 070c - include area and services for deck incubations and optical experiments with as much unobstructed sunlight as possible. S524 - seawater requirements with < 2° F rise in temperature.	070c p 17; 524 p 73

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11.11	Science Working Spaces	Mammal_Bird_Obs	Marine Mammal & Bird Observation space requirements.	Same as Minimum	A Marine Mammal Observation Area shall be provided at the level of the Pilot House or above. The area shall have obstruction-free visibility for at least a combined 180 degrees forward of the beam) and have space for three scientific personnel including chairs, a protected location for portable computers, and a mounting location for big eye-type binoculars. Observer locations shall be free from radiation hazards generated by radars and other communication equipment. The observer locations should not be in the normal exhaust stream. The area should have power and access to the data network.	Important	Mammal observation station top of bridge, or inside bridge.	area with 180 degree obstruction free visibility with space for three scientific personnel	070c p 17
12.01	Science and Shipboard Systems	Navigation	Navigation capabilities	Same as Minimum	An Integrated Bridge System shall be provided. The Integrated Bridge System shall be in accordance with the ABS Guide for Bridge Design and Navigational Equipment/Systems, Navigational Integrated Bridge System (NIBS). Equipment should be best available commercial systems, including but not limited to: Differential GPS; Automatic radio detection finder; Ship's depth finder; GPS assisted inertial reference system with gyro backup; Doppler speed log; and 10- and 3- cm radars. Provisions for electronic communication of Navigational information between the bridge and science systems should be incorporated.	Critical	Integrated bridge specified	S184 Nav system allignment defines need for benchmarks surveyed in reference to the centerline and in a common x,y,z axis grid; S424 Acoustic Nav specifies bridge depth finder and dual axis doppler speed log.; S438 - Integrated bridge system; S451 Specifi	184 p 32 ; 424 p 57; 438 p 61; 451 p 61; 494 p 62 - 63
12.02	Science and Shipboard Systems	Data_Network_ Computing	Data Network and Onboard Computing requirements	Same as Minimum	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, staterooms, and other working spaces. Connecting cables/wiring should be installed to all areas and include provisions for growth.	Critical	Data network specified, including fiber, copper, wireless		
12.03	Science and Shipboard Systems	Real_Time_Data_ Acquisition	Real-Time Data Acquisition system requirements	Same as Minimum	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 operators.	Critical	Underway data collection system provided post-delivery		

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12.04	Science and Shipboard Systems	Communications_ Internal	Internal Communications equipment requirements	Phones in all spaces; good comms throughout, including interior spaces, decks, and vans.	Telephone system, public address system, and sound powered telephone system	Critical	PA, internal phones and SPP specified	S432 Specifies SP phones, Dial Telephone system; S433 PA system; S434 Entertainment system; 436 Alarm system	432 p 59; 433 p 59-60; 434 p 60; 436 p 60 - 61
12.05	Science and Shipboard Systems	Communications_ External	External Communications equipment requirements	Same as minimum plus full-time internet (two antennae, e.g., HiSeasNet, if need be, no blind spots)	Commercially available voice and data channels for continuous communications to shore stations, other ships, boats, and aircraft including satellite, VHF, FAX, aircraft transceivers, cellular phone, and high speed data communications links.	Critical	GMDSS, VHF, Aircraft, cell phone, HiSeasNet and Fleet Broadband specified	S405 - Antennas, type and placement of antennas, especially Sat Comm antennas; S441 Exterior comms systems specifies GMDSS Sea Area A3 equipment plus 3 portable VHF radios, 2 A/C radios, at least one INMARSAT, Cellular connections with PABX/RJ-11 interfac	405 p52; 441 p 61

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12.06	Science and Shipboard Systems	Underway_Data_ Sampling	Underway Data Sampling and Collection requirements	Same as Minimum	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.	Very Important	All specified		
12.07	Science and Shipboard Systems	Scientific_Electrical_ Power	Scientific Electrical Power requirements	Same as Minimum	Use current IEEE 45 or equivalent standards for shipboard power and wiring and current IEEE standard for UPS and clean power specifications. Electrical service for the labs should include: 110 VAC, single phase 75-100 amps service for each lab; 208/230 VAC, 3-phase, 50 amps, "readily available" (i.e., in the panel, or 1-2 outlets); and 480VAC, 3-phase available "on demand" (for example, run into the lab from auxiliary outlets on deck). Provide for multiple simultaneous connections for 480V 3-phase, 208 - 230V 3-phase and single phase, and 110V single phase with up to 50 amps service for vans, laboratories, and on deck.	Critical	Abundant clean power available throughout.	Section 300 cableways and separation requirements. Section 320 Power Distribution and Lab Electrical requirements. (Voltages specified are 120 vice 110 and 340 vice 230 and there are no requirments for 480v). Specifies two science wireways and dedicated	300 p45; 320 p 48 - 49;
12.08	Science and Shipboard Systems	Lab_Water	Lab - Water requirements	Same as minimum. It is also desired that uncontaminated seawater intakes be available at multiple depths from the surface including access to surface water at about 1m depth.	Uncontaminated seawater should be supplied to most laboratories, vans, and several key deck areas. This water must be collected as close as possible to the bow and piping must be made from materials acceptable to the majority of science users. As a minimum, one uncontaminated seawater intake is required. A tank or system to supply feedwater to a deionizing system in the laboratories shall be provided.	Critical	Uncontaminated seawater available at every sink and on deck. Non-ferrous materials used whenever possible. Aux. System for incubators	S524 uncontaminated seawater system infrastructure; S532e deionizer feed water tank (SS) in lab;	524 p 73; 532e p 77
12.09	Science and Shipboard Systems	Lab_Air	Lab - Air requirements	Same as Minimum	The ship's service compressed air supply (@100 psi) should be available in the labs and have the ability to add filters as needed. Clean dry air needs are to be handled by bottled air or user supplied filter systems. Air quality should meet or exceed ISO 8573.1:2001 Class 1.2.1	Important	ISO 8573.1:2001 Class 1.2.1 air available in labs	S551 Compressed air requirements;	551 p 79 - 80;
12.10	Science and Shipboard Systems	Multibeam_deep_ water	Multibeam - deep water system	1° x 1° deep water multibeam	1° x 2° deep water multibeam	Critical	1x1 deep water specified with 1x0.5 option		J-6

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12.11	Science and Shipboard Systems	Multibeam_shallow_ water	Multibeam - shallow water capability	Same as Minimum	Multibeam system capable of obtaining useful data in water as shallow as 50 meters	Important	1x1 deep water specified with 1x0.5 option		J-6
12.12	Science and Shipboard Systems	ADCP	Acoustic Doppler Current Profiler (ADCP)	Same as minimum	Acoustic Doppler Current Profiling system with transducer wells for more than one frequency (i.e. 38, 75 or 150 kHz); hull mounted with a combined capability of 1000-meter depth and fine scale shallow water performance.	Critical	75 and 150 kHz ADCP specified, space for 38 kHz built in		J-6
12.13	Science and Shipboard Systems	Deep_Water_Echo_ Sounder	Deep Water Echo Sounder	Multi-frequency Deep Water Echo Sounder	12 kHz Echo Sounder	Critical	12 kHz general purpose echosounder		J-6
12.14	Science and Shipboard Systems	Sub_Bottom_ Profiler	Sub-Bottom Profiler	2 - 8 kHz Sub-Bottom Profiler	Capability to install 2 - 8 kHz Sub-Bottom Profiler	Very Important	Sub-bottom profiler integrated with Deep MB		J-6
12.15	Science and Shipboard Systems	Acoustic_Nav_ Tracking_System	Acoustic Navigation and Tracking System	Same as Minimum	Mounting location for transducers and equipment	Important	Space alloted on Centerboard		J-6
12.16	Science and Shipboard Systems	Underwater_ Communications	Underwater Communications system	Same as Minimum	Mounting location for transducers and equipment	Important	Space alloted on Centerboard		J-6
12.17	Science and Shipboard Systems	Additional_ Transducer_ Mounts	Additional Transducer mounting locations	Same as Minimum with additional instruments wells if space is available.	At least four transducer wells ideally situated for temporary or additional systems such as multiple ADCP systems, deep water echo sounder and sub bottom profiler systems. An instrument well accessible from the main deck or provision for over-the-side mounting. Ability to change instruments in wells while afloat without assistance from divers.	Critical	Abundant spare holes (19" & 22") in two rooms provided for project transducers. Diver-assisted installation	three 19 inch scientific transducers and one 24 inch transducer tube. These are in addition to those specified for specific pieces of equipment.	100g & 100h p 30, Attacment J-6

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12.18	Science and Shipboard Systems	Acoustic_ Performance	Acoustic performance and radiated noise	Same as Minimum	As acoustically quiet, as is feasible considering the choice of all shipboard systems, their location, and installation. 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. Airborne noise levels during normal operations at sustained speed or during over-the-side operations using dynamic positioning shall conform to standards in USCG NVIC No. 12-82 and IMO Resolution A.468(XII), "Code On Noise Levels On Board Ships." Sonar self noise should meet or exceed manufacturer's requirements. Underwater radiated noise and airborne noise specifications should be developed using an experienced shipboard noise consultant.	Critical	Underwater Radiated Noise criteria established	S-73 - Specific levels for airborne noise and sonar self-noise in the tables; S426 installation requirements for Scientific transducers and supporting equipment racks.	073 pp 21 - 24; Table 073-1 & Table 073-2; 426 p 57 - 58
13.01	Environmental and Maintenance	Discharges	Discharges over the side - holding tank requirements	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 48 hours or more. Design and outfit to make it possible for zero discharges of any kind for 24 hours or more.	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 36 hours. Design should allow for zero discharges on the starboard side, including deck drains, when required during normal operations.	Very Important	24 hour holding capacity	S505 specifies discharges on port side above the water line; S 528 Drain specifications in labs, decks, etc. ; S593 pollution systems, specifies discharge on port side	505 p 66; 528 p 73; 593 p 87;
13.02	Environmental and Maintenance	Waste_Management	Waste Management systems	Same as Minimum	A well thought out waste management plan must be developed during the design phases so that these vessels can prevent, control, or minimize all discharge of garbage and other wastes at sea. The use of all appropriate and best available systems and methods such as compactors, incinerators, vacuum toilets, low flow showers, oily water separators, efficient marine sanitary devices, recycling, adequate holding tanks, and others must be used to prevent, reduce, and control waste discharges. The location of garbage storage areas must be well defined. The vessel shall be designed and equipped so that it can effectively adhere to all local, state, federal, and international (MARPOL) pollution regulations, to prevent contamination of science experiments, protect the environment, and to ensure the health and safety of embarked personnel.	Very Important	Incinerator and compactor, seawater flushing, MSD	S529a Oily Waste; 593a Sewage systems with 96 hour holding period for black water, grey water and food waste; S593b solid waste includes incinerator, 24 hour staging area and trash compactor to meet Marpol V;	529a p 75; 593a p 88; 593b p 88;

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13.03	Environmental and Maintenance	Hazardous_Waste	Hazardous Waste storage requirements	Same as minimum	An on-deck hazardous storage capability for chemicals plus a holding capability for class C waste should be provided. Provisions for low-level radioactive waste storage will be incorporated in the radiation vans. Include storage for Class 9 Hazmat (includes lithium batteries)	Critical	Flammable storage locker with fire supression built in.	S671 - Hazardous Materials locker in the main lab, gasoline stowage rack (location not specified); S672 Hazardous Material Storeroom (not clear on hazardous waste)	671 p 117; 672 p 118 - 119
13.04	Environmental and Maintenance	Exhaust_Discharges	Exhaust Discharges	Same as Minimum	Discharges of engine exhaust, tank and sewage system vents, exhaust from fume hoods, and ventilation systems should be designed so they do not re-enter the ships interior or ventilation systems, and so they can all be directed away from the ship at the same time with proper placement of the relative wind (i.e. all on the port side aft). Exhaust and air system discharges should be separated from sensor locations as much as possible. An appropriately designed ship stack can easily accommodate and efficiently expel all engine exhaust and sewage system vent discharges. It should also provide both an educted and mechanically forced engine room and upper machinery space ventilation exhaust path adding efficiency to engine scavenging, air flow noise reduction on deck and insuring all sewage vent gas is routed well away from both ventilation intakes, deck areas and house openings. Engine choices should be made with the most enduring regulatory and performance utility in mind with appropriate soft patch access for removal and future updating a high priority as this consideration greatly increases the operational viability in an increasingly stringent regulatory environment where limited replacement budgets necessitate extended vessel life spans.	Very Important		S162 Stack Requirements; S593 exhaust discharge requirements; S593c Air emissions to meet most stringent Federal, State or local regulations.	162 p 31; 593 p 87; 593c p 89;

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13.05	Environmental and Maintenance	Green_Technology	Green Technology	Same as Minimum	Every effort should be made to incorporate recycled materials, non-polluting equipment and instrumentation and fuel efficient or alternative fuel technologies to make these vessels as environmentally friendly and cost effective as possible.	Important		Materials	078 p 25
13.06	Environmental and Maintenance	Maintainability	Maintainability	Same as Minimum	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. The choice of machinery and ship's systems should consider the cost and level of effort necessary to maintain and operate these systems.	Very Important		Repair and Maintenance, Reliability; requirements for equipment, machinery and materials; workmanship; materials; Machinery Access; Conditioned based monitoring for making repair and maintenance decisions; S 503 Pumps; S664 Engineer and ET workshops	070a p 13; 070g p 20; 070h p 20; 078 p 25; 081 p 27 - 28; 202 p35 Conditioned Based Monitoring; 503 p 63; 664 p 112
13.07	Environmental and Maintenance	Operability	Operability	Same as Minimum	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, scientists, and crewmembers.	Very Important		Human Engineering and Safety Requirements	077a & 077b pp 24 - 25
13.08	Environmental and Maintenance	Economy_Operation	Economy of Operation	Same as Minimum	Economy of operation has been a big benefit of the smaller classes of research vessels, and this aspect should be retained as much as possible in the new Ocean Class designs.	Very Important		Life Cycle Costs; Equipment and machinery requirements.	070a p 13; 070g p 20