



Antarctic Research Vessel (ARV)

Landing Craft Builder Specification

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Revision: P0



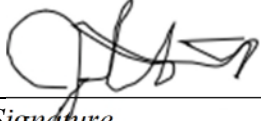
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Revision History

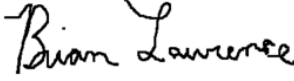
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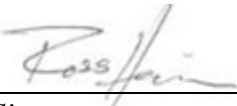


Signature James W. Holzgraf 8-2-2023
Print Name *Date*
James W. Holzgraf, Maritime Captain / Safety Lead, Leidos




Signature Brian Lawrence 8-2-2023
Print Name *Date*
Brian D. Lawrence, Solution Architect - RAM Lead, Leidos

Checked by:



Signature Ross Hein 8-2-2023
Print Name *Date*
Ross Hein, Science Mission Coordinator, Leidos ASC

Approved by:



Signature Michelle Gahagan 8-2-2023
Print Name *Date*
Michelle Gahagan, Project Engineer, Leidos ASC

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Table of Contents

Group 000 General 1

List of Tables

Table 1: Definitions..... 20
Table 2: References..... 22

Preliminary

Group 000 General

| Reqmt ID | Requirement Text |
|--------------|---|
| LC-000-1 | 000 GENERAL GUIDANCE AND ADMINISTRATION |
| LC-000.1-1 | 000.1 General Requirements |
| LC-000.1-1.1 | This document describes a Landing Craft (LC), a tender to the Antarctic Research Vessel (ARV), that will be designed and built according to the requirements of the National Science Foundation (NSF, the Owner), the Contract, and any other standards and regulations described herein. |
| LC-000.1-1.2 | This specification describes the requirements for construction of a Landing Craft (LC) for launch and recovery from the Antarctic Research Vessel (ARV). |
| LC-000.1-1.3 | All requirements specified in this document shall be met. |
| LC-000.1-1.4 | The LC shall be fully tested and outfitted at the time of delivery. |
| LC-000.1-1.5 | All material and equipment utilized in the construction and outfitting of the boat shall be new, unless specifically stated otherwise, herein. |
| LC-000.2-1 | 000.2 Objectives of this Document |
| LC-000.2-1.1 | 1. To establish absolute requirements for the vessel. |
| LC-000.2-1.2 | 2. To establish performance objectives for the vessel. |
| LC-000.2-1.3 | 3. To guide the contractor during the build process. |
| LC-000.3-1 | 000.3 Context of this Document |
| LC-000.3-1.1 | The intent of the level of detail provided in each specification herein is that, when all requirements are met, the resulting LC will achieve the balance of performance and cost desired by the Owner. |

| Reqmt ID | Requirement Text |
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| LC-000.4-1 | 000.4 CONVENTIONS |
| LC-000.4.1-1 | 000.4.1 Threshold and Objective Specifications |
| LC-000.4.1-1.1 | Most of the specifications provided in this document are threshold specifications. |
| LC-000.4.1-1.2 | Threshold specifications are requirements that must be met or exceeded to satisfy the Contract. |
| LC-000.4.1-1.3 | Some specifications also include an [Objective]. |
| LC-000.4.1-1.4 | [Objective] specifications need not be met to satisfy the Contract, but should be met, if possible, within the other constraints of the design. |
| LC-000.4.1-1.5 | Where a Threshold is given but an [Objective] is not, this implies there is no further goal than meeting the threshold value. |
| LC-000.4.2-1 | 000.4.2 Units |
| LC-000.4.2-1.1 | English units (feet [ft], long tons, gallons, etc.) shall be used unless otherwise specified. |
| LC-042-1 | 042 GENERAL ADMINISTRATIVE REQUIREMENTS |
| LC-042.1-1 | 042.1 General Requirements |
| LC-042.1-1.1 | Hull scantlings shall be determined in accordance with design category A ("ocean") in ISO 12215-5:2, "Small craft – Hull construction and Scantlings – Part 5: Design pressures, design stresses, scantling. |
| LC-042.1-1.2 | The vessel shall be constructed in the United States. |
| LC-042.1-1.3 | Design specifications shall include provisions for reliable equipment (including adequate backups and spares) that are protected from the elements to the maximum extent possible. |
| LC-042.1-1.4 | The vessel's average annual operational tempo shall be 60-75 days/year. |

| Reqmt ID | Requirement Text |
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| LC-044-1 | 044 SHIP OPERATION |
| LC-044.1-1 | 044.1 Overview |
| LC-044.1-1.1 | The vessel will be owned by the NSF and operated by a to-be-determined operator. |
| LC-044.1-1.2 | The LC will be a platform for science with a mission of transporting crew, scientific equipment, and shelter supplies to and from the beach and/or ice in a safe and cost-effective way with minimal impact to the local environment. |
| LC-044.1-1.3 | The vessel will serve the science community in the Southern Ocean and Antarctic areas, all times of the year, for 20 or more years. |
| LC-044.1-1.4 | While intended for operation in the southern hemisphere to support Antarctic operations, during the life of the vessel it is anticipated the LC will operate in tropical environments so the vessel must be capable of undertaking science operations in tropical water. |
| LC-044.1-1.5 | The LC shall be capable of conducting transport operations through Sea State 3, shall be capable of being recovered by the ship in Sea State 4 and shall be survivable through Sea State 5. |
| LC-044.2-1 | 044.2 Accommodations |
| LC-044.2-1.1 | Provisions for safety and sanitation for a Threshold of two (2) crew and four (4) scientists with an [Objective for two (2) crew and six (6) scientists]. |
| LC-044.2-1.2 | Seating arrangement for crew vessel operation shall include Threshold one (1) Captain helm chair and Threshold one (1) Crew with marine shock suspension and limited or no visibility obstructions. |
| LC-044.2-1.3 | The Seating arrangement for the Scientific Party shall include seating for Threshold four (4) [Objective six (6)]. |
| LC-044.2-1.4 | A worktable with bench seating shall be installed. |

| Reqmt ID | Requirement Text |
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| LC-044.2-1.5 | Threshold (50 gallons) [Objective (100 gallons)] permanent potable water tanks shall be installed. |
| LC-044.2-1.6 | All freshwater systems serving sinks shall be potable quality meeting U.S. Public Health Service standards. |
| LC-044.2-1.7 | The cabin shall be enclosed and have heating rated and sufficient for the polar environment. |
| LC-044.2-1.8 | The LC shall have the following sanitary space accommodations: |
| LC-044.2-1.8.1 | 1. One Marine Sanitary Device (MSD), flushable, and installed in accordance with 33 CFR Part 159. |
| LC-044.2-1.8.2 | 2. Sink basin with potable water faucet and electric pump. |
| LC-044.2-1.8.3 | 3. One Mirror. |
| LC-044.2-1.8.4 | 4. Storage for appropriate sanitary space cleaners and materials. |
| LC-044.2-1.8.5 | 5. Two coat hanger hooks. |
| LC-044.3-1 | 044.3 Working Decks |
| LC-044.3-1.1 | All working decks shall be equipped with easily accessible IP6 rate 120V power outlets, seawater washdown ports, and external cabin to deck voice communications. |
| LC-044.3-1.2 | Working decks shall explore the option for heating traction mats to alleviate ice buildup. |
| LC-044.3-1.3 | The working deck shall have the following requirements: |
| LC-044.3-1.3.1 | 1. An open obstruction free foredeck. |
| LC-044.3-1.3.2 | 2. Ability to accommodate loading of a standard sized 4-wheeled ATV and/or a Skandik super wide track. |
| LC-044.3-1.3.3 | 3. Non-skid self-draining deck. |

| Reqmt ID | Requirement Text |
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| LC-044.3-1.3.4 | 4. High-capacity deck drains. |
| LC-044.3-1.3.5 | 5. Port/Stbd floor rail for lashing. |
| LC-044.3-1.3.6 | 6. Flush deck tie downs points spaced with customer guidance. |
| LC-044.4-1 | 044.4 Scientific Systems and Equipment |
| LC-044.4-1.1 | The vessel shall be capable of deploying, retrieving, and towing glider packages from its J-Bar Davit and winch. |
| LC-044.4-1.2 | The LC shall have a J-bar davit rated at 800 lbs., with port and starboard foundations, and a common purpose electric winch. |
| LC-044.5-1 | 044.5 Launch and Recovery |
| LC-044.5-1.1 | Capability to be recovered from ARV boat deck level in up to threshold Sea State 4 and survivable in Sea State 5; following NATO STANAG 4194 Sea State Scale. |
| LC-044.5-1.2 | The LC shall also have the capability to be lifted by a crane therefore will need a four (4) point lift system installed to accommodate a bridle lift at full displacement. |
| LC-044.5-1.3 | The vessel and lift points must be built to allow launch with two (2) personnel onboard. |
| LC-044.6-1 | 044.6 Environmental Requirements |
| LC-044.6-1.1 | The LC shall be designed to operate in a maximum external dry bulb temperature of 100 degrees F. |
| LC-044.6-1.2 | The LC shall be designed to operate in a maximum external wet bulb temperature of 82 degrees F. |
| LC-044.6-1.3 | The LC shall be designed to operate in a minimum external dry bulb temperature of -49 degrees F. |
| LC-044.6-1.4 | The LC shall be designed to operate in a maximum water temperature of 90 degrees F. |

| Reqmt ID | Requirement Text |
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| LC-044.6-1.5 | The LC shall be designed to operate in a minimum water temperature of 28 degrees F. |
| LC-050-1 | 050 SHIP SYSTEM PERFORMANCE |
| LC-050-1.1 | The LC shall be capable of achieving the defined operational speeds with the propulsion plant operating at no more than 85% of MCR. |
| LC-050-1.2 | The LC shall carry sufficient fuel to achieve the required ranges. |
| LC-050-1.3 | The LC must be safe and controllable at all speeds up to the maximum attainable speed and under all specified loading conditions where craft orientation, motions, and accelerations do not pose a hazard to the crew or passengers, and which are not otherwise controllable by good seamanship and boat handling. |
| LC-050-1.4 | At transit and max speeds, the LC shall reach a directionally stable plane with no porpoising or other undesired characteristics. |
| LC-050-1.5 | The LC shall demonstrate a simplified stability test for an "exposed route" in accordance with 46 CFR Sub Chapter T, 178.330 in the presence of the Owner. |
| LC-050-1.6 | Avoidance Test: Meet the requirements of the ABYC avoidance line test (H-26.8.3.2) and 33 CFR 183.53 "Quick Turn Test" & "Test Course" test at full speed. |
| LC-051-1 | 051 TOWING |
| LC-051-1.1 | The LC shall be capable of towing a variety of craft of similar displacement and weight in conditions up to Sea State 5 astern and Sea State 2 alongside. |
| LC-051-1.2 | The LC shall be capable of being towed by the bow or alongside. |
| LC-051-1.3 | The LC shall have bow port and starboard tow posts. |
| LC-051-1.4 | The LC shall have an aft tow post. |
| LC-051-1.5 | Tow guide stops shall be installed on engine guard rail. |

| Reqmt ID | Requirement Text |
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| LC-061-1 | 061 HULL STRUCTURE |
| LC-061-1.1 | The structure includes the hull bottom, sides, transom, and deck(s) including internal structures (longitudinal stiffeners, keelsons, girders, foundations, transverse frames, bulkheads, etc.) and above deck structures including railings, mast(s) deck lockers, consoles etc. |
| LC-061-1.2 | 316L Corrosion Resistant Steel (CRES) fasteners and self-locking nuts shall be used. |
| LC-061-1.3 | CRES hardware shall be insulated from the aluminum hull and structure. |
| LC-061-1.4 | The hull structure material shall be aluminum and the design category shall be Category A (“Ocean”) and in accordance with “heavy duty workboats” of Annex J of ISO 12215-5:2019. |
| LC-061-1.5 | Material grade selected shall be suitable for operation in Antarctic Waters per ABS Guide for Vessels Operating in Low Temperature Environments. |
| LC-061-1.6 | Hull plating shall be 5083 H116 or 5086 H116, meeting ASTM B928 requirements for intergranular corrosion resistance, with minimum 0.250” bottom thickness and minimum 0.188” sides. |
| LC-061-1.7 | Provide cathodic protection per ABYC E-2 Cathodic Protection. |
| LC-061-1.8 | The hull structure shall support an integrated aluminum fuel tank. |
| LC-061-1.9 | The hull structure shall support an integrated potable water tank. |
| LC-063-1 | 063 ELECTRICAL |
| LC-063-1.1 | The LC shall have the following electrical services installed: |
| LC-063-1.1.1 | 1. Dual service marine battery charger. |
| LC-063-1.1.2 | 2. Preheaters / block heaters (Engines). |
| LC-063-1.1.3 | 3. Waterproof D/C outlet with dual USB C and cigarette lighter socket. |

| Reqmt ID | Requirement Text |
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| LC-063-1.1.4 | 4. 1-2-Both-Off battery disconnect switch. |
| LC-063-1.1.5 | 5. Electrical shore-power umbilical for charging while on parent vessel. |
| LC-063-1.1.6 | 6. Manual / Automatic bilge pump switch within reach of operator. |
| LC-063-1.1.7 | 7. 12/24V, waterproof circuit breaker panel for installed electronics. |
| LC-063-1.1.8 | 8. Two (2) deep cycle marine starting batteries. |
| LC-063-1.1.9 | 9. Two (2) deep cycle marine house batteries. |
| LC-063-1.1.10 | 10. 50 Amp Shore power umbilical. |
| LC-063-1.1.11 | 11. Cabin heat |
| LC-064-1 | 064 COMMAND AND SURVEILLANCE |
| LC-064-1.1 | The following Command and Surveillance equipment shall be installed: |
| LC-064-1.1.1 | 1. AIS |
| LC-064-1.1.2 | 2. Depth Sounder |
| LC-064-1.1.3 | 3. VHF Radio with fixed whip antenna |
| LC-064-1.1.4 | 4. Fish finder |
| LC-064-1.1.5 | 5. Analog Compass |
| LC-064-1.1.6 | 6. ECDIS |
| LC-064-1.1.7 | 7. Navigations lights as defined by the appropriate CFRs |
| LC-064-1.1.8 | 8. Dash gauges (temp, oil press, rpm, fuel, trim, hours) |

| Reqmt ID | Requirement Text |
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| LC-064-1.1.9 | 9. Furuno X-Band Closed Array Radar |
| LC-065-1 | 065 AUXILIARY SYSTEMS |
| LC-065-1.1 | The following Auxiliary systems shall be installed: |
| LC-065-1.1.1 | 1. Bilge pump with float switch in each sealed compartment |
| LC-065-1.1.2 | 2. Glycol loops for hydraulics |
| LC-065-1.1.3 | 3. J bar foundations one (1) Port and one (1) starboard with a minimum working load of 800 lbs. |
| LC-065-1.1.4 | 4. J Bar winch maximum working load 800 lbs. |
| LC-065-1.1.5 | 5. J Bar with ability to interchange location from Port to Starboard |
| LC-065-1.1.6 | 5. Knuckle crane 3,200 lbs. (Max Carrying Capacity) |
| LC-066-1 | 066 OUTFITTING |
| LC-066-1.1 | The LC shall have the following outfitting items on-hand or installed where applicable: |
| LC-066-1.1.1 | 1. An emergency stern retractable dive ladder installed on the aft platform. |
| LC-066-1.1.2 | 2. Portable CO2 fire extinguisher x3 |
| LC-066-1.1.3 | 3. Oars with stowage |
| LC-066-1.1.4 | 4. Tool set |
| LC-066-1.1.5 | 5. Hardened removable dive ladder |
| LC-066-1.1.6 | 6. Ladder to cabin top |
| LC-066-1.1.7 | 7. Cabin top non-skid |

| Reqmt ID | Requirement Text |
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| LC-066-1.2 | A retractable mast shall be installed and have the following characteristics: |
| LC-066-1.2.1 | 1. Be easily retractable by one crew member in SS4 for launch and recovery operations. |
| LC-066-1.2.2 | 2. Be retractable vertically or laid down horizontally. |
| LC-066-1.2.3 | 3. Have a locking device for the deployed and secured position. |
| LC-070-1 | 070 GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION |
| LC-070-1.1 | The Human Engineering principles of ASTM F1166, Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities, shall be followed for design of controls and indicators and for interfaces with machinery and gear handling systems, as well as outfitting, access, and egress. |
| LC-070.1-1 | 070.1 General Requirements |
| LC-070.1-1.1 | The LC shall have the following characteristics and specifications: |
| LC-070.1-1.1.1 | 1. Fuel Type - Diesel |
| LC-070.1-1.1.2 | 2. Drive Type - Outboard |
| LC-070.1-1.1.3 | 3. Dual Engine |
| LC-070.1-1.1.4 | 4. Electrical Power - Diesel 5kW Generator |
| LC-070.1-1.1.5 | 5. Weight (Lightship) - 10,000 lbs. |
| LC-070.1-1.1.6 | 6. Full Displacement (Max) - 21,000 lbs. |
| LC-070.1-1.1.7 | 7. Length 30'-34' |
| LC-070.1-1.1.8 | 8. Height (Max) - 12' |
| LC-070.1-1.1.9 | 9. Width (Max) - 12' |

| Reqmt ID | Requirement Text |
|-----------------|--|
| LC-070.1-1.1.10 | 10. Bottom Contour - Low Deadrise Planing Hull. |
| LC-070.1-1.1.11 | 11. Integrated diesel fuel tank. |
| LC-070.2-1 | 070.2 Storage |
| LC-070.2-1.1 | The LC shall have the following stowage accommodations: |
| LC-070.2-1.1.1 | 1. Bench seating storage |
| LC-070.2-1.1.2 | 2. Anchor and rode with bow locker storage |
| LC-070.3-1 | 070.3 Handrails, Guards, Lifelines |
| LC-070.3-1.1 | The LC shall have the following accommodations: |
| LC-070.3-1.1.1 | 1. Deck rail handrails |
| LC-070.3-1.1.2 | 2. Cabin top handrails |
| LC-070.3-1.1.3 | 3. Engine crash rail |
| LC-070.3-1.1.4 | 4. Cabin perimeter handrails |
| LC-070.4-1 | 070.4 Performance Specifications |
| LC-070.4-1.1 | The vessel design shall meet or exceed the following Performance threshold requirements. |
| LC-070.4-1.1.1 | 1. Transit Speed - Threshold: 20kts [Objective: 22kts]. |
| LC-070.4-1.1.2 | 2. Max Speed - Threshold: 25kts [Objective: 30kts]. |
| LC-070.4-1.1.3 | 3. Endurance Speed - Threshold: 16kts. |
| LC-070.4-1.1.4 | 4. Maximum endurance without replenishment: - Threshold: 12hrs [Objective: 36hrs]. |
| LC-070.4-1.1.5 | 5. Range - Threshold: 192nm [Objective: 576nm]. |

| Reqmt ID | Requirement Text |
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| LC-070.5-1 | 070.5 Parent Craft Requirements |
| LC-070.5-1.1 | The LC design in terms of the hull form shall be directly traceable, at a minimum, to one boat, referred to here as the Parent Craft, of the same design, or same family of designs, with a minimum of two years of commercial or Government service. |
| LC-070.5-1.2 | The Parent Craft shall be a mature, proven design with the following attributes: |
| LC-070.5-1.2.1 | 1. No more than 35 feet or less than 30 feet in overall length. |
| LC-070.5-1.2.2 | 2. Not more than 13 feet in overall beam. |
| LC-070.5-1.2.3 | 3. Not weigh more than 25,000 lbs. in the performance weight condition. |
| LC-070.5-1.2.4 | 4. Have a sustained speed of 25 knots. |
| LC-071-1 | 071 ACCESS |
| LC-071-1.1 | The pilothouse shall contain two means of egress. |
| LC-071-1.2 | Egress shall be through a quick acting door or hatch. |
| LC-071-1.3 | A quick acting door shall be provided to access the working deck from the pilothouse. |
| LC-071-1.4 | Access to compartments containing equipment, machinery, or spare parts shall be provided to facilitate removal without disassembling the component. |
| LC-071-1.5 | The access routes, size, quantity, and location of removable patches shall be determined by the Contractor based on the installed equipment and the requirements of these specifications. |
| LC-071-1.6 | Access shall be arranged to be clear of piping, wireways, ducts, and other obstructions. |
| LC-071-1.7 | Access shall be provided for engine removal and allow a direct vertical lift without disassembly of the engine. |

| Reqmt ID | Requirement Text |
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| LC-071-1.8 | Access shall be provided for generator removal and shall allow removal without disassembly of the engine. |
| LC-071-1.9 | The LC shall have readily accessible accesses to non-manned spaces to provide for inspections and damage control while underway. |
| LC-071-1.10 | The LC design, arrangement, and construction shall ensure maintenance and repair personnel can physically access and conduct maintenance or repair, under operational conditions, without the need for awkward bending or twisting. |
| LC-071-1.11 | Equipment design and installation shall provide the maintainer with complete visual and physical access and a favorable working level and safety/hazard precautions for the parts of a system on which maintenance is performed, including, support equipment interfaces, access openings, adjustment points, test points, servicing points, and connections. |
| LC-071-1.12 | Access shall be provided to bilge areas that are below the static waterline in the full load condition and shall have the following characteristics: |
| LC-071-1.12.1 | 1. Inaccessible areas shall drain to the lowest point. |
| LC-071-1.12.2 | 2. Access to the lowest point of the bilge to ensure it can be reached for maintenance, checked for water content, completely dewatered, and wiped clean of any residue. |
| LC-071-1.12.3 | 3. Access the lowest point of the bilge without the use of tools. |
| LC-071-1.13 | Check points that require routine maintenance checks daily or underway, such as dipsticks, sight glasses, gauges, and strainers, shall be located so they are readily accessible to the crew. |
| LC-073-1 | 073 NOISE AND VIBRATION |
| LC-073-1.1 | Onboard A-weighted noise level in the cabin at all speeds in calm water conditions cannot exceed 75 decibels (dBA). |
| LC-073-1.2 | At Typical Survey speeds in calm waters, A-weighted noise levels in the cabin with the doors and windows closed shall not exceed 70 dBA. |

| Reqmt ID | Requirement Text |
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| LC-074-1 | 074 WELDING |
| LC-074-1.1 | Welding, brazing, and related procedures including joint design, joint strength calculations, edge preparation, fabrication, and records, shall be in accordance with the standards set forth by the American Welding Society (AWS) for the materials being welded and the intended service, except as specifically directed herein. |
| LC-074-1.2 | For aluminum, recommendations, and information in AWS D3.7-90: 2004 “Guide for Aluminum Hull Welding” shall be followed. |
| LC-074-1.3 | Procedure qualification, welder's qualification, and nondestructive test personnel qualification for welders and welding inspectors shall be in accordance with the American Welding Society (AWS). |
| LC-075-1 | 075 FASTENERS |
| LC-075-1.1 | Fasteners shall be of corrosion resistant materials and made of 316 series stainless steel except as otherwise noted. |
| LC-075-1.2 | Unique mounting fasteners not made of stainless steel that are provided with OEM equipment may only be used when not exposed to saltwater or saltwater spray. |
| LC-075-1.3 | No fasteners shall be directly threaded into aluminum alloys. |
| LC-075-1.4 | Galvanically compatible non-coated helical coil inserts or pressed-in threaded inserts shall be used when direct threading is required. |
| LC-075-1.5 | Any fasteners in direct contact with dissimilar metals shall be insulated or isolated. |

| Reqmt ID | Requirement Text |
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| LC-077-1 | 077 SAFETY |
| LC-077.1-1 | 077.1 Human Engineering |
| LC-077.1-1.1 | Criteria specific to ASTM F1166 shall be applied in the design of compartments, spaces, work and control stations, and facilities. |
| LC-077.1-1.2 | Factors affecting both normal and emergency conditions, such as illumination and environmental conditions, shall be as outlined in ASTM F1337. |
| LC-077.1-1.3 | Vessel systems shall be designed for operation, maintenance, and repair by the height range of the U.S. population, bounded between the 5th percentile female to the 95th percentile male. Refer to ABS Guidance Notes on the Application of Ergonomics to Marine Systems. |
| LC-077.2-1 | 077.2 System Safety |
| LC-077.2-1.1 | The vessel design shall reflect system and personnel safety considerations, including the minimization of the potential for human error during operation and maintenance, under routine, non-routine, and emergency conditions. |
| LC-077.2-1.2 | System safety shall be integrated into the design to avoid hazardous manual handling operations as practicable and shall limit activities to the required range of physical capabilities. |
| LC-077.2-1.3 | Safety guards shall be installed over the unprotected moving parts of rotating or oscillating equipment and machinery that could pose a hazard to personnel. |
| LC-077.2-1.4 | Safety guards shall be installed over moving wire ropes that could be contacted by personnel. |
| LC-077.2-1.5 | Slip resistant (non-skid), painted deck covering shall be applied to all interior areas, all exteriors deck spaces, and to the roof of the cabin. |
| LC-077.2-1.6 | SKYDEX shall be an [Objective] for the vessel floorings. |
| LC-077.2-1.7 | Weather decks shall use a marine grade, commercially manufactured pedestrian non-skid coating. |

| Reqmt ID | Requirement Text |
|----------------|--|
| LC-077.2-1.8 | Field Formulated non-skid coatings (i.e., sandblasting grit stirred into or sprinkled over ordinary deck paint) shall not be used. |
| LC-077.2-1.9 | Non-skid coatings shall use mineral grit only and shall be applied by roller or trowel. |
| LC-077.2-1.10 | The vessel shall have an air collar or similar fendering system for close approach safety. |
| LC-077.2-1.11 | The arrangement of seating, electronics, and lighting shall maximize system functionality while minimizing crew fatigue. |
| LC-077.2-1.12 | Arrangement of windows and doors shall provide 180 degrees forward visibility with not more than 5 percent obstruction. |
| LC-077.2-1.13 | Access shall be provided around the pilothouse on both sides. Handholds and/or handrails shall be provided along the route. |
| LC-077.2-1.14 | Standing headroom inside the cabin shall not be less than 80 inches. |
| LC-077.2-1.15 | The LC shall provide the crew with the capability to reach down in the water and retrieve a person or object. |
| LC-077.2-1.16 | The boat shall provide for unassisted self-recovery of able-bodied crewmembers from the water. |
| LC-077.2-1.17 | The LC walkways, deck space, and associated deck-mounted items shall be configured to minimize obstacles including snag, bump, and trip hazards in accordance with ASTM F1166. |
| LC-077.3-1 | 077.3 Safety Outfitting |
| LC-077.3-1.1 | The LC shall have the following Safety equipment and accommodations: |
| LC-077.3-1.1.1 | 1. Waterproof container with appropriate emergency signal kit. |
| LC-077.3-1.1.2 | 2. First aid kit. |
| LC-077.3-1.1.3 | 3. Handheld LED search light with D/C charger. |

| Reqmt ID | Requirement Text |
|----------------|--|
| LC-077.3-1.1.4 | 4. Water rescue throw bag. |
| LC-077.3-1.1.5 | 5. Two (2) 8' aluminum pike poles |
| LC-078-1 | 078 MATERIALS |
| LC-078-1.1 | The hull and superstructure of the vessel shall be built of 5000 series aluminum. |
| LC-078-1.2 | Aluminum Alloys selection shall follow guidance from Table 1 found in ABYC T-1 Guidelines for Use of Aluminum in Boat and Yacht Construction. |
| LC-078-1.3 | Dissimilar metals that are not electrolytically compatible shall not be joined directly. |
| LC-078-1.4 | Electrolytic corrosion shall be prevented by insulating dissimilar metals from each other with gaskets, washers, and sleeves, or bushings of insulating materials. |
| LC-078-1.5 | Unless otherwise specified, piping system materials shall be in accordance with ASTM F1155. |
| LC-078-1.6 | All materials used in applications exposed to the weather, located in bilges, or used in ballast tanks shall be suitable for the corrosive sea water environment. |
| LC-078.1-1 | 078.1 Prohibited Materials |
| LC-078.1-1.1 | <p>The following materials shall not be used in the design or construction of the ship:</p> <ul style="list-style-type: none"> Asbestos Mercury Polychlorinated Biphenyls (LCB) Tributyltin (TBT) Class I and II Ozone Depleting Substances (ODS) Beryllium Cadmium Carbon Tetrachloride |

| Reqmt ID | Requirement Text |
|--------------|--|
| LC-078.1-1.2 | The following materials shall not be used in the design or construction of the ship without Owner approval: 1,1,1, Trichloroethane Arsenic Benzene Benzidine Beta-Naphthylamine Xylene Toluene Antimony Lead Methyl Ethyl Ketone Methyl Isobutyl Ketone Nickel Cyanide Chromium Selenium O-Toluidine |
| LC-081-1 | 081 MAINTENANCE |
| LC-081.1-1 | 081.1 General |
| LC-081.1-1.1 | Operating and maintenance costs, safety, reliability, shall be the paramount design drivers across all elements of the Science Workboat design. |
| LC-081.1-1.2 | The SHIPBUILDER shall be responsible for performing all scheduled maintenance of installed equipment during construction per OEM guidance. |
| LC-081.1-1.3 | Equipment, machinery, and materials shall be selected for long service life, low maintenance, high reliability, ease of operation by shipboard personnel, and availability of spare parts and service from the manufacturer. |
| LC-081.1-1.4 | The fendering system shall have a service life of at least five years. |
| LC-081.1-1.5 | The propulsion system equipment shall have a Mean Time between Overhauls or Major Service of no less than 750 hours. |
| LC-081.1-1.6 | The generator shall have a Mean Time between Overhauls or Major Service of no less than 750 hours. |

| Reqmt ID | Requirement Text |
|---------------------|---|
| LC-081.2-1 | 081.2 Maintenance Access |
| LC-081.2-1.1 | Vessel layout and machinery arrangement shall include adequate space for inspection, repair and maintenance functions including equipment removal and storage of spare parts. |
| LC-081.2-1.2 | Equipment and machinery shall be installed with access areas for operation, maintenance, adjustment, and repair without having to dismantle adjacent machinery, piping, or structure. |
| LC-081.2-1.3 | Maintenance envelopes shall be in accordance with original equipment manufacturer's guidance. |
| LC-081.2-1.4 | Insufficient clear area to maintain or operate equipment even where manufacturer's clearance envelopes are provided will be the responsibility of the contractor to correct. |
| LC-081.2-1.5 | Equipment and machinery shall be installed with equipment removal routes. |
| LC-081.2-1.6 | Pipes, ducts, wireways, and other permanent fittings shall be accessible for maintenance, and shall be kept clear of equipment removal routes. |
| LC-081.2-1.7 | Pad-eyes and lifting fittings shall be provided and attached to adequate structure, to permit equipment and machinery maintenance, removals, and installations. |
| LC-081.3-1 | 081.3 Lifting Gear |
| LC-081.3-1.1 | Pad-eyes of rated capacity shall be installed to permit removal of machinery components from the vessel. |
| LC-086-1 | 086 TECHNICAL MANUALS AND OTHER DATA |
| LC-086-1.1 | Specifications for equipment shall require all equipment vendors to provide parts lists, manuals, and maintenance procedures in electronic form for integration with a Computerized Maintenance Management System (CMMS). |

Table 1: Definitions

| Acronym/Term | Description |
|--------------|--|
| ABS | American Bureau of Shipping |
| ABYC | American Boat and Yacht Council |
| AIS | Automatic Identification System |
| ARV | Antarctic Research Vessel |
| ASTM | American Society for Testing and Materials International |
| AWS | American Welding Society |
| CFR | United States Code of Federal Regulations |
| CMMS | Computerized Maintenance Management System |
| CO2 | Carbon Dioxide |
| Construction | The term 'construction' means the construction of the ship to meet the requirements identified in the Contract |
| Contract | The written agreement between the Owner and the Contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the work, furnishing of labor, provision of materials, and the basis of payment. |
| CRES | Corrosion Resistant Steel |
| dBA | Decibels |
| D/C | Direct Current |
| ECDIS | Electronic Chart Display Information System |
| F | Fahrenheit |
| ft | Feet |
| ISO | International Organization for Standardization |
| kW | Kilowatt |
| kts. | Nautical Miles (per hour) |
| Lbs. | Pounds |
| LCB | Polychlorinated Biphenyls |
| LC | Landing Craft |
| LED | Light-Emitting Diode |
| m | Meters |
| Max | Maximum |
| MCR | Maximum Continuous Rating |
| MSD | Marine Sanitation Device |

| Acronym/Term | Description |
|--------------|---|
| NATO | North Atlantic Treaty Organization |
| nm | Nautical Miles |
| NSF | National Science Foundation |
| OEM | Original Equipment Manufacturer |
| Owner | The National Science Foundation (NSF), or other designated agents or employees of NSF, to the extent that those individuals have been authorized by NSF to act on its behalf. |
| ODS | Ozone Depleting Substances |
| PFD | Personal Flotation Device |
| Porpoising | A sustained repetitive motion than causes a boat's bow to rise up and down out of the water while on or attempting planing speed. |
| P/S | Port and Starboard |
| RPM | Rotations Per Minute |
| SS# | Sea State |
| STANAG | Standardization Agreement |
| TBT | Tributyltin |
| USB | Universal Serial Bus |
| VHF | Very High Frequency |
| V | Volt(s) |

PRELIMINARY

Table 2: References

| American Bureau of Shipping (ABS) References |
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| 1. ABS Guide for Vessels Operating in Low Temperature Environments, September 2021 |
| 2. ABS Guidance Notes on the Application of Ergonomics to Marine Systems, August 2018 |
| American Society for Testing and Materials (ASTM) |
| 3. ASTM B928, Standard Specification for High Magnesium Aluminum-Alloy Products for Marine Service and Similar Environments. |
| American Welding Society (AWS) |
| 4. AWS D3.7-90: 2004, Guide for Aluminum Hull Welding. |
| 5. AWS B5.1:2013-AMD1 Specification for the Qualification of Welding Inspectors |
| International Organization for Standardization (ISO) |
| 6. ISO 12215-Small craft – Hull construction and Scantlings |
| North Atlantic Treaty Organization (NATO) Standards Agreement (STANAG) |
| 7. NATO STANAG 4194 Sea State Scale |

Preliminary