Acquisition Directorate
Research & Development Center

Polar Icebreaker Operational Requirements Document

Industry Version

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N O T I C E

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EXECUTIVE SUMMARY

The United States Coast Guard's (USCG) Polar Icebreaker (PIB) Operational Requirements Document (ORD) is the formal statement, developed by the Sponsor in collaboration with the stakeholders, of the operational performance and related operational parameters for the proposed concept. The PIB ORD consolidates and describes the operational system in terms of a range of acceptable and desirable standards of performance. In addition, the PIB ORD documents support and maintenance requirements and serves as the source document for a host of systems engineering activities, ongoing requirements analysis and cost estimating to ensure the success of the program. The PIB ORD was developed by a 46-member, 11-Agency Integrated Product Team (IPT) to describe the operating requirements that span the doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) spectrum needed to meet the mission performance gaps identified in the 2012 High Latitude Mission Analysis Report (HLMAR). The HLMAR identified the following mission gaps in the high latitudes: Ice Operations (IO), Defense Readiness (DR), Aids to Navigation (AtoN), Living Marine Resources (LMR), Marine Safety (MS), Other Law Enforcement (OLE), Marine Environmental Protection (MEP), Ports, Waterways, & Coastal Security (PWCS), and Search and Rescue (SAR).

National Security Presidential Directive 66 (NSPD 66) / Homeland Security Presidential Directive 25 (HSPD 25) Arctic Region Policy states, "The United States is an Arctic nation, with varied and compelling interests in that region." NSPD 66 / HSPD 25 identifies a range of U.S. policies and associated actions that the U.S. will take to further those policies. The document further tasks the Secretaries of State, Defense, and Homeland Security to "Develop greater capabilities and capacity, as necessary…" and to "Project a sovereign United States maritime presence for the Arctic in support of essential United States interests." The National Strategy for the Arctic Region prioritizes actions and positions the U.S. to respond effectively to the changing conditions in the Arctic. United States Antarctic policy is influenced by the Antarctic Treaty of 1959. Amplifying guidance to the Antarctic Treaty is provided in National Security Decision Memoranda and Presidential Memorandum 6646. Presidential Decision Directive/National Security Council Report 26 (PDD/NSC-26) U.S. Antarctica Policy states that "the United States has important foreign policy and national security interests in Antarctica."

The PIB will operate worldwide and will be exposed to extreme environmental conditions found in the Polar, Tropical, and Temperate regions. The PIB will experience ice up to large concentrations of multi-year consolidated pack ice with ridging, air temperatures ranging from -72 degrees Fahrenheit (°F) to 114°F, sea water temperatures ranging from 28.8°F to 87°F, wind speeds that can exceed 100 miles per hour (mph) (87 knots (kts)) and sea conditions up to sea state 8. Some of these extremes will be encountered as the PIB transits tropical and/or temperate zones, others will be encountered within the intended polar operational areas.

The PIB ORD identifies the effectiveness requirements that define the operational performance required of the PIB to complete its missions. These statements identify the special or unique requirements of the PIB pertaining to: Basic Requirements, Communications, Information Technology and Intelligence, Navigation, and Sensors. Highlights of the PIB effectiveness requirements include:

- The PIB shall be capable of independently breaking through ice with a thickness $\geq$ 6 ft (threshold) / $\geq$ 8 ft (objective) at a continuous speed $\geq$ 3 kts.
- The PIB shall be capable of independently breaking through ridged ice with a thickness of 21 ft.

- The PIB shall have a fully mission capable (in accordance with Table 20) cutter endurance per deployment without replenishment (subsistence and fuel) ≥ 80 days underway (threshold) / ≥ 90 days underway (objective).
- The PIB shall have the capability to exchange information (voice and data) with: USCG, DoD, DHS, NATO, DoS, NSF and NOAA.

The PIB's suitability requirements will form the basis for portions of the system specification and the Integrated Logistics Support Plan (ILSP). These statements identify the special or unique requirements of the PIB pertaining to: Design Drivers, Supportability and Sustainment (Integrated Logistics), Reliability, Availability and Maintainability, Survivability, Human Systems Integration, Environmental Considerations, Documentation, and Security. Highlights of the PIB suitability requirements include:

- The PIB shall be designed and built to meet applicable United States laws and regulations and applicable international conventions, codes, resolutions and circulars for a vessel of its type engaged on international unlimited voyages. This specifically includes, but is not limited to acts, regulations and treaties governing operations in the Polar Regions (Arctic and Antarctic) and the domestic water of the United States.
- The PIB shall have an A_O of 0.85 (threshold) and 0.92 (objective) based on the total Mission Critical Functions (MCF) listed in Table 20 that defines the minimum functions required for the PIB to maneuver and control the cutter, conduct damage control, and sustain the crew.

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VERSION SUMMARY

Version	Change	Effective Date
0.1	Polar Icebreaker Operational Requirements Document – First Draft	26NOV2014
0.2	Polar Icebreaker Operational Requirements Document – First Final	10DEC2014
0.3	Polar Icebreaker Integrated Product Team Review	20JUL2015
0.4	Polar Icebreaker Operational Requirements Document – Second Draft	07AUG2015
0.5	Polar Icebreaker Operational Requirements Document – Second Final	20AUG2015
0.6	Polar Icebreaker Operational Requirements Document - Concurrent Clearance	21AUG2015
1.0	Polar Icebreaker Operational Requirements Document - Sequential Clearance	09NOV2015

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1 INTRODUCTION

1.1 Purpose

The United States Coast Guard's (USCG) Polar Icebreaker (PIB) Operational Requirements Document (ORD) is the formal statement of operational performance and related operational parameters for the proposed system (United States Coast Guard (USCG (2)), 2013). The PIB ORD serves as the source document for a host of system engineering activities, ongoing requirements analysis, cost estimating and as a "contract" between the Sponsor and the Program Manager (PM) (Publication (PUB) 7-7, 2011). The PIB ORD was developed by a 46-member, 11-Agency Integrated Product Team (IPT) to describe the operating requirements that span the doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) spectrum in the high latitudes needed to meet the mission needs identified in the Polar Icebreaker Mission Need Statement (MNS). The high latitudes include areas of both the Arctic and Antarctic as defined below:

> Arctic: As defined by the Arctic Research and Policy Act of 1984 this area includes: "All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."
>
> Arctic Circle: The Arctic Circle is one of the five major circles that mark maps of the earth. For Epoch 2010, it is the parallel of latitude that runs 66 degrees 33 minutes 44 seconds (or 66.562 degrees) north of the equator.
>
> Antarctic: All land and waters south of 60 degrees south latitude.

The HLMAR analyzed the USCG's 11 mandated missions in the high latitude regions identifying nine mission gaps. The Coast Guard's Counter Drug and Alien Migrant Interdiction Operations missions were not identified as mission gaps in the high latitudes. Table 1 identifies the mission gaps identified in the HLMAR.

Table 1. USCG high latitudes mission performance gaps.

USCG Missions with Gaps in the High Latitudes		
Ice Operations (IO)[1]	Defense Readiness (DR)	Aids to Navigation (AtoN)
Living Marine Resources (LMR)	Marine Safety (MS)	Other Law Enforcement (OLE)
Marine Environmental Protection (MEP)	Ports, Waterways, & Coastal Security (PWCS)	Search and Rescue (SAR)

[1] Ice Operations directly support the Nation's science and survey needs in the Polar Regions. Section 3.1.15 further defines the science and survey mission support requirements.

In addition to the HLMAR, the 2011 Navy Arctic Capabilities Based Assessment identified the following as the Navy's highest priority Arctic gaps:

- Conduct training, exercise and education.
- Provide environmental information.

- Maneuver safely on the sea surface.

The PIB MNS and the PIB CONOPS further analyzed the USCG's nine mission gaps in the high latitudes linking the missions to the Department of Homeland Security's (DHS) Missions and Goals identified in the 2014 Quadrennial Homeland Security Review (QHSR). These linkages are reflected in Table 2.

Table 2. Polar Icebreaker linkage to DHS/USCG mission and goals.

DHS Missions and Goals	USCG Missions
1. Prevent Terrorism and Enhance Security	Ports, Waterways, and Coastal Security Defense Readiness
1.1 Prevent Terrorist Attacks	
1.2 Prevent and Protect Against the Unauthorized Acquisition or Use of Chemical, Biological, Radiological, and Nuclear (CBRN) Materials and Capabilities	
1.3 Reduce Risks to the Nation's Most Critical Infrastructure, Key Leadership, and Events	
2. Secure and Manage our Borders	Ice Operations Ports, Waterways, and Coastal Security Defense Readiness Search and Rescue Other Law Enforcement Living Marine Resources Marine Safety Aids to Navigation
2.1 Secure U.S. Air, Land, Sea Borders and Approaches	
2.2 Safeguard and Expedite Lawful Trade and Travel	
2.3 Disrupt and Dismantle Transnational Criminal Organizations and Other Illicit Actors	
3. Enforce and Administer our Immigration Laws	Not Directly Supported
4. Strengthen the Nation's Cyber Security	Defense Readiness Ports, Waterways, and Coastal Security
4.1 Strengthen the Security and Resilience of Critical Infrastructure	
4.2 Secure the Federal Civilian Government Information Technology Enterprise	
5. Strengthen National Preparedness and Resilience	Aids to Navigation Marine Safety Search and Rescue Ice Operations Marine Environmental Protection
5.1 Enhance National Preparedness	
5.2 Mitigate Hazards and Vulnerabilities	
5.3 Ensure Effective Emergency Response	
5.4 Enable Rapid Recovery	
Maturing and Strengthening (M&S) the Homeland Security Enterprise	Search and Rescue Marine Safety Marine Environmental Protection Ice Operations Living Marine Resources Other Law Enforcement Defense Readiness Ports, Waterways, and Coastal Security
M&S 1 Integrate Intelligence, Information Sharing and Operations	
M&S 2 Enhance Partnerships and Outreach	
M&S 3 Strengthen the DHS International Affairs Enterprise in Support of Homeland Security Missions	
M&S 4 Conduct Homeland Security Research and Development	
M&S 5 Train and Exercise Frontline Operators and First Responders	

1.2 Background

The USCG's Polar Icebreaking Operations Program is charged with providing the United States with the capability and resources necessary to carry out and support federally mandated missions in the Polar Regions. The program also facilitates the movement of maritime transportation through ice-laden waters that assists other governmental and scientific organizations in the pursuit of science activities. The United States Arctic policy, as discussed in National Security Presidential Directive (NSPD) 66/Homeland Security Presidential Directive (HSPD) 25 (2009) provides the foundation and guidance to meet the national security and homeland security requirements in the Arctic region to include protecting the Arctic environment and resources, and ensuring that the management of natural resources and economic development are environmentally sustainable. The United States' National Strategy for the Arctic Region (NSAR), released in May 2013, further defines the Nation's strategic priorities for the Arctic region and is built upon three lines of effort:

- Advance United States Security Interests.
- Pursue Responsible Arctic Region Stewardship.
- Strengthen International Cooperation.

The USCG's Arctic Strategy, also released May 2013, supports the NSAR and the U.S. Navy Arctic Roadmap 2014 - 2030 by outlining the USCG's strategic objectives in the Arctic as:

- Improving Awareness.
- Modernizing Governance.
- Broadening Partnerships.

United States Antarctic Policy is influenced by the Antarctic Treaty of 1959. Amplifying guidance to the Antarctic Treaty is provided in National Security Memorandum 318, dated 25 February 1976, Presidential Memorandum 6646, dated 5 February 1982, and Presidential Decision Directive (PDD)/National Security Council (NSC)-26, dated 9 March, 1996. United States Antarctic policy observes the following principles: using the Antarctic for peaceful purposes, facilitating scientific research and international cooperation in the Antarctic, facilitating the rights of inspection afforded in Article VII of the Treaty, and preserving and conserving living resources in the Antarctic.

The USCG's current fleet of PIBs consists of two heavy icebreakers, Coast Guard Cutter (CGC) POLAR STAR and CGC POLAR SEA (not operational) and one medium icebreaker, CGC HEALY. The USCG's heavy icebreakers have both exceeded their design service life. CGC POLAR STAR has recently undergone a service life extension designed to allow the cutter to operate for an additional 7-10 years. Table 3 provides the current status for each icebreaker as well as their icebreaking capacities.

Table 3. USCG polar icebreaking capacity.

Platform	Year Commissioned	Service Life Design	Estimated End of Service Life[1]	Icebreaking Capacity
POLAR STAR	1976	30	2020–2023	6 ft@3 Knots (kts) /21 ft back & ram
POLAR SEA	1978	30	2010 (Currently Inactive)	6 ft@3kts /21 ft back & ram
HEALY	2000	30	2030	4.5 ft @ 3kts /8 ft back & ram

[1] *Dates include additional service life provided by Service Life Extension Projects (SLEP)*

The USCG utilizes operational hours and Days Away From Homeport (DAFHP) to track operational tempo and personnel tempo for its cutters and crews. Currently, each class of PIB uses the same maximum metric values: 3,300 operational hours or 185 DAFHP per fiscal year (FY). The USCG calculates one DAFHP as 17.84 operational hours. The delta of 6.16 hours in a 24 hour period correlates to port calls for crew rest and logistics during deployments. CGC HEALY has operated at 106 percent of targeted operational capacity during the period of 2006 - 2014. CGC POLAR SEA has been inactive since 2011 and CGC POLAR STAR completed reactivation and recommenced operations in 2014. Table 4 provides a breakdown of operational tempo and DAFHP targets for CGC HEALY, CGC POLAR SEA and CGC POLAR STAR from FY 2006 through FY 2014.

Table 4. Polar Icebreaker operational hours and DAFHP.

FY	CGC HEALY		CGC POLAR SEA		CGC POLAR STAR	
	Operational Hours / Percent of Target	DAFHP / Percent of Target	Operational Hours / Percent of Target	DAFHP / Percent of Target	Operational Hours / Percent of Target	DAFHP / Percent of Target
2006	3,634 / 110%	191 / 103%	802 / 24%	38 / 21%	Inactive	Inactive
2007	3,620 / 110%	166 / 90%	2,818 / 85%	141 / 76%	Inactive	Inactive
2008	4,055 / 123%	181 / 98%	1,661 / 50%	75 / 41%	Inactive	Inactive
2009	4,194 / 127%	198 / 107%	1,949 / 59%	83 / 45%	Inactive	Inactive
2010	3,046 / 92%	153 / 83%	2,236 / 68%	115 / 62%	Inactive	Inactive
2011	2,964 / 90%	159 / 86 %	Inactive	Inactive	Inactive	Inactive
2012	3,829 / 116%	205 / 111%	Inactive	Inactive	Inactive	Inactive
2013	2,527 / 77%	145 / 78%	Inactive	Inactive	Inactive	Inactive
2014	3,607 / 109%	192 / 103%	Inactive	Inactive	2,508 / 76%	189 / 102%
Total	31,476 / 106%	1,590 / 95%	9,466 / 57%	452 / 49%	2,508 / 76%	189 / 102%

Note: The National Science Foundation (NSF) had budget authority for USCG polar icebreaking from 2006 to 2011.Operational availability of POLAR SEA was reduced in 2006 due to maintenance and again in 2010 due to premature engine failure. From 2008 to 2010, the NSF contracted foreign icebreakers for Operation Deep Freeze at McMurdo Station, Antarctica. POLAR SEA stood by in Seattle, WA as an emergency back-up to the contracted vessels.

As national assets, heavy icebreakers are often requested to support other agency operations such as NSF through the U.S. Pacific Command's Operation Deep Freeze, the annual break out of McMurdo Station, Antarctica in support of the U.S. Antarctic Program as well as Department of State (DoS) Antarctic inspection operations. In 2011 and 2012, NSF requested the USCG explore making icebreaker assistance available for Operation Deep Freeze; however, the USCG was unable to provide the support due to the reduced capacity and capability of the operational fleet as well as national Arctic commitments.

1.3 Timeframe

The High Latitude Mission Analysis Report, July 2012, documented current and expected Coast Guard capability and capacity gaps in the Polar Regions and concluded that additional icebreaking vessels are required to meet national requirements. Notwithstanding the acquisition timelines presented below, the United States is at risk of failing to achieve national strategic objectives in the Polar Regions should the

Coast Guard not acquire heavy icebreaker capabilities as soon as possible. The projected timeframe in which the PIB program can satisfy these operational requirements is based on an acquisition plan and a funding profile that has not yet been approved. Accordingly, the below dates will require reassessment based on the results of ongoing programming decisions and budget approvals.

1.3.1 Initial Operational Capability Date

The Initial Operational Capability (IOC) date is anticipated to occur during or before FY-2026. IOC is defined as the delivery of the vessel.

1.3.2 Coast Guard Support Date

The Coast Guard Support Date (CGSD) is the formal transition from CG-932 to Surface Forces Logistics Center Product Line (SFLC PL) and is anticipated to occur during or before FY-2028. CGSD will occur when the following logistic elements are in place and the CG mission support community accepts sustainment responsibility for the asset:

1.3.2.1 An approved Integrated Support Plan (ISP) shall be in place.

1.3.2.2 A job task analysis shall be completed and used to validate a final manpower requirement for cutter crew and shore side support personnel.

1.3.2.3 Shore side support personnel shall be identified and in place.

1.3.2.4 Sustainment training solutions for the crew and shore side support personnel shall be identified.

1.3.2.5 Major training aids and permanent Coast Guard training facilities to support the PIB(s) shall be identified.

1.3.2.6 The PIB will be maintained using Coast Guard, commercial and Other Government Agency (OGA) facilities with a level of funding commensurate with Operational Availability specified in this document.

1.3.2.7 All maintenance procedures shall be validated with levels and types of maintenance identified.

1.3.2.8 The Coast Guard shall have access to technical data required to operate, maintain, diagnose, and repair the lead ship in both hard copy and electronic form.

1.3.2.9 Placed under Configuration Management (CM) control in accordance with the USCG Configuration Manual M4130.6 (Series).

1.3.2.10 Homeport shore-side facility requirements shall be identified in terms of space, volume, equipment, and utilities to support operations and maintenance. Facility modifications required to support lead ship shall be identified.

1.4 Full Operational Capability Date

The Full Operational Capability (FOC) date occurs upon the successful completion of operational testing and evaluation and is anticipated to occur during or before FY-2028.

1.5 Constraints

Constraints are limitations imposed upon the PIB by organizations, laws, policies and factors external to the USCG.

1.5.1 International Operations

The PIB will operate in international waters, within the territorial seas of foreign governments, and in the fragile ecosystems of the high latitude regions. Therefore, the PIB shall, to the maximum extent possible, consider international maritime standards, including those for safety, machinery, equipment, environmental compliance, signaling, communications, weather, meteorology and oceanography (METOC), and navigation support including, but not limited to the International Maritime Organization's (IMO) Polar Code, Convention on Safety of Life at Sea (SOLAS), International Convention for the Prevention of Pollution from Ships (MARPOL), and the Antarctic Treaty.

1.5.2 Panama Canal

The Panama Canal provides an economical transit route between the Pacific Ocean to the Atlantic Ocean. The PIB shall meet Panama Canal transit requirements in order to expedite transit time. The Panama Canal is scheduled to be upgraded by 2015. The current locks require ships to be less than 320.04 meters (m) (1,050 ft) long, less than 33.53 m (110 (feet) ft) wide and have a draft of less than 12.56 m (41.2 ft) deep. The new lock chambers will be 426.72 m (1,400 ft) long, 54.86 m (180 ft) wide, and 18.29 m (60 ft) deep. The PIB shall be capable of transiting the new size locks.

1.5.3 Communications in the High Latitudes

Vast distances, lack of communication architecture, severe weather conditions, high latitude ionic disturbances, and geomagnetic storms combine to make communications in the high latitudes difficult. Line of Sight (LOS) and beyond LOS communication in the high latitudes are severely degraded above 65 degrees north and south latitudes.

1.5.4 Dry Dock Facilities

There are a limited number of dry dock facilities in the United States that have the capacity to handle a PIB due to the density (tons per square foot) of the PIB's footprint. Drydock capacity limitation shall be a factor in homeporting/design decisions.

2 MISSION REQUIREMENTS

This section contains the background information specific to the operational context of the PIB during the execution of its missions.

2.1 Operating Requirements

2.1.1 Operating Environment

The PIB will operate for extended periods of time in an open ocean environment and littoral zones (littoral waters are considered those waters between the shoreline out to 50 miles offshore) while executing its assigned missions. Due to the nature of its responsibilities, the PIB shall be capable of conducting extended deployments to the Arctic and Antarctic regions during the same calendar year. The remoteness of the Arctic and Antarctic requires the PIB to be self-sufficient during mission execution and capable of long transits between logistical stops. The expectation that the PIB will operate in all oceans requires that the PIB be capable of operating in and surviving extremely harsh environments and severe maritime weather conditions. Open ocean transits may subject the PIB to hurricane/tropical cyclone force winds capable of producing sea state 8 conditions (29.5 ft – 45.5 ft).

The hazardous marine conditions in which the PIB will operate are a result of wind, seas, reduced visibility, extreme temperatures, vessel icing and sea ice conditions. The most extreme sea states that the PIB will encounter are anticipated to occur during transit periods to and from the Arctic and Antarctic. The low pressure cells that move clockwise around Antarctica generate high winds and seas, resulting in violent ship motion, testing the limits of equipment durability and human performance during transits across the Southern Ocean. Cyclonic conditions in the vicinity of tropical Australia can occur during any month with the highest frequency occurring during the months of January, February, and March and are capable of producing sea state 8 conditions (National Geospatial-Intelligence Agency (NGA), 2013). In the North Pacific Ocean leading to the Beaufort Sea, occasional sudden storms can occur where the lack of natural wind barriers results in unrestricted winds. These storms bring cold temperatures and occur most frequently between September and November. The storms commonly produce gale-force winds up to 40 kts, and hurricane strength winds (74 mph and greater) have been recorded in the region (Veltkamp and Wilcox, 2007).

The PIB will experience severe sea surface ice conditions while operating in the Arctic and Antarctic regions. The *Analysis of Polar Icebreaker Requirements* (2015) compiled the following ice conditions information:

2.1.1.1 Arctic

2.1.1.1.1 Ice Thickness: First Year Ice (FYI) thickness expected to be encountered averages 2 m (6.5 ft). Long term trends in FYI maximum ice thickness and decadal comparisons were assessed and showed a trend of 1 to 3 centimeters (0.4 to 1.2 inches) decrease per decade.

2.1.1.1.2 Ice Strength: FYI flexural strength varies across the year and across the Arctic but for the times of year and expected locations the PIB will operate, it will encounter FYI flexural strengths between .5 Megapascals (MPa) to .7 MPa.

2.1.1.1.3 Ice Coverage / Concentration: Ice Coverage has decreased, in both winter (-3% per decade) and summer (-13.3% per decade). This decrease is attributed to an increase in air temperature. Ice Concentrations in the Beaufort and Chukchi Seas have decreased approximately 50% (8 tenths to 4 tenths) in summer. Winter concentrations remain constant at 10 tenths in the Beaufort and Chukchi Seas. Central Arctic concentrations have remained constant in both summer and winter at 10 tenths.

2.1.1.1.4 MYI: Data collected over 35+ years indicates that MYI average thickness is approximately 6.5 m (21.3 ft) in the western Arctic.

2.1.1.1.5 Ice Ridges: Based on data collected from over 200 ridges, typical ridge sails and keels expected to be encountered are: Southern Beaufort Sea: Sail 2.75m (9 ft) , Keel 12 m (39.4 ft); Beaufort Ice Pack: Sails 5 m (16.4 ft), Keels 18 m (59 ft); Chukchi Sea: Sails 2 m (6.5 ft), Keels 10 m (32.8 ft).

2.1.1.2 Antarctic

2.1.1.2.1 Ice Thickness: FYI ice thickness expected to be encountered is approximately 2 m (6.5 ft). Long term trends in FYI maximum ice thickness show no change in FYI thickness.

2.1.1.2.2 Ice Strength: FYI flexural strength varies across the year but for the times of year the PIB will operate, it will encounter FYI flexural strengths between .5 MPa to .7 MPa. Average FYI flexural strength is not decreasing.

2.1.1.2.3 Ice Coverage / Concentration: In contrast to the Arctic, there has been an increase in sea ice coverage in the Antarctic. The increase in austral winter is +1.3% per decade and the increase in summer is +4.5% per decade

2.1.1.2.4 MYI: Limited data has been collected in the Antarctic to assess MYI thickness. Based on the limited data, average MYI thickness is estimated to be approximately 7.9 m (25.9 ft).

2.1.1.2.5 Ice Ridges: Given the increase in ice coverage ridging and the spatial density (frequency of encounter) is not expected to decrease. Ridge size and frequency has not changed based on data collected over the past 10 years.

2.1.2 Operational Functions

The PIB CONOPS identifies the operational and mission support functional capabilities that the PIB shall perform in order to complete its assigned missions. Functional capabilities and their working definitions are provided in Table 5.

Table 5. PIB operational functions.

Functional Capability	Working Definition for Establishing Linkage Between Activities and the Functional Capability
Break Ice	Capability to create a passage through ice bound waters
Maneuverability/Sea Keeping/Navigation	Capability to transit at various courses and speeds from one location to the next to include traversing tropical latitudes
Escort Vessels	Capability to guide vessels through surface ice conditions
Boat Operations	Capability to conduct operations with organic and non-organic boats
Aviation Operations	Capability to conduct operations with organic and non-organic aircraft
Defensive/Offensive Operations	Capability to defend against threats and employ armament
Sensors	Capability to sense, detect, and characterize the surrounding environment and to gather and transmit data about it
Boarding Operations	Capability to prosecute a target of interest and place a fully trained boarding team with required equipment on another vessel including a landing party
Search and Rescue	Capability to locate and assist mariners in distress
Damage Control	Capability to respond to organic and non-organic damage
Towing Vessels	Capability to take another vessel in tow
Marine Environmental Response	Capability to respond to a marine environmental incident
Science/Survey Missions	Capability to collect and analyze information in support of science and survey operations
Command and Control	Capability to integrate multiple assets participating in an operation
Communications	Capability to transfer data and voice internally and externally
Mission Support	Capability to sustain and maintain the PIB, deployed assets, and crew
Diving Operations	Capability to deploy and retrieve personnel into the water in order to conduct underwater maintenance, repair, damage control, AtoN, search, recovery, salvage, and security measures.
U/W Refueling/Replenishment	Capability to receive and transfer liquids and supplies while underway
Heavy Lift	Capability to transport and handle heavy (> 1 ton), indivisible items

In order to successfully fulfill the operational and mission support functional capabilities, the PIB shall be capable of performing the activities in Table 6.

Table 6. PIB activities.

No.	Category	Activity
1	Break Ice	Conduct ice breaking operations
2		Groom/maintain a channel through ice
3		Break out beset vessels
4	Maneuvering/ Seakeeping/ Navigation	Moor without assistance
5		Anchor/weigh anchor
6		Get underway without assistance
7		Avoid collisions and allisions
8		Maintain assigned station
9		Maintain position for direct water recovery
10		Calculate intercept with contact of interest
11		Fix own position
12		Update and maintain navigation references (charts and publications)
13		Maintain navigation log
14		Navigate safely in all environmental conditions cognizant of hydrographic restrictions
15		Collect environmental data
16		Fix positions of other vessels
17		Track ice conditions beyond the horizon
18	Escort Vessels	Escort vessels in ice conditions
19	Boat Operations	Launch boats
20		Operate two boats simultaneously
21		Recover boats
22		Stow boats
23	Aviation Operations	Launch organic/non-organic aircraft
24		Operate organic/non-organic aircraft
25		Control and track organic/non-organic aircraft
26		Recover organic/non-organic aircraft
26		Hangar organic aircraft
28		Conduct vertical replenishment (VERTREP)
29		Conduct helicopter in-flight refueling (HIFR)

Table 6. PIB activities (continued).

No.	Category	Activity
30	Defensive/Offensive Operations	Perform Operations Security
31		Apply physical security
32		Positively identify friend or foe
33		Provide personal protective equipment
34		Protect boarding team
35		Perform unit defense
36		Apply Rules of Engagement/Use of Force
37		Perform safety measures
38		Respond to a casualty
39		Recover from a casualty
40		Protect cutter and crew from casualty
41		Perform/enact anti-terrorism/force protection (AT/FP) measures
42	Intelligence Operations	Plan and direct law enforcement intelligence activities
44		Collect law enforcement intelligence
46		Receive law enforcement intelligence
48		Process and exploit law enforcement intelligence
50		Analyze and produce law enforcement intelligence
52		Disseminate law enforcement intelligence
54		Evaluate law enforcement intelligence and provide feedback
57	Sensors	Search for contact of interest
58		Detect surface contact of interest
59		Collect target data with organic sensors
60		Analyze data to identify contact of interest
61		Collect environmental conditions data (sea, air and ice)
62		Analyze environmental conditions data (sea, air and ice)
63	Boarding Operations	Stop/neutralize a vessel through the use of force continuum
64		Conduct boarding operations
65		Apply Rules of Engagement/Use of Force
66		Detain suspects

Table 6. PIB activities (continued).

No.	Category	Activity
67	Boarding Operations (cont'd)	Arrest suspects
68		Collect evidence
69		Issue violations
70		Seize property
71		Employ custody crew
72		Hold contraband
73		Hold other evidence
74		Recover objects from the water
75		Embark detachments
76		Transfer personnel at sea
77		Transfer seized assets, personnel, and evidence at sea
78	Search and Rescue	Coordinate and direct search and rescue activities
79		Execute surface search for missing or distressed persons, vessels, aircraft
80		Render mechanical assistance
81		Provide temporary shelter
82	Damage Control	Provide initial and follow up basic medical services
83		Plan, train for and execute damage control tasks for own ship
84		Assist other vessels with damage control
85		Monitor damage control
86	Towing Vessels	Conduct towing operations
87	Marine Environmental Response	Coordinate and direct pollution response activities
88		Transfer pollution response equipment
89	Science/Survey Missions	Support the deployment of science/survey devices
90		Support the recovery of science/survey devices and artifacts
91		Support the science and survey data analysis
92		Support the launch of airborne, surface and sub-surface unmanned vehicles
93		Support the recovery of airborne, surface and sub-surface unmanned vehicles
94	Command and Control	Plan operations
95		Establish liaisons
96		Establish search and operations area
97		Allocate resources
98		Coordinate resources
99		Issue orders
100		Maintain a common operational picture
101		Evaluate results
102		Create lessons learned
103	Communications	Sound and display required signals

Table 6. PIB activities (continued).

No.	Category	Activity
104	Communications (cont'd)	Communicate voice and data with Blue Forces
105		Communicate voice and data internally
106		Communicate clear, protected and secure voice and data where applicable
107		Receive distress calls
108		Determine direction to received calls
109		Conduct simultaneous communications with Department of Defense (DoD) and foreign entities
110		Conduct simultaneous communications with land, surface and air assets
111		Conduct simultaneous communications with federal, state and local law enforcement and regulatory agencies
112		Communicate via loudhailer
113		Store, search, retrieve and archive information
114		Communicate via flag hoist
115		Access USCG Data Network
117		Access physically separated science/survey support networks
118		Support Electronic AtoN Operations / Marine Safety Information (MSI) operations
119		Support the transfer/communication of science data and artifacts
120	Mission Support	Conduct training
121		Receive training
122		Provide supply support (internal)
123		Provide personnel administration
124		Perform honors and ceremonies
125		Accommodate the crew and embarked detachments – morale, welfare and recreation
126		Accommodate the crew – professional development
127		Accommodate the crew and embarked detachments – berthing
128		Accommodate the crew and embarked detachments – subsistence
129		Accommodate the crew and embarked detachments – health care
130		Receive guest and visitors
131		Plan organizational level maintenance
132		Execute organizational level maintenance
133		Track organizational level maintenance
134		Plan depot level maintenance

Table 6. PIB activities (continued).

No.	Category	Activity
135	Mission Support (Cont'd)	Facilitate depot level maintenance
136		Track depot level maintenance
137		Plan organic boat organizational maintenance
138		Execute organic boat organizational maintenance
139		Track organic boat organizational maintenance
140		Plan organic aircraft organizational maintenance
141		Execute organic aircraft organizational maintenance
142		Track organic aircraft organizational maintenance
143		Monitor/maintain stability
144		Export electrical power
145		Receive hotel services in port
146		Store data
147	Diving Operations	Support a Dive Detachment in conducting underwater hull inspections, maintenance, repair, damage control, AtoN, search, recovery, salvage, and security measures
148	Refueling/Replenishment	Transfer and receive liquids in port and at sea
149		Transfer and receive cargo in port and at sea
150		On load equipment
151		Off load equipment
152		Transport AtoN Equipment

2.1.3 Interoperability Requirements

The PIB will be an integral asset in a command and control environment. The PIB shall exchange information (voice, video, and data) at various classification levels with USCG/DoD/Other Government Agency (OGA)/Allied government's operational assets, including land-based operational centers, other vessels, and aircraft. The PIB shall work with other federal agencies (inside and outside of DHS), as well as state, local, tribal and foreign governments. The PIB shall also be able to communicate and exchange information with private and commercial vessels. The PIB shall be able to communicate simultaneously with multiple operational assets and shore side command and control facilities in order to fully execute its command and control duties.

2.1.4 Geographic Area

The PIB will primarily operate in the Polar Regions, but the transit routes to and from these areas require the PIB to operate world-wide. Figure 1 (USCG (4), 2012) highlights key logistical ports that the PIB may utilize as well as the vast distances between operational areas.

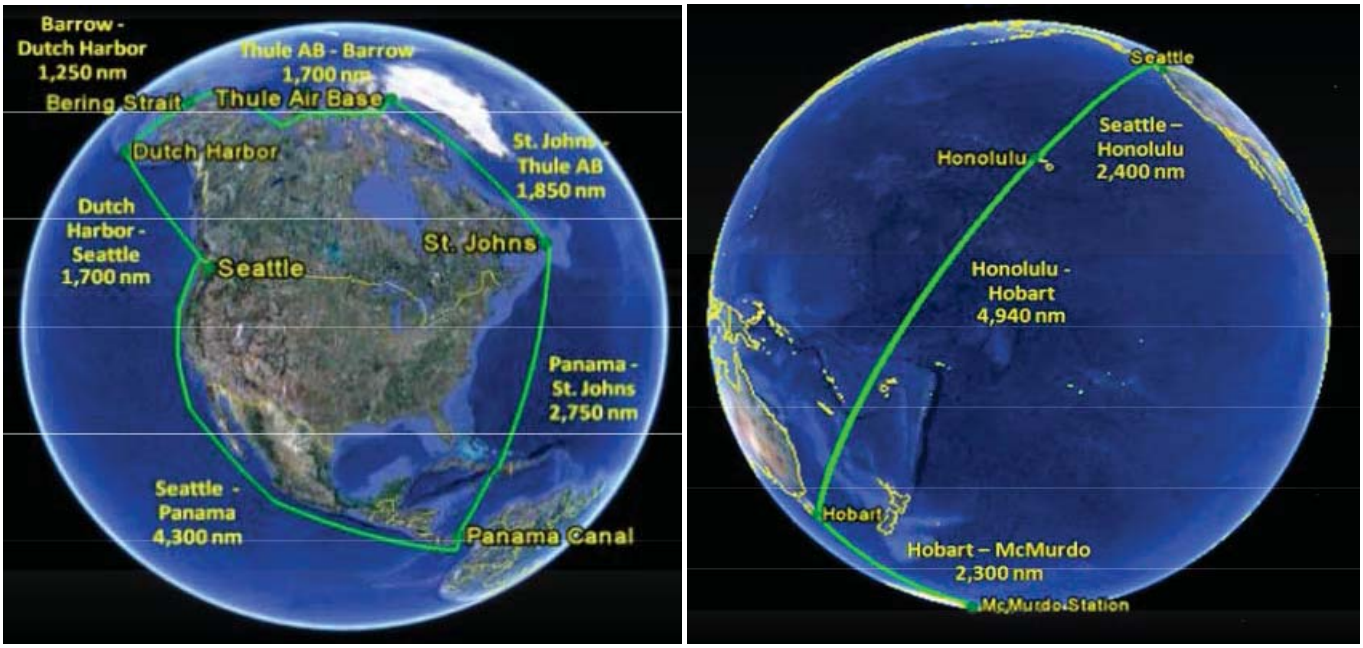

Figure 1. High latitude key locations and transit distances.

The PIB will operate in the following regions:

2.1.4.1 Arctic: As defined by the Arctic Research and Policy Act of 1984 this area includes: "All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."

2.1.4.2 Antarctic: All land and waters south of 60 degrees south latitude.

2.1.4.3 Equatorial: Land and seas located between the Tropics of Cancer and Capricorn.

2.1.4.4 Littoral: For the purposes of this document, littoral waters are considered those waters between the shoreline out to 50 miles offshore.

2.1.4.5 Deepwater: As described in Commandant Instruction (COMDTINST) M16014.2 (Series) this area is primarily defined as waters that extend beyond 50 miles offshore.

2.1.5 Climatic Envelope

The PIB will operate in a variety of climates and maritime weather conditions, including tropical, dry, temperate, and polar climates. The PIB will encounter air temperatures that range from -72 degrees Fahrenheit (°F) to 114°F, and sea water temperatures that range from 28.8°F to 87°F. In addition to the extreme air and sea water temperature, the PIB will experience currents of up to 8 kts with salinity ranges of 20 to 34 parts per thousand (ppt) and winds that can reach well above 100 mph (87 kts). The PIB will be expected to operate in all seasons, both day and night, including extended periods of darkness and light, through all marine weather conditions to include hail, dust, sleet, fog, haze, smoke, drizzle, rain, snow, thunderstorm, blowing spray, sleet showers, ground fog, ice fog, ice crystals, rain showers, snow showers,

freezing rain, and/or freezing drizzle, and low to zero visibility or white out conditions. The following is a synopsis of expected climatological conditions for the regions listed in section 2.1.4.

2.1.5.1 Arctic: The Arctic region yields extremely cold air and water temperatures with the summer's high temperatures only reaching near 40°F and water temperatures rarely reaching above 30°F. Winters bring continuous darkness (polar night), stable weather conditions and clear skies while the Arctic summers bring continuous day (midnight sun), dense fog and weak cyclones. Average wind speeds reach between six and 12 mph (five and 10 kts) and are most prevalent from the East. A National Aeronautics and Space Administration (NASA) study indicates that the frequency and intensity of Arctic storms has increased over the past half century provoking an increase in Arctic sea ice drift. Maximum wind gusts have been measured up to 110 mph (96 kts) during storm conditions. The Arctic waters have the lowest salinity range of Earth's major oceans of 20 to 32 ppt and an average current speed of 0.33 kts (NOAA, 2013).

2.1.5.2 Antarctic: The Antarctic can produce some of the most extreme weather conditions that the PIB will experience. McMurdo Station, Antarctica features a polar ice cap climate with an average high/low temperature of 7°F/-6°F with an average water temperature near 28°F (Lalli and Parsons, 1993). McMurdo Station averages 228 days below 0°F each year with average wind speeds reaching between 13 mph (11 kts) and 15 mph (13 kts). The highest recorded wind velocity in Antarctica was 199 mph (173 kts) measured at Dumont d'Urville, July of 1972 (http://antarctica.kulgun.net/Weather/). Cyclonic activity is most pronounced west of the Ross Sea due to the cold continental air masses meeting the relatively warmer waters of the Ross Sea. The cyclonic activity is most frequent during September and October (NGA, 2011).

2.1.5.3 Equatorial, Littoral, and Deepwater: Due to the vastness of this region, average air temperatures during a single voyage fall within a large range (High: 80°F, Low: 36°F) with extreme highs/lows broadening the range further to 114°F to -8°F. Water temperatures also vary greatly during a single voyage with a range of 29°F to 87°F. The average wind speed in these regions is 11 mph (10 kts) with winds reaching 150 mph (130 kts) during cyclones. Cyclonic activity is prevalent in the Southern Pacific Ocean during the months of November through April. These waters have a salinity range between 22 and 34 ppt and currents that can reach speeds of 8 kts in the Strait of Magellan (NGA, 2013).

2.2 Concept of Operations

The following Mission Operations Scenarios are a synopsis of the operational scenarios developed for the PIB CONOPS. The scenarios describe operations that are envisioned for the PIB in terms of the activities anticipated to be conducted during mission execution.

2.2.1 Mission Operations Scenario #1

Missions fulfilled: Ice Operations, Defense Readiness

While en route to Antarctica in support of Operation Deep Freeze and the annual break-in of McMurdo Station, OGA scientists conduct sonar surveys of the ocean floor using vessel-mounted systems operated by the PIB crew. The data obtained is then transmitted back to research laboratories, production centers, and platforms as the mission warrants. During the transit, the polar icebreaker experiences extreme fluctuations in air temperature (-59ºF to 114ºF) and sea temperature (28°F to 87°F) while transiting through the tropics and into Antarctic waters.

The PIB calls on Sydney, Australia and Hobart, Tasmania, Australia for crew rest and refueling. In addition, the PIB loads scientific equipment and stores using onboard weight handling equipment and conducts military and civilian personnel transfers including the on-load of a dive detachment (DIVEDET). As the polar icebreaker heads south, personnel use all available METOC information, including Optimal Track Ship Routing (OTSR) recommendations, to determine the best route through the notoriously rough Southern Ocean. Once the PIB enters the Southern Ocean, it shifts its operational control (OPCON) to the DoD's Support Forces Antarctica (SFA) and communicates with DoD personnel in Hawaii and the continental U.S. As the icebreaker enters the ice pack in the Ross Sea, the crew launches an unmanned aerial system (UAS) to survey the ice ahead of the cutter and gain information about the best track to McMurdo Station. The crew also receives continuous satellite information on weather and ice conditions. Upon choosing the best route, the cutter recovers the UAS, completes the transit to the edge of the fast ice, communicates via very high frequency (VHF) radio and satellite communications with NSF personnel on station and back in Washington, D.C., and commences breaking the channel for the resupply ships.

While in the vicinity of McMurdo, the ship receives fresh food and mail coordinated by shore-based support operations. Upon completing the break-in and arriving at McMurdo Station, the icebreaker offloads cargo and supports local science missions using the ship's helicopters to transport field parties. Significantly cold temperatures and lack of southerly winds to facilitate clearing of the channel requires substantial additional clearing work to keep the channel open. The PIB utilizes its independent ballast system to offset the fuel spent during icebreaker operations. The PIB continues flushing the channel and successfully completes the inbound and outbound escort of the resupply ships.

Having completed escort operations, the PIB departs McMurdo to support the U.S. Antarctic Treaty inspection team as well as project U.S. sovereignty and influence. The PIB contacts the international stations 24 hours in advance via high frequency (HF) voice communications before transporting the inspection team via boats and helicopters to Mario Zucchelli (Italian), Dumont D'Urville (French), Casey (Australian), Davis (Australian), and Mirny (Russian) stations.

2.2.2 Mission Operations Scenario #2

Missions fulfilled: Ice Operations, Search and Rescue, Marine Environmental Protection

The PIB is supporting Arctic science missions for the NOAA and the NSF. The embarked field parties are deploying atmospheric sensors and buoys for METOC investigations and capturing/tagging/releasing seals to further marine mammal research. A cruise ship suffers a steering casualty while approaching Herschel Island, Canada and strikes a submerged pinnacle. The cruise ship begins taking on water and sinking in

high seas, winds and blowing snow. The distance to the distressed tour vessel is at the extreme range of land-based helicopters from Alaska or Canada. The ship's captain sends a MAYDAY call to the Joint Rescue Coordination Centre (JRCC), Trenton, Ontario, and to the USCG Rescue Coordination Center (RCC) Juneau. Per the Arctic SAR Agreement and the United States / Canada Memorandum of Understanding (MOU) regarding icebreaking assistance, the polar icebreaker is diverted from its science missions to assist the cruise ship.

While en route to the scene, the PIB's flight deck and in-flight refueling capability are used as a "lily pad" for USCG, Canadian, and other shore-based helicopters from Barrow and Deadhorse to transfer passengers and crew to a temporary camp ashore. Once on scene, the PIB becomes the on-scene coordinator (OSC) with interoperability on both secure and non-secure communication modes. Due to the remote location of the cruise ship, there are few resources on-scene. While coordinating the rescue efforts, the PIB maintains awareness of the local ice conditions using satellite ice imagery and evaluates potential environmental response requirements including oil spill recovery and containment as a result of a sheen emanating from the disabled cruise ship. The PIB utilizes its boats to deploy booms to contain the pollution until it can be retrieved from the water. Additionally, the PIB uses the cutter's boats to transfer rescue and assistance teams and gear to the cruise ship to conduct damage assessments. The cutter boats and helicopters are used to bring the passengers and crew aboard for transit ashore. The DIVEDET stands by for unaccounted for personnel search and recovery. All 300 passengers and crew are accounted for with injuries ranging from exposure to contusions and broken bones. The onboard medical personnel use the medical equipment suite to provide emergency medical attention, stabilizing passengers' conditions until further medical treatment can be provided.

2.2.3 Mission Operations Scenario #3

Missions fulfilled: Ice Operations, Living Marine Resources, Aids to Navigation, Marine Safety, and Other Law Enforcement

The polar icebreaker sails for a three part Arctic patrol for fisheries law enforcement, Maritime Domain Awareness (MDA), and scientific support. While en route, members from the USCG regional fisheries training team and an embarked NOAA fishery biologist provide fishery identification training and the latest information regarding regulations including gear restrictions, illegal catches, and exclusion zones. While on patrol, the crew of the PIB notices a vessel on its radio detection and ranging (RADAR) system that is operating inside a known fishery exclusion zone.

The Commanding Officer of the PIB directs the Officer of the Deck (OOD) to investigate further, launches the embarked helicopter and sets course towards the vessel. Once the helicopter is overhead of the fishing vessel, the aircrew observes the vessel actively harvesting fish inside the fishery exclusion zone and relays this information via voice communications back to the PIB. The helicopter maintains visual contact with the vessel until the PIB arrives on-scene and launches a boat with a boarding team to interdict the vessel. The boarding team embarks the fishing vessel, conducts an inspection of the vessel's required safety equipment and issues a notice of violation for fishing within an exclusion zone. The PIB receives authorization from the District 17 (D17) Command Center to terminate the voyage and escorts the vessel into the nearest U.S. port where the fishing vessel's catch is formally seized.

Following the fisheries patrol, the PIB transits to the Beaufort Sea, conducting queries via radio communications for all vessels encountered while monitoring maritime traffic with installed C4ISR

equipment. In support of NOAA, U.S. Navy, and NGA interests, the PIB deploys Autonomous Underwater Vehicles (AUV) to assist with bottom-mapping surveys. While executing its patrol, the PIB identifies an unidentified surface contact via RADAR. The OOD contacts the Commanding Officer and is directed to alter course to intercept. As the PIB approached the contact of interest, the lookout identifies the contact as a 9' X 35' buoy adrift, posing a hazard to navigation. The PIB utilizes its heavy lift capability to place the buoy securely on deck for later transfer. At the direction of D17, the PIB rendezvous with CGC SYCAMORE, an ice-capable USCG Seagoing 225 ft Buoy Tender (WLB) on patrol in support of Operation Arctic Shield. The PIB conducts underway refueling operations, transferring fuel to the buoy tender, enabling it to extend its on scene endurance. In addition, the PIB transfers the captured buoy to CGC SYCAMORE.

For the final portion of the patrol, the polar icebreaker rendezvous with the Research Vessel SIKULIAQ, operated by the University of Alaska Fairbanks School of Fisheries and Ocean Sciences, to conduct joint science operations. The PIB uses its boat to transfer personnel from SIKULIAQ to host a final cruise planning conference. In company with the PIB, SIKULIAQ is able to transit further into the ice than solo operations allow and conduct science experiments as planned.

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3 EFFECTIVENESS REQUIREMENTS

The effectiveness requirements describe the operational capabilities necessary to effectively satisfy mission performance requirements.

3.1 Basic Requirements

3.1.1 Ice Breaking

3.1.1.1 (KPP) The PIB shall be capable of independently breaking though ice with a thickness ≥ 6 ft (threshold) / ≥ 8 ft (objective) at a continuous speed ≥ 3 kts.

3.1.1.2 (KPP) The PIB shall be capable of independently breaking through ridged ice with a thickness of 21 ft.

3.1.1.3 The PIB shall be capable of breaking a single-pass channel to a width of at least 83 ft.

3.1.2 Endurance

3.1.2.1 (KPP) The PIB shall have a fully mission capable (in accordance with Table 20) cutter endurance per deployment without replenishment (subsistence and fuel) ≥ 80 days underway (threshold) / ≥ 90 days underway (objective).

3.1.3 Speed

3.1.3.1 The PIB shall have a sustained speed of 15 kts.

3.1.4 Range

3.1.4.1 The PIB shall have a minimum range of 21,500 nautical miles at 12 kts in ice free waters.

3.1.5 Operational Tempo

3.1.5.1 The PIB shall have the capability of performing 3,300 Operational Hours (threshold) / 4,050 Operational Hours (objective) per year.[1]

[1]*The USCG is currently transitioning from the use of DAFHP to Operational Hours as the metric for operational tempo. The threshold and objective figures contained in this requirement represent 185 and 225 DAFHP respectively.*

3.1.6 Seakeeping

3.1.6.1 The PIB stability shall provide the ability to conduct evolutions in the conditions listed in Table 7. The Sea States contained in Table 7 are based on the Bretschneider formulation and are defined in Appendix D.

Table 7. PIB seakeeping requirements.

Sea State	Operations
Sea State 1 (0.3 ft)	Fueling Alongside Moving Cargo within Designated Topside Cargo Areas Transfer Recovered Oil
Sea State 3 (4.1 ft)	Underway Replenishment (UNREP) and Strike Down Fuel Astern Boat Operations (Launch and Recovery Only) of Cargo Landing Capable Boat Deploy & Retrieve Divers from the Water Recover Personnel Directly from the Water/Ice Surface/Alongside Platform Recover Unconscious Personnel Directly from the Water/Ice Surface/Alongside Platform
Sea State 4 (8.2 ft)	Boat Operations (Launch and Recovery Only) of OTH Capable Boat on best course and speed Aviation Operations (Launch and Recovery) on best course and speed Rescue and Assistance Vertical Replenishment (VERTREP) and Strike Down on best course and speed Science/Survey Support
Mid Sea State 5 (10.6 ft)	Towing
Sea State 7 (29.5 ft)	Limited Ops
Sea State 8 (45.5 ft)	Survive

3.1.6.2 The PIB shall have the ballast capability to compensate for fuel consumed through operations.

3.1.6.2.1 The PIB shall have the capability to treat the water of its independent ballast tanks prior to discharge to enable worldwide discharge of ballast water.

3.1.7 Maneuvering, Mooring, Anchoring and Berthing

3.1.7.1 The PIB shall have the capability to be conned from a location that allows visual evaluation of ice conditions for a minimum distance of 12 NM in all directions.

3.1.7.2 The PIB shall be capable of maneuvering alongside piers in ice covered waters up to the threshold continuous icebreaking capability.

3.1.7.3 The PIB shall be capable of maneuvering close aboard vessels to within a distance of half the PIB's width in ice covered waters up to the threshold continuous icebreaking capability.

3.1.7.4 The PIB shall be capable of mooring to a pier on both port and starboard sides and Mediterranean moors.

3.1.7.5 The PIB shall be able to berth without the assistance of tugs.

3.1.7.6 The PIB shall be capable of mooring (breasting) alongside a similar sized vessel.

3.1.7.7 The PIB shall have two anchors. Each anchor shall have the capability to anchor the PIB in 70 kts of wind in a depth of water that is at least 5 times the ship's draft.

3.1.7.8 The PIB shall provide accommodation ladders for port and starboard access from the pier or ice to the shipboard enclosed quarterdeck stations throughout all tidal variances within the intended operation area.

3.1.8 Lighting

3.1.8.1 The PIB's exterior and interior spaces directly visible from outside of the PIB shall have lighting fixtures that provide illumination that will:

3.1.8.1.1 Preserve dark-adapted vision of unaided personnel.

Note: Unaided personnel are those personnel involved in the operation at-hand who are not using a night vision imaging system (NVIS)

3.1.8.1.2 Not interfere with aided users on the weather deck, in watch stations, and in special compartments and stations.

3.1.8.1.3 Provide general illumination that will be useable with NVIS operations on weather decks and in compartments opening to the weather and/or having port lights (windows) to the weather.

3.1.8.2 The PIB shall be capable of operating under Darkened Ship conditions in accordance with the Naval Ship's Technical Manual (NSTM) Chapter 330 (Series).

3.1.8.3 The PIB's electronic and mechanical equipment shall have adjustable light emission settings to prevent external light emission and/or for NVIS compatibility.

3.1.8.4 The PIB shall be capable of providing forward lighting to aid in ice breaking during dark conditions.

3.1.9 Cargo Handling and Underway Replenishment

3.1.9.1 The PIB shall be capable of underway transfer, strike-down, and stowage of stores from VERTREP locations.

3.1.9.2 The PIB shall be capable of delivering aviation fuels, diesel fuels, and potable water while underway from storage and service tanks to United States Navy (USN)/USCG/North Atlantic Treaty Organization (NATO) vessels 240 feet or less in length in either astern tow or alongside.

3.1.9.3 The PIB shall be capable of receiving underway replenishment of fuel and water from USN/NATO/Allied Navy vessels, Military Sealift Command or other designated vessels.

3.1.9.4 The PIB shall be able to pump aviation fuels, diesel fuels, and water to shore facilities, including U.S. Scientific Research Stations.

3.1.9.5 The PIB shall be capable of organic mechanical cargo handling while alongside piers.

3.1.9.6 The PIB shall be capable of moving cargo within topside cargo areas through sea state 1 while underway, anchored or hove to.

3.1.9.7 The PIB shall have a designated topside cargo area capable of transporting (not simultaneously):

3.1.9.7.1 Three 9 ft x 35 ft buoys including associated buoy mooring equipment.

3.1.9.7.2 Six twenty foot equivalent units (TEU) with a maximum weight of 20 tons each.

3.1.10 Aviation Capabilities

3.1.10.1 The PIB shall meet certification criteria for Level I, Class 2 aviation operations for the following aircraft in accordance with the USCG Shipboard Helicopter Operations Procedures Manual, COMDTINST 3710.2 (Series). Servicing of the aircraft shall be performed on the flight deck.

3.1.10.1.1 United States Navy (USN)/United States Marine Corps (USMC)/United States Air Force (USAF)/United States Army (USA) Utility Helicopter (UH)-1.

3.1.10.1.2 USA Observation Helicopter (OH)-6.

3.1.10.1.3 USMC/USA/USAF/Customs and Borders Protection (CBP) H-60.

3.1.10.1.4 Civilian and NATO variants of the UH-1, OH-6, H-60, or H-65.

3.1.10.2 The PIB shall be able to hangar a total of two of any combination of the following aircraft:

3.1.10.2.1 USCG H-65 with blade-folding capability.

3.1.10.2.2 USCG/USN H-60 with blade-folding capability.

3.1.10.2.3 UAS (not to exceed the footprint of an USCG H-60 with blade folding capability).

3.1.10.3 The PIB shall have sufficient hangar space to enable one aircraft or the UAS to be moved in/out without disturbing the other aircraft or UAS.

3.1.10.4 The PIB shall meet certification criteria for Level I, Class 1 aviation operations for a total of two of any combination of the following aircraft in accordance with the USCG Shipboard Helicopter Operations Procedures Manual, COMDTINST 3710.2 (Series).

3.1.10.4.1 USCG H-65 with blade-folding capability.

3.1.10.4.2 USCG/USN H-60 with blade-folding capability.

3.1.10.4.3 UAS (not to exceed the footprint of an USCG H-60 with blade folding capability) and shall include:

3.1.10.4.3.1 Command and Control of an organic UAS.

3.1.10.4.3.2 An automatic UAS launch and recovery system.

3.1.10.5 The PIB shall be capable of storing two USCG H-60 helicopter support kits (HSK) or one USCG H-60 HSK and one UAV support kit, whichever is larger, to support a 150 day aviation deployment.

3.1.10.6 The PIB shall be able to conduct flight operations on its flight deck while the hangar is occupied with other aircraft/UAS.

3.1.10.7 The PIB shall be able to conduct VERTREP with the following airframes in accordance with the USCG Shipboard-Helicopter Operational Procedures Manual, COMDTINST M3710.2 (Series).

3.1.10.7.1 USA/USN/USMC/USAF UH-1.

3.1.10.7.2 USA H-47.

3.1.10.7.3 USN/USMC H-53.

3.1.10.7.4 USCG/USN/USMC/USA/USAF/CBP H-60.

3.1.10.7.5 USCG H-65.

3.1.10.8 The PIB shall be capable of conducting HIFR of the following airframes in accordance with the USCG Shipboard-Helicopter Operational Procedures Manual, COMDTINST M3710.2 (Series).

3.1.10.8.1 USCG/USN H-60.

3.1.10.8.2 USCG H-65.

3.1.10.9 The PIB shall have the capability for straight-in, sliding, oblique, and athwartships helicopter approaches to continue from the Final Approach Area to the Touchdown and Liftoff Area, with an unobstructed flight path free from obstacle penetration into the path.

3.1.10.10 The PIB shall have the capability for an H-65 to be mechanically secured to the flight deck immediately after landing without the use of tie-down personnel.

3.1.10.11 The PIB shall have the capability to support mobile mechanical traversing of the USCG/USN H-60.

3.1.10.12 The PIB flight deck shall be within the unobstructed field of view of the PIB primary aviation control station.

3.1.10.13 The PIB flight deck shall be observable from the PIB secondary aviation control station.

3.1.10.14 The PIB shall have the aviation fuel capacity to operate an H-60 for 250 flight hours with 24 flight hours of fuel capacity in service tanks.

3.1.10.15 The PIB shall be capable of supporting Tactical Air Navigation (TACAN).

3.1.11 Boat Capabilities

3.1.11.1 The PIB shall have the capability to independently launch, recover, fuel, maintain and operate two assigned boats with over-the-horizon (OTH) capability.

3.1.11.2 The PIB shall have the capability to launch, recover, fuel, maintain, and operate at least one assigned cargo landing boat capable of landing a minimum capacity of 4,500 pounds (e.g., people, cargo, and equipment).

3.1.11.3 The PIB shall be capable of transferring fuel directly from the service tanks to each organic boat's permanent storage location utilizing a permanently installed system.

3.1.11.4 The PIB shall provide electrical and plumbed running potable water supplies at each boat bay and boat launch location.

3.1.11.5 The PIB shall have the capability to support the performance of organizational level boat maintenance and servicing including the capability to store adequate spare parts.

3.1.11.6 The PIB shall have the capability to support the performance of organizational level boat maintenance within an area internal to the ship.

3.1.11.7 The PIB's OTH boat launch/recovery system shall be capable of launching at least one boat from its secured state within 8 minutes.

3.1.11.8 The PIB shall have the capability for bridge personnel to monitor boat launch and recovery operations via video monitor.

3.1.11.9 The PIB shall have the capability to launch and recover one boat while simultaneously conducting each of the following operations:

3.1.11.9.1 Being towed.

3.1.11.9.2 Condition I steaming.

3.1.11.9.3 Flight operations.

3.1.11.9.4 Astern refueling of other vessels.

3.1.11.9.5 Towing astern.

3.1.11.10 The PIB shall have the capability to launch and recover on both port and starboard sides.

3.1.11.11 The PIB shall have boat bays onboard capable of protecting boats from the environment during storage and maintenance.

3.1.11.12 The PIB shall allow the Boat Launch Operator to visually monitor boat launch and recovery operations from the primary boat control station to include personnel embarkation and operations alongside.

3.1.11.13 The PIB shall provide the boat safety supervisor an unobstructed field of view to monitor boat launch and recovery operations.

3.1.12 Boarding Operations

3.1.12.1 The PIB shall have the capability to deliver, support, and recover one 8-person boarding team and their gear, trained and outfitted in accordance with the Maritime Law Enforcement Manual, COMDTINST M16247.1 (Series) via cutter boat operated by a boat crew in accordance with USCG policy.

3.1.13 Rescue and Assistance

3.1.13.1 The PIB shall be capable of delivering portable damage control equipment (i.e. dewatering, plugging/patching, firefighting, etc.) to other vessels in distress.

3.1.13.2 The PIB shall have the ability, with the use of recovery personnel and mechanical apparatus, to recover unconscious personnel directly from the water.

3.1.13.3 The PIB shall have the ability, with the use of recovery personnel and mechanical apparatus, to recover unconscious personnel directly from the ice surface.

3.1.13.4 The PIB shall have the ability, with the use of recovery personnel and mechanical apparatus, to recover/deliver unconscious personnel from/to an alongside platform.

3.1.13.5 The PIB shall have the ability, with the use of recovery personnel and mechanical apparatus, to recover/deliver personnel from/to the water.

3.1.13.6 The PIB shall have the ability, with the use of recovery personnel and mechanical apparatus, to recover personnel directly from the ice surface.

3.1.13.7 The PIB shall have the ability, with the use of recovery personnel and mechanical apparatus, to recover/deliver personnel from/to an alongside platform.

3.1.14 Towing Capabilities

3.1.14.1 The PIB shall have the capacity to tow astern a vessel not exceeding an equivalent displacement to that of the PIB.

3.1.14.1.1 The PIB's tow bit shall not impede the operation of stern equipment.

3.1.14.2 The PIB shall have the ability to be towed by the bow.

3.1.14.3 The PIB shall be capable of accepting harbor tug assist.

3.1.15 Dive Detachment Missions Support

3.1.15.1 The PIB shall have the capability to support a DIVEDET of 7 personnel and their equipment, in accordance with the USCG Diving Policies and Procedures Manual, COMDTINST M3150.1 (Series) and the USN Diving Manual, SS521-AG-PRO-010 (Series).

3.1.15.2 The PIB shall provide space weight and power to support a portable hyperbaric chamber.

3.1.15.3 The PIB shall be capable of supporting a DIVEDET conducting the following ship husbandry tasks to include:

3.1.15.3.1 Cofferdam placement and removal.

3.1.15.3.2 Plugging.

3.1.15.3.3 Patching.

3.1.15.3.4 Transducer plate placement and removal.

3.1.15.3.5 Zinc installation and removal.

3.1.15.3.6 Hull inspections.

3.1.15.3.7 Hull cleanings.

3.1.15.3.8 Propeller/Pod calibrations (if applicable).

3.1.15.3.9 Shaft seals to facilitate shaft boot replacement.

3.1.15.4 The PIB shall be capable of supporting a DIVEDET providing underwater force protection hull security sweeps under elevated THREATCONs.

3.1.15.5 The PIB shall be capable of conducting AtoN diving operations to a depth of 190 feet when staffed with dive team personnel in accordance with the USCG Diving Policies and Procedures Manual, COMDTINST M3150.1 (Series).

3.1.15.6 The PIB shall be capable of supporting a DIVEDET with Remotely Operated Vehicle (ROV) capabilities not to exceed the PIB's lifting and deck space capacity.

3.1.16 OGA Science/Survey Mission Support

3.1.16.1 The PIB shall have the capability to conduct marine weather observations in accordance with the USCG's Marine Weather Observation and Reporting Manual, COMDTINST M3140.2 (Series).

3.1.16.2 The PIB shall have the capability to support conducting oceanographic observations to include:

3.1.16.2.1 Hydrographic cast.

3.1.16.2.2 Mapping surveys to include the shelf Arctic ridged and basins and full ocean depth.

3.1.16.2.3 Biological sampling.

3.1.16.2.4 Jumbo Coring.

3.1.16.2.5 Trawling.

3.1.16.2.6 Bottom Sampling.

3.1.16.2.7 Plankton tows.

3.1.16.2.8 Conduct continuous measurements and data recording of oceanic properties.

3.1.16.3 The PIB shall have the capability to support conducting bathymetric measurements.

3.1.16.4 The PIB shall have the capability to support conducting hydrographic surveys in accordance with the International Hydrographic Organization (IHO) Standards for Hydrographic Surveys (Series).

3.1.16.5 The PIB shall have the capability to support conducting continuous surveys of water depth and sub-bottom profiling.

3.1.16.6 The PIB shall provide dedicated location(s) and reserved space, weight, power, hotel services, data network and phones to accommodate six 10 ft x 20 ft science vans that do not interfere with flight deck operations.

3.1.16.7 The PIB shall provide the space, weight, and power for a reconfigurable science wet lab.

3.1.16.8 The PIB shall provide the space, weight, and power for a reconfigurable science dry lab.

3.1.16.9 The PIB shall provide the space, weight, and power for a reconfigurable electronics lab with designated cableways to a reconfigurable topside antenna mounting area.

3.1.16.10 The PIB shall have the capability to support monitoring atmospheric patterns using onboard RADAR.

3.1.16.11 The PIB shall provide reserved space, weight, and power for one 265 ft^2 science freezer.

3.1.16.12 The PIB shall provide reserved space, weight, and power for one 170 ft^2 science refrigerator.

3.1.16.13 The PIB shall provide reserved space, weight, and power for two 105 ft^2 walk in climate control chambers.

3.1.16.14 The PIB shall have the capability to support the deployment and retrieval of research buoys up to 5 ft x11 ft with 3000lb sinkers and up to 2000m of cable.

3.1.16.15 The PIB shall have the capability to support conducting marine mammal observations.

3.1.16.16 The PIB shall have the capability to support conducting ambient air sampling.

3.1.16.17 The PIB shall have the capability to support conducting atmospheric observations.

3.1.16.18 The PIB shall have the capability to provide ambient, continuous flow sea water samples in open waters and ice covered waters.

3.1.16.19 The PIB shall have the capability to launch and retrieve sub-surface hydrographic moorings.

3.1.16.20 The PIB shall have the capability to launch and recover surface and sub-surface unmanned vehicles not to exceed the PIB's lifting and deck space capacity.

3.1.16.21 The PIB shall provide storage capacity to operate with zero discharge into the water for 5 days.

3.1.17 Heavy Lift

3.1.17.1 The PIB shall have a heavy lift capability with a minimum capacity of 20 tons extending to at least one lift point 25 feet past the widest point of the ship's beam on both the port and starboard side of the ship.

3.1.17.2 The PIB shall be capable of providing non-simultaneous heavy lift capacity to both port and starboard sides of the PIB.

3.1.17.3 The PIB shall have the capability to provide a heavy lift capacity from:

3.1.17.3.1 Pier/ice/water's edge to the PIB.

3.1.17.3.2 PIB to pier/ice/water's edge.

3.1.17.3.3 Across working deck areas.

3.1.17.3.4 To/from topside cargo areas.

3.1.18 Aids to Navigation

3.1.18.1 The PIB shall be capable of transporting and exchanging with a servicing vessel a minimum of three 9’ X 35’ buoys and buoy mooring equipment in accordance with the AtoN Technical Manual, COMDTINST M16500.3 (Series), and AtoN Seamanship Manual, COMTDINST M16500.21 (Series).

3.1.19 Marine Environmental Response

3.1.19.1 The PIB shall be capable of monitoring response activities in open water, at the ice edge and in an ice field in all light and operating conditions.

3.1.19.2 The PIB shall be capable of directing response activities in open water, at the ice edge and in an ice field.

3.1.19.3 The PIB shall be capable of conducting response activities in open water, at the ice edge and in an ice field if equipped with non-organic response equipment.

3.1.19.4 The PIB shall provide reserved space, weight, and power for storage and transport of one USCG Vessel of Opportunity Skimming System not to exceed the heavy lift capacity and exterior storage space capacity.

3.1.19.5 The PIB shall be capable of transferring oil and hazardous material retrieved by surface skimming equipment if equipped with non-organic response equipment.

3.1.19.6 The PIB shall provide reserved space, weight, and power for storage and transport of equipment used for application and monitoring of alternative marine environmental response technologies (e.g., burning and dispersants) not to exceed the heavy lift capacity and exterior storage space capacity.

3.1.20 Defensive/Offensive Capability Systems

3.1.20.1 The PIB shall have the capability to employ removable weaponry.

Table 8. PIB defensive/offensive capability systems.

Requirement Statement
3.1.20.1.1 The PIB shall have the ability to conduct warning shots against surface targets.
3.1.20.1.2 The PIB shall have the ability to conduct disabling fire against surface targets.

3.2 Communications, Information Technology and Intelligence

3.2.1 Interoperability

3.2.1.1 (KPP) The PIB shall have the capability to exchange information (voice and data) with:

3.2.1.1.1 USCG.

3.2.1.1.2 DoD.

3.2.1.1.3 DHS.

3.2.1.1.4 NATO.

3.2.1.1.5 DoS.

3.2.1.1.6 NSF.

3.2.1.1.7 NOAA.

3.2.2 External Communications

3.2.2.1 The PIB shall have the capability to communicate simultaneously via external radio frequency communication paths across the radio frequency spectrum.

3.2.2.2 The PIB external communications system shall be accessible from the major ship operations and mission support spaces**.**

3.2.2.3 The PIB shall be capable of voice and data communication on U.S. recognized maritime voice and data distress frequencies.

3.2.2.4 The PIB shall be capable of recording audio of all permanently installed radio communications for storing and archiving in accordance with USCG policy.

3.2.2.5 The PIB shall have a communications management capability for displaying and configuring external voice communications circuits from watch-station positions as identified in Table 11.

3.2.2.6 The PIB's communication suite shall accommodate telemedicine to include direct consultations (using voice/video/data) by shore-side medical professionals.

3.2.3 Internal Communications

3.2.3.1 The PIB shall have ships interior communications capabilities, including topside, for voice and data.

3.2.3.1.1 The PIB shall have the capability to announce alarms and voice throughout all manned spaces of the cutter from the Bridge, Damage Control Spaces, Quarterdeck, and Engineering Control Spaces.

3.2.3.1.2 The PIB shall be able to selectively announce alarms and shipboard messages in manned space to promote crew rest.

3.2.3.1.3 The PIB shall have a non-electrically powered voice communications capability for ship control, navigation, weapons control, and emergencies.

3.2.3.1.4 The PIB shall have a wired networked capability for exchanging voice, data and video throughout all manned spaces including science vans when deployed.

3.2.3.1.5 The PIB shall provide the capability to process unclassified, controlled and classified information to include safety, security, and cutter operations.

3.2.3.1.6 The PIB shall have the capability to display unclassified recorded video throughout all manned spaces.

3.2.3.1.6.1 The PIB shall have the capability to record, store (48 hours), archive (185 days) and display safety, security and tactical/Full Motion Video (FMV).

3.2.3.1.7 The PIB shall have a system in place to allow uninterrupted radio (Shipboard Working Frequency) communications to all manned spaces and weather decks.

3.2.3.1.8 The PIB shall have a personal wireless paging system capable of communicating to all unclassified manned spaces and weather decks.

3.2.4 OGA Science/Survey Mission Support (Communications)

3.2.4.1 The PIB shall provide a voice, data, and video network capability physically separated from the PIB's operations network for embarked OGA science/survey teams throughout their associated work spaces.

3.2.4.2 The PIB shall have the capability to automatically export navigation sensor data to the UNCLAS segregated networking environment.

3.2.4.3 The PIB shall have the capability to automatically export meteorological sensor data to the UNCLAS segregated networking environment.

3.2.4.4 The PIB shall have the capability to automatically record, selectively display and automatically format meteorological information for reporting purposes.

3.2.5 Shore Tie

3.2.5.1 The PIB shall have the following shore tie connection types (fuel, potable water, firefighting water, electrical, sewage, data, entertainment system, telephone, lube and hydraulic oil and oily waste) accessible on both the port and starboard sides.

3.2.5.1.1 The PIB shall utilize the USCG standard shore tie for voice, data and video, data accessible on both the port and starboard sides.

3.2.6 Command and Control

3.2.6.1 The PIB shall have an integrated capability from watchstations to exercise command and control over own ship operations and systems; organic boat and air assets; and other surface and air assets when assigned.

3.2.6.1.1 The PIB shall have an integrated command and control and navigation system.

3.2.6.1.2 The PIB shall have the capability to display command and control information in locations outlined in Table 12.

Table 9. Command and Control (C2) display access.

Space	Unclassified C2 Display	Classified C2 Display
Bridge	X	
Conning Stations	X	
Helo Control Station	X	
Commanding Officer's Cabin	X	
OPS Stateroom	X	
Engineering Control Center	X	

3.2.6.2 The PIB's command and control system shall operate in all environmental conditions that the PIB will encounter.

3.2.6.3 The PIB's command and control system shall be certified and accredited for cybersecurity in accordance with DOD in accordance with DOD Directive 8500.01 (Series), Cybersecurity.

3.2.6.4 The PIB's command and control system shall provide alerts based on default criteria.

3.2.6.5 The PIB's command and control system shall provide alerts based on user-defined criteria.

3.2.6.6 The PIB's command and control system shall be capable of participating in a Common Operational Picture (COP) synchronized environment.

3.2.6.7 The PIB's command and control system shall provide a user interface to synchronize own-ship track data with the COP.

3.2.6.8 The PIB's command and control system shall provide a user interface to display emergency and distress signals.

3.2.6.9 The PIB's command and control system shall receive and display Radio Direction Finding data.

3.2.6.10 The PIB's command and control system shall receive and display electronic Line of Bearing (LOB) data.

3.2.6.11 The PIB's command and control system shall receive and display data from meteorological sensors.

3.2.6.12 The PIB's command and control system shall provide a user interface to select and deselect tracks.

3.2.6.13 The PIB's command and control system shall associate or correlate track data to create a track.

3.2.6.14 The PIB's command and control system shall provide a user interface to automatically or manually set track priority.

3.2.6.15 The PIB's command and control system shall provide a user interface to manually set track priority.

3.2.6.16 The PIB's command and control system shall have the capability to automatically sort all tracks by priority (highest threat/priority) based on user defined parameters.

3.2.6.17 The PIB's command and control system shall provide a user interface to define and create grid parameters.

3.2.6.18 The PIB's command and control system shall automatically identify and classify tracks in user defined grids based on user defined parameters.

3.2.6.19 The PIB's command and control system shall correlate tracks on a single contact when received from multiple sources.

3.2.6.20 The PIB's command and control system shall provide decision support tools for display tailoring such as overlays, track groups, filters and track analysis.

3.2.6.21 The PIB's command and control system shall provide a system administrator function.

3.2.6.22 The PIB shall provide a user interface to the video system for display of the safety and security camera system(s) data and video.

3.2.6.23 The PIB shall provide a user interface to the video system for display of the Flight Deck Video System (FDVS) data and video.

3.2.6.24 The PIB's command and control system shall receive and display search patterns from external sources.

3.2.6.25 The PIB's command and control system shall convert search pattern data into an overlay.

3.2.6.26 The PIB's command and control system shall transmit and receive data to/from own-ship navigation systems.

3.2.6.27 The PIB's command and control system shall display electronic chart data in accordance with USCG Navigation Standards Manual, COMDTINST M3530.2 (Series).

3.2.6.28 The PIB's command and control system shall receive data from the Global Positioning System (GPS).

3.2.6.29 The PIB's command and control system shall receive data from the Differential Global Positioning System (DGPS).

3.2.6.30 The PIB's command and control system shall provide Sensitive but Unclassified (SBU) Local Area Network (LAN) connectivity to the internet via the USCG and DHS data network while underway and pier side.

3.2.6.31 The PIB's command and control system shall display and provide user access to the USCG Standard Image.

3.2.6.32 The PIB's command and control system shall calculate and display track information in near real time.

3.2.6.33 The PIB's command and control system shall be interoperable with Joint C2 systems.

3.2.6.34 The PIB's command and control system component and subsystem open architecture standards shall be designed in accordance with the USCG Command, Control, Communications, Computers, and the Information Technology (C4IT) Enterprise Architecture (EA) policy, COMDTINST 5230.68 (Series).

3.2.6.35 The PIB's command and control system operator console shall accommodate a two screen display.

3.2.6.36 The PIB's command and control system shall provide a user interface to define training scenarios.

3.2.6.37 The PIB's command and control system shall provide a scenario based training module capable of both in port and underway operation.

3.2.6.38 The PIB's command and control system shall be designed to enhance safety, reduce operator fatigue, and crew discomfort.

3.2.6.39 The PIB's command and control system shall be provided the necessary diagnostics data and information, tools and test equipment/sets, technical documentation, material and skills to perform maintenance.

3.2.6.40 The PIB's command and control system shall be designed to maintain the asset CONOPS-identified workload and crew size for operations, maintenance and manpower.

3.2.6.41 The PIB's command and control system shall be operated by asset CONOPS-identified support personnel.

3.2.6.42 The PIB's command and control system shall be supportable and maintainable within the current force structure.

3.2.6.43 The PIB's command and control system shall restrict personnel competencies to existing CG workforce competencies so as not to exceed demands on human aptitudes (cognitive, physical, & sensory) necessary for operation, maintenance, and support of equipment consistent with these aptitudes.

3.2.6.44 The PIB's command and control system performance support and training systems shall support validated system performance requirements while minimizing resident training requirements based on analysis of the as-built configuration.

3.2.6.45 The PIB's command and control system performance support and training requirements will be in place to ensure C4ISR operators and maintainers are prepared to perform validated performance requirements at delivery and throughout the system’s lifecycle.

3.2.6.46 The PIB's command and control system shall achieve a human performance reliability measure (e.g. task accuracy, time on task, situational awareness, workload, usability) that is $\geq$ a baseline of current human performance while using current/equivalent C4ISR systems.

3.2.6.47 The PIB's command and control system shall use systematic and systemic analyses to determine optimal sustainment performance support and training solutions, and no sustainment solution shall be implemented without analysis.

3.2.6.48 The PIB's command and control system shall use during deployment a combination of existing Coast Guard training, manufacturer training, and familiarization instruction to ensure initial C4ISR operators and maintainers are prepared to perform validated performance requirements at delivery.

3.2.6.49 The PIB's command and control system shall use a blended performance support system of resident training, on-the-job training, advanced distributed learning, simulators/emulators, electronic performance support, and unit level technical support to sustain operator and maintainer performance, as supported by performance support and training analyses.

3.2.6.50 The PIB's command and control system shall provide near-real time access to shore-based performance support and training systems, including but not limited to personnel and logistics database and streaming video, to support C4ISR operators and maintainers.

3.2.6.51 The PIB's command and control system shall provide embedded onboard performance support systems.

3.2.6.52 The PIB's command and control system shall provide embedded performance support and training capabilities for training exercises or drills, and delivering learning content and performance support while simultaneously conducting real world operations.

3.2.6.53 The PIB's command and control system electronic-based performance support and training solutions shall use readily-transferred, existing skills to operate.

3.2.6.54 The PIB's command and control system electronic-based performance support and training solutions shall be automated and portable.

3.2.6.55 The PIB's command and control system shall use non-instructional performance support tools to minimize resident training requirements.

3.2.6.56 The PIB's command and control system shall be tolerant of human errors that result in mission-critical errors or produce safety or health hazards.

3.2.6.57 The PIB's command and control system shall be designed in accordance with human factors engineering design standards and best practices.

3.2.6.58 The PIB's command and control system shall achieve a Human Reliability Analysis Element Grade of three (3) or higher in accordance with NEI 00-02 Probabilistic Risk Assessment (PRA) Peer Review Process Guidance (Series) as measured at the Human Reliability Analysis Supporting Requirement Compliance Level II or higher as defined in ASME/ANS RA-S-1.4-2013: Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants (Series).

3.3 Navigation

3.3.1 Navigation Systems

3.3.1.1 The PIB's navigation system shall provide the capability to navigate in the open-ocean, coastal waters, harbors, and navigable rivers throughout the world.

3.3.1.1.1 The PIB shall have the capability to navigate using electronic charts and all federally approved radio navigation sources as defined in USCG policy.

3.3.1.1.2 The PIB shall have the capability to navigate using paper charts.

3.3.1.1.3 The PIB shall be able to use non-radio navigation sources as defined in USCG policy.

3.3.1.1.4 The PIB shall have the capability to display organic sensor information on its electronic navigation chart.

3.3.1.1.5 The PIB shall have the capability to receive, display and relay automated positioning and safety of navigation information associated with own ship and other ships.

3.3.1.1.6 The PIB shall have the capability to automatically adjust heading to follow a user inputted voyage plan, in addition to manual control functions.

3.3.1.2 The PIB shall be in compliance with USCG policy for navigation lighting, day shapes and sound signals.

3.3.1.3 The PIB shall have the ability to automatically record and display on demand, digitally and on paper, all required navigation log entries in accordance with USCG policy.

3.3.1.4 The PIB shall have the ability to display international flags and pennants in accordance with USN/USCG policy.

3.3.1.5 The PIB's navigation system shall transmit automated positioning and safety of navigation data to the Command and Control system.

3.3.1.6 The PIB's navigation system shall provide a user interface to input data into a voyage plan.

3.3.1.7 The PIB's navigation system shall automatically transmit heading changes to the auto-pilot based on a user defined voyage plan.

3.3.1.8 The PIB's navigation system shall provide CG Electronic Charting in accordance with the USCG Navigation Standards Manual, COMDTINST M3530.2 (Series).

3.3.1.9 The PIB's navigation system shall display navigation information in accordance with the USCG Navigation Standards Manual, COMDTINST M3530.2 (Series).

3.3.1.10 The PIB's navigation system shall display electronic chart data in accordance with the USCG Navigation Standards Manual, COMDTINST M3530.2 (Series).

3.3.1.11 The PIB's navigation system shall provide a user interface to edit charts, maps, and overlays.

3.3.1.12 The PIB's navigation system shall automatically plot own-ship position on an electronic chart.

3.3.1.13 The PIB's navigation system shall operate in the Relative and True-motion modes for chart displays.

3.3.1.14 The PIB's navigation system shall display water current speed and water current direction.

3.3.1.15 The PIB's navigation system shall perform Man Overboard calculations based on the current environmental conditions.

3.3.1.16 The PIB's navigation system shall provide a user interface to initiate Man Overboard calculations by a single user action.

3.3.1.17 The PIB's navigation system shall predict the most probable position of a Man Overboard using ship recorded sensor data and user defined data.

3.3.1.18 The PIB's navigation system shall receive, and display automated positioning and safety of navigation data from own-ship sensors.

3.3.1.19 The PIB's navigation system shall display own-ship sensor information.

3.3.1.20 The PIB's navigation system shall correlate sensor data with chart data to determine navigational positions.

3.3.1.21 The PIB's navigation system shall receive and display data and video from the Surface Search RADAR.

3.3.1.22 The PIB's navigation system shall receive and display data from the following Navigation Systems:

3.3.1.22.1 The PIB's navigation system shall receive and display data from the GPS.

3.3.1.22.2 The PIB's navigation system shall receive and display data from the DGPS.

3.3.1.22.3 The PIB's navigation system shall receive and display data from the PPS.

3.3.1.22.4 The PIB's navigation system shall receive and display data from the Global Navigation Satellite System (GLONASS).

3.3.1.22.5 The PIB's navigation system shall receive and display data from the Galileo Global Navigation Satellite System (GNSS).

3.3.1.22.6 The PIB's navigation system shall receive and display data from the BeiDou Navigation Satellite System.

3.3.1.23 The PIB's navigation system shall receive data from the Radio Direction Finder (RDF).

3.3.1.24 The PIB's navigation system shall receive and display data from the Gyrocompass.

3.3.1.25 The PIB's navigation system shall receive and display data from the Fluxgate Compass.

3.3.1.26 The PIB's navigation system shall transmit, receive and display data to/from the Autopilot.

3.3.1.27 The PIB's navigation system shall receive and display data from the Wind Speed Indicator System.

3.3.1.28 The PIB's navigation system shall calculate and display True Wind.

3.3.1.29 The PIB's navigation system shall receive and display data from the Speed Log.

3.3.1.30 The PIB's navigation system shall receive and display water temperature.

3.3.1.31 The PIB's navigation system shall receive and display depth data from the Depth Sounder and other SONAR systems as so equipped.

3.3.1.32 The PIB's navigation system shall allow the operator to display a true course and speed through water vector.

3.3.1.33 The PIB's navigation system shall allow the operator to display Course Made Good and Speed over Ground vector.

3.3.1.34 The PIB's navigation system shall store electronic chart data.

3.3.1.35 The PIB's navigation system shall store navigational overlays.

3.3.1.36 The PIB's navigation system shall store updates to electronic chart data, e.g., Electronic Navigational Charts (ENC) source, edition, date, cell and update history.

3.3.1.37 The PIB's navigation system shall record and store navigation log entries in accordance with USCG Procedures for the Preparation and Disposition of Cutter Logs, COMDTINST M3123.12 (Series).

3.3.1.38 The PIB shall have lighting to notify escorted vessels when it becomes stopped or beset during icebreaking operations.

3.4 Sensors

3.4.1 Surface Search RADAR

3.4.1.1 The PIB shall have a navigational surface search RADAR, with a surface search detection capability as outlined in Table 15, which is integrated into the Command and Control system.

3.4.1.2 The PIB shall have a secondary, independent, IMO compliant navigational surface search RADAR which is integrated with the Command and Control system.

3.4.1.3 The PIB shall be capable of detecting sea ice by electronic means.

3.4.2 Air Search RADAR

3.4.2.1 The PIB shall be designed to provide airspace management for organic aircraft operating in controlled and uncontrolled airspace by providing installed organic systems.

3.5 Measures of Effectiveness

Measures of Effectiveness (MOE) are operational outcome measures that identify the most critical performance requirements needed to meet system-level capabilities. Table 17 contains the initial MOEs identified for each mission task for the PIB.

3.6 Measures of Performance

Measures of Performance (MOP) are measures of a system characteristic (e.g. range, speed, logistics footprint, etc.) chosen to support one or more MOEs. Table 17 contains the initial MOPs for each associated MOE and mission task.

Table 10. Measures of effectiveness and measures of performance.

Mission Task	Initial MoE	Initial MoP
Icebreaking Operations (IO)	Icebreaking Operations Performance	Ability to Break Ice, Endurance
	Ice Management	Vessel escort / channel break-in, vessel moor/unmoor support in brash ice, turning diameter in ice
	Optimization of time in Area Of Responsibility (AOR) (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Maintenance Time
Defense Readiness (DR)	Icebreaking Operations Performance	Ability to Break Ice, Endurance
	Ice Management	Vessel escort / channel break-in, vessel moor/unmoor support in brash ice, turning diameter in ice
	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
Aids to Navigation (AtoN)	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
	Ability to affect AtoN/MSI/Oceanographic Data Support during a deployment	C4ISR/Lifting/Deployment Capacity, Storage Capacity, Deployable Boat Capabilities
Living Marine Resources (LMR)	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
	Ability to affect Mission Related Detections, Classifications & Identifications of TOI during a deployment	C4ISR, Aviation Capacity
	Ability to affect Mission Related Prosecutions of TOI during a deployment	C4ISR, Deployable Boat Capabilities, Aviation Capacity
Marine Safety (MS)	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
	Ability to affect Mission Related Detections, Classifications & Identifications of TOI during a deployment	C4ISR, Aviation Capacity
	Ability to affect Mission Related Prosecutions of TOI during a deployment	C4ISR, Deployable Boat Capabilities, Aviation Capacity

Table 10. Measures of effectiveness and measures of performance (continued).

Mission Task	Initial MoE	Initial MoP
Marine Environmental Protection (MEP)	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
	Ability to affect Mission Related Detections, Classifications & Identifications of TOI during a deployment	C4ISR, Aviation Capacity
	Ability to affect Mission Related Prosecutions of TOI during a deployment	C4ISR, Deployable Boat Capabilities, Lifting/Deployment Capacity, Storage Capacity
Other Law Enforcement (OLE)	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
Ports, Waterways and Coastal Security (PWCS)	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
Search and Rescue (SAR)	Optimization of time in AOR (Open Water)	Transit Speed, Endurance
	Operational Availability	Maintenance Execution, Available Maintenance Time
	Ability to affect Mission Related Detections, Classifications & Identifications of TOI during a deployment	C4ISR, Aviation Capacity
	Ability to affect Mission Related Prosecutions of TOI during a deployment	C4ISR, Deployable Boat Capabilities, Aviation Capacity

4 SUITABILITY REQUIREMENTS

The suitability requirements will serve as the basis for portions of the system specification and the Integrated Logistics Support Plan (ILSP).

4.1 Design Drivers

4.1.1 Design Concept – Constraints/Limitations

4.1.1.1 The PIB shall be designed and built to meet applicable United States Laws and Regulations and applicable International Conventions, Codes, Resolutions and Circulars for a vessel of its type engaged on international unlimited voyages. This specifically includes, but is not limited to Acts, Regulations and Treaties governing operations in the Polar Regions (Arctic and Antarctic) and the domestic water of the United States.

4.1.1.2 The PIB shall be designed based upon the capability for continuous and independent operations in a low threat environment with a Service Life of 30 years.

4.1.1.3 The PIB's design shall ensure the structure has a fatigue service life of the design service life plus 10 years.

4.1.1.4 The PIB shall be designed to protect systems from functional degradation allowing for full mission capabilities while operating within air temperature ranges of -40°F to 114°F.

4.1.1.5 The PIB shall be designed with the capability of surviving through a minimum air temperature of -72 °F.

4.1.1.6 The PIB shall be designed at all phases from concept through production to provide safety and protection for personnel from all anticipated operating environments.

4.1.1.7 The PIB shall be designed to facilitate maintenance and replacement of components and subsystems.

4.1.1.8 The PIB shall be designed with multiple propulsion machines.

4.1.1.9 The PIB shall be designed with multiple propulsors.

4.1.1.10 The PIB shall be designed with multiple steering systems.

4.1.2 Commonality

4.1.2.1 The PIB shall be designed to use common and USCG fleet standard equipment, such as electronics, engines, weapon systems, hardware and software. Other common equipment including existing DHS/DoD/USN Program of Record/USCG equipment and government approved systems will be used whenever possible to reduce training costs and time, increase workforce availability and on-the-job training, increase operational readiness/effectiveness, and reduce parts inventories. System design concepts shall be consistent, though not necessarily identical across operating units of (the same type) various ship classes.

4.1.3 Open System

4.1.3.1 The PIB shall be designed with components and subsystems compliant with open architecture standards to facilitate future upgrades, modularity, and levels of servicing.

4.1.4 Technology

4.1.4.1 The PIB shall utilize state-of-the-market technology to facilitate ease of manufacturing processes, automation of operations, performance monitoring and maintenance. Such technology shall be proven, non-developmental, and commercially available.

4.1.4.2 The PIB shall take advantage of Commercial-Off-the-Shelf (COTS) or Government-Off-the-Shelf (GOTS) equipment and systems. Technology that is at the end of its life cycle or market availability will be avoided to preclude sustainability and supportability issues.

4.1.5 Habitability and Outfit

4.1.5.1 The PIB shall provide messing, berthing, sanitary facilities, and workspaces for all permanently attached crewmembers and 50 embarked personnel.[1]

[1] *Includes DIVEDET and LEDET deployed with 20 person AVDET (if LEDET is embarked, SCIDET will remain ashore)*

Table 11. PIB embarked personnel detachments.

Detachment (DET)[2]	Number of Personnel
Dive (DIVEDET)	7
Law Enforcement (LEDET)	8
Aviation (AVDET)[3]	20
Science (SCIDET)	20

[2] *Mix of embarked personnel detachments will be dependent upon the PIB's mission set for each specific deployment.*

[3] *The detachment of personnel to support the UAS are included in the total AVDET.*

4.1.5.2 The PIB shall provide Officer/Chief Petty Officer/Senior Embarked berthing as follows:

4.1.5.2.1 Commanding Officer: Separate compartment with individual berthing, sanitary facilities and adjacent office space.

4.1.5.2.2 Executive Officer: Separate compartment with individual berthing, sanitary facilities and adjacent office space.

4.1.5.2.3 Engineer Officer: Separate compartment with individual berthing, sanitary facilities and adjacent office space.

4.1.5.2.4 Operations Officer: Separate compartment with individual berthing, sanitary facilities and adjacent office space.

4.1.5.2.5 Senior Embarked Person: Separate compartment with individual berthing, sanitary facilities and adjacent office space.

4.1.5.2.6 All other Officers and Chief Petty Officers assigned aboard the PIB as permanent party crew members: Separate compartment with shared berthing for two individuals and shared sanitary facilities.

4.1.5.3 The PIB shall provide berthing compartments with adjacent sanitary facilities for all embarked personnel (with exception of personnel listed under 4.1.5.2) that accommodate no more than four individuals.

4.1.5.4 The PIB shall provide berthing compartments with adjacent sanitary facilities for all non-permanent party crew detachment personnel that accommodate no more than four individuals.

4.1.5.5 The PIB shall have medical facilities in accordance with the Coast Guard Medical Manual, COMDTINST M6000.1(Series); Coast Guard Health Services Allowance List, Afloat, COMDTINST M6700.6 (Series); and United States Navy Shipboard Medical Procedures Manual, Commander Naval Surface Forces Instruction (COMNAVSURFORINST) 6000.1 (Series).

4.1.5.6 The PIB shall have a designated medical overflow area to accommodate at least 10 percent of crew/embarked detachments.

4.1.5.7 The PIB shall have separate assigned multi-purpose spaces for Officers, Chief Petty Officers, engineering department, deck department, operations department, support department and other embarked personnel.

4.1.5.7.1 The PIB’s multi-purpose Officer space shall accommodate all Officers seated simultaneously.

4.1.5.7.2 The PIB’s multi-purpose Chief Petty Officer space shall accommodate all Chief Petty Officers seated simultaneously.

4.1.5.7.3 The PIB’s 5 additional, separate multi-purpose spaces shall each accommodate 20 percent of the assigned crew.

4.1.5.8 The PIB dining facilities shall accommodate at least 75 percent of the crew and embarked personnel at the same time.

4.1.5.9 The PIB shall be capable of accommodating mixed gender crews up to a 50-50 percent gender mix.

4.1.6 Food Service Operations

4.1.6.1 The PIB shall utilize a single food service preparation area to prepare and serve food to the maximum number of crew/embarked personnel for four meals per 24-hour period.

4.1.6.2 The PIB shall have sufficient cold and dry food storage to meet endurance parameters.

4.1.7 Training Support

4.1.7.1 The PIB shall provide a dedicated space to assemble at least 25 seated personnel and one presenter for training, briefings, and instruction.

4.1.7.1.1 The PIB's dedicated space shall be outfitted to support effective delivery of mixed-media instruction to include audio visual display capability, LAN connections and receptacles.

4.1.8 Morale and Well-Being

4.1.8.1 The PIB shall have a ship's store and secure storage to provide basic consumables for purchase by the crew/embarked personnel.

4.1.8.1.1 The PIB's ship's store secure storage shall accommodate endurance requirements.

4.1.8.2 The PIB shall have a dedicated gym/exercise facility to accommodate at least 15 percent of crew/embarked personnel to conduct a mix of cardiovascular, strength and flexibility conditioning exercises.

4.1.8.3 The PIB shall provide self-service commercial grade laundry facilities to allow 20 percent of the crew/embarked personnel to wash and dry all personal clothing, uniforms and organizational clothing within a 16 hour period.

4.1.8.4 The PIB shall have a dedicated space to store equipment for Morale, Welfare and Recreation (MWR).

4.1.8.5 The PIB shall have a dedicated space for the ship's barber shop.

4.1.8.6 The PIB shall have the ability to receive and display satellite television signals over a physically separated network in the following spaces:

4.1.8.6.1 Mess deck.

4.1.8.6.2 All lounge spaces.

4.1.8.6.3 Training space.

4.1.8.6.4 All Officer Staterooms.

4.1.8.6.5 All Chief Petty Officer Staterooms.

4.1.8.6.6 Senior embarked person stateroom.

4.1.9 Storage Capacity

4.1.9.1 The PIB shall have ordnance storage capacity to ensure ammunition is available for all armament in accordance with the USCG Ordnance Manual, COMDTINST M8000.2 (Series).

4.1.9.2 The PIB's magazines and ready service lockers shall comply with the USCG Ordnance Manual, COMDTINST M8000.2 (Series).

4.1.9.3 The PIB shall provide central hazardous materials (HAZMAT) storage to hold HAZMAT for maintenance, operations and science/survey support.

4.1.9.4 The PIB shall provide each work space with HAZMAT ready storage for up to 2 days of HAZMAT required for maintenance and operations.

4.1.9.5 The PIB shall provide HAZMAT storage sufficient to hold waste generated during underway operations.

4.1.9.6 The PIB shall provide dedicated storage areas for organizational clothing for all embarked persons.

4.1.9.7 The PIB shall provide dedicated storage of Personal Protective Equipment (PPE) for all embarked persons.

4.1.9.8 The PIB shall provide dedicated storage that will accommodate all solid waste streams in accordance with the PIB’s endurance requirements.

4.1.9.8.1 The PIB shall be capable of processing solid waste streams.

4.1.10 Work Space

4.1.10.1 The PIB shall include dedicated administrative work spaces for each of the PIB departments.

4.1.10.1.1 The PIB’s departmental administrative work spaces and divisional workshops are mutually exclusive spaces and shall not be shared.

4.1.10.2 The PIB shall include the appropriate number of dedicated work spaces for each applicable organization component in accordance with the USCG Cutter Organizational Manual, COMDTINST M5400.16 (Series).

4.1.10.3 The PIB shall have a dedicated workspace to accommodate the AVDET.

4.1.10.4 The PIB shall have a dedicated workspace to accommodate the DIVEDET.

4.1.10.5 The PIB weapons maintenance facilities shall meet physical security requirements for stowage in accordance with the USCG Ordnance Manual, COMDTINST M8000.2 (Series).

4.1.10.6 The PIB shall have a law enforcement work space.

4.1.10.7 The PIB's law enforcement work space shall be accessible from the weather decks, the hangar and from the interior of the ship.

4.1.10.8 The PIB's law enforcement work space shall allow for simultaneous dressing of the boarding team and boat crew.

4.1.10.9 The PIB shall have a dedicated space at each boat storage position to store boat deck personnel protective equipment.

4.2 Supportability and Sustainment (Integrated Logistics)

4.2.1 Integrated Logistics Support

4.2.1.1 The PIB maintenance philosophy shall follow the standard Coast Guard bi-level structure: organizational and depot levels that ensures vessel supportability criteria and characteristics are equally and thoroughly integrated into the cutter design, systems integration, construction, testing, and life cycle support planning processes.

4.2.1.2 The PIB's organizational level maintenance shall be such that it can be completed by the PIB's crew within the constraints of their labor capacity and capability.

4.2.1.3 The PIB maintenance requirements and procedures shall be founded on Reliability-Centered Maintenance (RCM) principles in accordance with the Naval Engineering Manual, COMDTINST M9000.6 (Series) and the Maintenance Management Policy, COMDTINST 4790.3 (Series).

4.2.1.4 The PIB shall include automated capabilities to identify system faults, localize failed components, and guide organizational level maintenance.

4.2.1.5 The PIB's Integrated Logistics Support requirements shall be in accordance with the Coast Guard Business Model and will be further delineated in the ILSP.

4.2.1.6 The PIB shall be supported and sustained by a logistics system to ensure ship systems will be capable of continuous operation between maintenance periods during extended independent operations in accordance with the PIB CONOPS such that mission critical functions are maintained.

4.2.1.7 The PIB shall incorporate non-intrusive means for diagnostics and maintenance data collection for mission essential systems and equipment.

4.2.1.8 The PIB shall have equipment removal routes and access capable of minor equipment and machinery removal within 72 hours.

4.2.1.9 The PIB shall have maintenance envelopes surrounding major equipment and machinery to support in-place maintenance.

4.2.1.10 The PIB provisioning strategy (including ship design impacts) shall be tailored for routine, extended, and isolated operations conducted far from sources of logistics support.

4.2.1.11 The PIB's sparing shall allow for organizational accomplishment of unscheduled maintenance to Mission Critical Function (MCF), as identified in Table 20, equipment that would typically be depot level in homeport or Continental United States (CONUS) locations.

4.2.1.11.1 The PIB's sparing shall allow for all scheduled organizational level maintenance that is required to achieve mission availability requirements.

4.2.1.12 The PIB provisioning strategy shall rely upon USCG proven sparing models.

4.2.1.12.1 The PIB's provisioning strategy shall account for mission capability, readiness and availability.

4.2.1.12.2 The PIB's provisioning strategy shall use USCG enterprise automated logistics support.

4.2.1.12.3 The PIB's packaging and preservation requirements shall be developed to support PIB operational and maintenance concepts.

4.2.1.12.4 The PIB's packaging and preservation shall comply with the latest regulations and minimal crew workload for disposal.

4.2.1.13 The PIB's supply support shall be provided through existing USCG logistics processes and organization.

4.2.1.14 The PIB shall be turned over from the Program Office to Sponsor with all outfitting items and data to meet operational mission and all maintenance requirements.

4.2.1.15 The PIB's depot level maintenance philosophy shall be based upon a triennial drydock schedule.

4.2.2 Ship's Berth Facilities

4.2.2.1 The PIB's homeport shall have the capability for a PIB to moor starboard or port side to the pier.

4.2.2.2 The PIB's homeport shall have a minimum berth length of ship length overall +20 percent.

4.2.2.3 The PIB's berth shall provide a fender system sufficient for a vessel of its size to protect the cutter and pier.

4.2.2.4 The PIB's homeport shall have single cutter berths for each PIB.

4.2.2.5 The PIB shall have dedicated, independent on board power generation capability sized to support the maximum in port electrical load.

4.2.2.6 The PIB's homeport shall have metered hotel facilities in accordance with Table 19.

Table 12. PIB homeport hotel services.

Shore Service	Threshold
Electrical	120% of PIB max electrical load
Potable Water	100% of PIB need
Sewage	100% of PIB need
Telephone	Ten (10) telephone lines
Television	One (1) commercial service
Data	125% of PIB need
Fire Protection Water	100% of PIB need

4.2.3 Packaging, Handling, Storage and Transportation

4.2.3.1 The PIB shall be capable of extended deployments from homeports and bases in the United States. Packaging, handling, storage and transportation of equipment, supplies, mail, packages, and other support materials shall support PIB operations including forward deployed, conducting training and other activities, and "out of hemisphere" operations.

4.3 Reliability, Availability and Maintainability

4.3.1 Design Criteria

4.3.1.1 The PIB's design criteria shall be established to include redundancy and to ensure all scheduled and unscheduled maintenance may be completed in order to achieve the required availability.

4.3.1.1.1 The PIB's design criteria shall include visual and physical accessibility, work clearance for maintenance, compatibility with automatic test equipment (ATE), training requirements, and support equipment (including calibration if applicable).

4.3.1.2 The PIB's reliability, redundancy and reparability shall be such that all crew repairable equipment essential to life support, mobility and mission performance can be kept operational with acceptable performance degradation for 10 months.

4.3.2 Definitions

The definitions in Cost Guard logistics policy and guidance will be used except as listed in the following:

4.3.2.1 Operational Availability (A_O) – The probability that the PIB is able to fulfill primary mission requirements at any random point during its scheduled underway deployment.

4.3.2.2 Operational Mission Failure (OMF) – Any malfunction or combination of malfunctions that prevent the PIB from achieving a mission critical function.

4.3.2.3 Mission Critical Function (MCF) – Functions which are essential to conduct the primary mission requirements.

4.3.2.4 Mean Logistics Delay Time (MLDT) – The mean time spent waiting for parts or supplies required to correct a failure or perform maintenance.

4.3.2.5 Mean Maintenance Time (MMT) – The average of preventative and corrective maintenance times. MMT does not include logistics delay time or administrative delay time.

4.3.2.6 Mean Time Between Maintenance (MTBM) – The average time between all system maintenance actions that, for PIB A_O calculation, restore or prevent an OMF.

4.3.3 Operational Availability (A_O)

4.3.3.1 The PIB shall have an A_O of 0.85 (threshold) and 0.92 (objective) based on the total Mission Critical Functions (MCF) listed in Table 20 that defines the minimum functions required for the PIB to maneuver and control the cutter, conduct damage control, and sustain the crew.

A_O shall be calculated using the following formula:

A_O = MTBM / (MTBM + MMT + MLDT)

For MCF other than critical crew sustainment, the scheduled homeport periods, dockside and drydock availabilities shall not be included in the A_O calculation. The availability window for crew sustainment MCF's includes all inport and underway time, with the exception of planned depot maintenance on crew sustainment MCF's.

Table 13. PIB Mission Critical Functions.

Mission Critical Function	Maneuvering and Ship Control	Damage Control and Auxiliaries	Crew Sustainment
Description of scope of MCF	Engineering control, Main propulsion, Power generation and distribution, Steering, Navigation, Ice breaking, External communications, Internal communication	Firefighting, Drainage and Deballast, DC Monitoring/Response System, Heavy lift and boat davit systems	Potable water, Food service and storage, Waste Management, Heating, Ventilation, and Air Conditioning (HVAC)

4.4 Survivability

4.4.1 Damage Control

4.4.1.1 The PIB shall have one central location to direct all shipboard damage control and remotely control permanently installed damage control systems.

4.4.1.2 The PIB shall have the capability to direct all shipboard damage control from the bridge and Engineering Control Center as secondary locations.

4.4.1.3 The PIB shall have designated Repair Lockers and be outfitted in accordance with NSTM Chapters 555 volume 1, 079 volume 2 and 074 volume 3 (Series).

4.4.1.4 The PIB shall provide fixed damage control systems including an automated detection and monitoring capability to detect smoke, fire, flooding, and toxic gas per the NSTM Chapters 555 volume 1, 079 volume 2 and 074 volume 3 (Series).

4.4.1.5 The PIB shall provide fixed damage control systems including a remote initial response capability to counter fire and flooding.

4.4.1.6 The PIB’s damage control system shall maintain one human machine interface (HMI) design for all consoles.

4.4.1.7 The PIB’s damage control system shall display information for the user to complete damage control tasks successfully.

4.4.1.8 The PIB’s damage control system shall display alarms and events.

4.4.1.9 The PIB’s damage control system shall include real-time alarm and event monitoring information.

4.4.1.10 The PIB’s damage control system shall include historical alarm and event monitoring information.

4.4.1.11 The PIB’s damage control system information shall be displayed on the quarterdeck.

4.4.1.12 The PIB’s damage control capability shall be operable by the inport watch.

4.4.1.13 The PIB's damage control capability shall allow the setting of all standard material conditions.

4.4.1.14 The PIB shall have an identified decontamination station.

4.4.1.15 The PIB shall have a closed circuit television (CCTV) capability to manage damage control situations and safety/security of the ship.

4.4.1.16 The PIB shall have the capability to display damage control system information on the bridge, quarterdeck and in all repair lockers for monitoring.

4.4.2 Wintering Over

4.4.2.1 The PIB shall be capable of wintering over for a minimum of 210 days.[1]

[1] *This requirement is not intended to provide an operational capability or sustain any more than the minimum necessary crew to ensure ship survival.*

4.4.3 Crew Rescue and Life Raft Capabilities

4.4.3.1 The PIB shall have a man overboard indicator system for all personal protective flotation equipment used by the crew.

4.4.3.2 The PIB shall have a life raft system capable of accommodating all crew and embarked personnel.

4.4.4 Recoverability

4.4.4.1 The PIB shall be designed with enhanced arrangement, such as equipment separation and redundancies, to ensure survivability consistent with Coast Guard Technical Standards.

4.5 Human Systems Integration

4.5.1 Human Systems Integration Processes

4.5.1.1 The PIB and its systems shall incorporate Human Systems Integration (HSI) processes, which will improve human performance effectiveness, efficiency, and safety of the crew and ship, and all support systems.

4.5.1.2 The PIB and its systems, sub-systems, equipment, hardware/software and facilities used in operations, maintenance, setup, and support shall be selected and designed in accordance with human factors engineering design standards and practices in accordance with the American Society for Testing and Materials (ASTM) Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities (ASTM F1166-07(Series)).

4.5.1.3 The PIB and its systems shall be selected and designed in accordance with human factors engineering design standards and practices in accordance with the Standard Practice for Human Engineering Program Requirements for Ships and Marine Systems, Equipment, and Facilities (ASTM F1337-10 (Series)).

4.5.1.4 The PIB shall provide berthing and leisure facilities that are designed to accommodate the 5th percentile sized female to 95th percentile sized male (ASTM F1166 (Series)).

4.5.1.5 The PIB shall be designed to accommodate the 5th percentile female to 95th percentile male for all operational and maintenance tasks while wearing the appropriate personal protective equipment (PPE) and using the required tools (ASTM F1166 (Series)).

4.5.1.6 The PIB shall be designed using the process defined in the Standard Practice for Human Engineering Program Requirements for Ships and Marine Systems, Equipment, and Facilities (ASTM 1337 (Series)).

4.5.1.7 The PIB's performance support and training shall be defined, developed and implemented in accordance with the USCG Training System Standard Operating Procedures (Series).

4.5.1.8 The PIB's design shall comply with system safety and risk management guidance in MIL-STD-882E.

4.5.1.9 The PIB shall have the capability for manned (non-machinery) space air temperatures to be adjustable and maintained between 68°F (heating season) and 80°F (cooling season).

4.5.2 Operational Sustainment and Workforce Allocation

4.5.2.1 The PIB shall be capable of being operated, maintained and supported underway by an assigned crew complement (excluding detachments) as determined by the Coast Guard's manpower requirements process in accordance with the Staffing Logic and Manpower Requirements Manual COMDTINST M5310.5 (Series), the Competency Management System Manual COMDTINST M5300.2 (Series) and the Performance Training and Education Manual COMDTINST M1500.10 (Series).

4.5.2.1.1 The PIB's bridge watch-station tasks shall be capable of being performed by the minimum number of personnel specified in the Coast Guard Navigation Standards Manual, COMDTINST M3530.2 (Series).

4.5.2.1.2 The PIB's engineering watch-station duties shall be performed by no more than two persons with unmanned engine rooms for normal, unrestricted operating conditions.

4.5.2.1.3 The PIB's operations center/communications watch-station duties shall be performed by two persons for normal, unrestricted operating conditions.

4.5.2.1.4 Inport watch-station duties shall be performed by no more than eight persons for homeport conditions.

4.6 Environmental Considerations

4.6.1 Environmental Safety and Occupational Health

4.6.1.1 The PIB shall comply with USCG, national, and local safety and occupational health instructions, directives, and regulations.

4.7 Training

4.7.1 Training Concept

4.7.1.1 The PIB's C2, Navigation, Damage Control and Machinery Control systems shall incorporate an embedded training capability that enables a seamless continuum of training, including the capability to maximize training at sea while minimizing resident training ashore.

4.7.1.1.1 The PIB’s embedded training capability includes any internal and/or external hardware and/or software capabilities (simulated or emulated) built into, strapped onto, plugged into, or integrated with PIB systems in order to train, sustain, and enhance individual and team skill proficiencies necessary to operate and maintain the PIB.

4.7.1.1.2 The PIB’s embedded training systems shall provide users with continuous mode awareness of simulated versus real-world data.

4.7.1.2 The PIB's performance support and training requirements will be in place to ensure operators and maintainers are prepared to perform validated performance requirements at delivery and throughout the system’s lifecycle.

4.8 Documentation

4.8.1 Document Management

4.8.1.1 The PIB shall be outfitted with the manuals required to operate and maintain, for all organizational and depot level maintenance, the equipment of the ship and its subsystems in both hard copy and electronic form.

4.8.1.2 The PIB shall be outfitted with the drawings required to operate and maintain, for all organizational and depot level maintenance, the equipment of the ship and its subsystems in both hard copy and electronic form in accordance with USCG Naval Engineering Computer Aided Design, COMDTINST M9085.1 (Series).

4.8.1.3 The PIB shall be provided the capability to update the hard copy and electronic forms of the operations and maintenance manuals as changes are published.

4.9 Security

4.9.1 Security Features

4.9.1.1 The PIB shall have all security features required by USCG policy and required for joint interoperability.

4.9.2 Access Control

4.9.2.1 The PIB shall be fitted with an automated system to account for and record all permanently assigned crew members that boards and departs the ship.

4.9.3 Classified and Sensitive Material

4.9.3.1 The PIB shall have facilities for handling, storing, processing and destruction of material with various levels of classification.

4.9.4 Accreditation

4.9.4.1 The PIB information systems (including C2, propulsion control, machinery control, data networks and communication) shall be certified and accredited for cybersecurity in accordance with DoD, Intelligence Community, and USCG policies.

5 KEY PERFORMANCE PARAMETERS

Key Performance Parameters (KPPs) state the quantifiable and measurable system capabilities or characteristics considered essential for successful accomplishment of the PIB's missions identified in the PIB MNS. Each KPP is linked to a specific mission and organizational goal of the USCG and DHS. The KPPs are limited to those requirements needed to reach the overall desired capabilities of the system. Failure to meet a KPP threshold will require reevaluation of the program by the Sponsor and the Acquisition Decision Authority (ADA).

Table 14. Key Performance Parameters.

Title	Requirement	Threshold	Objective
Icebreaking	3.1.1.1 The PIB shall be capable of independently breaking through ice with a thickness:	≥ 6 ft at a continuous speed ≥ 3 kts	≥ 8 ft at a continuous speed ≥ 3 kts
	3.1.1.2 The PIB shall be capable of independently breaking through ridged ice with a thickness of:	21 ft	Same as Threshold
Endurance	3.1.2.1 The PIB shall have a fully mission capable (In accordance with Table 20) cutter endurance per deployment without replenishment (subsistence and fuel) of:	≥ 80 days underway	≥ 90 days underway
Interoperability	3.2.1.1 The PIB shall have the capability to exchange information (voice and data) with:	USCG, DoD, DHS, NATO, DoS, NSF and NOAA.	Same as Threshold

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6 CRITICAL OPERATIONAL ISSUES

Critical Operational Issues (COIs) are the operational effectiveness and operational suitability issues (not characteristics, parameters, or thresholds) that shall be examined during Operational Test and Evaluation (OT&E) to evaluate/assess the system's capability to safely perform its mission.

6.1 Operational Effectiveness COIs

6.1.1 Protection Response (PR)

6.1.1.1 Can the PIB perform USCG Emergent Response for Search and Rescue (SAR) and National Emergency Response Operations (NERO)?

6.1.2 Law Enforcement Response (LER)

6.1.2.1 Can the PIB perform USCG Enforcement Response for Law Enforcement and Homeland Security?

6.1.3 Surveillance and Reconnaissance (SR)

6.1.3.1 Can the PIB contribute to Maritime Domain Awareness?

6.1.4 Defense Readiness (DR)

6.1.4.1 Can the PIB provide Defense Readiness to Combatant Commanders?

6.1.5 Maintain Mobility (MM)

6.1.5.1 Can the PIB provide USCG services to maintain movement of vessels and equipment in civil and military maritime environments?

6.1.6 Transport (TRAN)

6.1.6.1 Can the PIB provide USCG organic transportation of people and equipment?

6.1.7 Force Movement (FM)

6.1.7.1 Can the PIB be prepared for operational employment and move from ready locations to the intended area of operations?

6.1.8 Information Management (IM)

6.1.8.1 Can the PIB perform Information Management in support of USCG Missions?

6.1.9 Force Protection (FP)

6.1.9.1 Can the PIB provide Force Protection?

6.1.10 Cyber Security (CS)

6.1.10.1 Can the PIB protect and defend information and information systems by ensuring their availability, integrity, authentication, confidentiality, and non-repudiation, including providing for restoration of information systems by incorporating protection, detection, and reaction capabilities?

6.2 Operational Suitability COIs

6.2.1 Reliability

6.2.1.1 Will the reliability of the PIB support completion of its mission?

6.2.2 Maintainability

6.2.2.1 Will the PIB be maintainable by fleet personnel or commercial support and maintenance activities when applicable?

6.2.3 Availability

6.2.3.1 Will the availability of the PIB support completion of its missions?

6.2.4 Logistic Supportability

6.2.4.1 Will the PIB be logistically supportable?

6.2.5 Crewing

6.2.5.1 Will the crew of the PIB be able to operate and maintain the ship and its systems in order to ensure mission/operational success and within cost and time guidelines?

APPENDICES

APPENDIX A. REFERENCES

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APPENDIX B. LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

–	Minus (in mathematical equation)
%	Percent
/	Divided By (in mathematical equation)
+	Plus (in mathematical equation)
=	Equal (in mathematical equation)
°	Degree
AA	Alternatives Analysis
ADA	Acquisition Decision Authority
ADE	Acquisition Decision Event
AGI	Auxiliary General Intelligence
AK	Alaska
ALE	Automatic Link Establishment
A_O	Operational Availability
AOR	Area of Responsibility
ASTM	American Society for Testing and Materials
AT/FP	Anti-Terrorism/Force Protection
ATE	Automatic Test Equipment
AtoN	Aids to Navigation
AUV	Autonomous Underwater Vehicle
AVDET	Aviation Detachment
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
C4IT	Command, Control, Communications, Computers, and the Information Technology
CBA	Capabilities Based Assessment
CBP	Customs and Border Protection
CCTV	Closed Circuit Television
CG-751	Coast Guard Office of Cutter Forces
CG-9326	Coast Guard Office of Major Systems Acquisition Program Manager (Polar Icebreaker Replacement Program)
CGC	Coast Guard Cutter
CGSD	Coast Guard Support Date
CH	Channel
CJCS	Chairman of the Joint Chief of Staff
CJCSI	Chairman of the Joint Chief of Staff Instruction
CM	Configuration Management
COI	Critical Operational Issue
COLREGS	Collision Regulations
COMDTINST	Commandant Instruction
COMNAVSURFORINST	Commander Naval Surface Forces Instruction
COMSATCOM	Commercial Satellite Communications

COMSEC	Communications Security
CONOPS	Concept of Operations
CONUS	Continental United States
COP	Common Operating Picture
COTS	Commercial-off-the-Shelf
D17	District 17
DAFHP	Days Away From Homeport
DET	Detachment
DGPS	Differential Global Positioning System
DHS	Department of Homeland Security
DIVEDET	Dive Detachment
DoD	Department of Defense
DoS	Department of State
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities
DR	Defense Readiness
DSC	Digital Selective Calling
DWL	Design Water Line
EA	Enterprise Architecture
E-AtoN	Electronic Aids to Navigation
ECINS	Electronic Charting and Integrated Navigation System
EHF	Extremely High Frequency
EPS	Enhanced Polar System
F	Fahrenheit
FDVS	Flight Deck Video System
FM	Force Movement
FMV	Full Motion Video
FOC	Full Operational Capability
FOUO	For Official Use Only
FP	Force Protection
FPCON	Force Protection Condition
ft	Feet
FY	Fiscal Year
FYI	First Year Ice
GLONASS	Global Navigation Satellite System
GNSS	Galileo Navigation Satellite System
GOTS	Government-off-the-Shelf
gpm	Gallons Per Minute
GPS	Global Positioning System
HAZMAT	Hazardous Material
HELO	Helicopter

HF	High Frequency
HIFR	Helicopter In Flight Refueling
HLMAR	High Latitude Mission Analysis Report
HMI	Human Machine Interface
HSI	Human Systems Integration
HSK	Helicopter Support Kit
HSPD	Homeland Security Presidential Directive
HVAC	Heating, Ventilation, and Air Conditioning
IAS	Integrated Anti-Swimmer System
IBS CID	Integrated Broadcast Service Common Interactive Broadcast
IEC	International Electro Technical Commission
IHO	International Hydrographic Organization
ILS	Integrated Logistics Support
ILSP	Integrated Logistics Support Plan
IM	Information Management
IMO	International Maritime Organization
INMARSAT	International Marine Satellite
IO	Ice Operations
IOC	Initial Operational Capability
IPT	Integrated Product Team
ISO	International Organization for Standardization
ISP	Integrated Support Plan
JIATF	Joint Interagency Task Force
JICD	Joint Interface Control Document
JRCC	Joint Rescue Coordination Center
JTF	Joint Task Force
KBps	Kilobytes per Second
km^2	Square Kilometers
kts	Knots
LAN	Local Area Network
LDT	Logistics Delay Time
LEDET	Law Enforcement Detachment
LER	Law Enforcement Response
LMR	Living Marine Resources
LOB	Line of Bearing
LOS	Line of Sight
m	Meter
M&S	Maturing and Strengthening
m/s	Meters per Second
m^2	Square Meter
MARPOL	International Convention on the Prevention of Pollution from Ships
MBps	Megabytes per second

MCF	Mission Critical Function
MCR	Maximum Continuous Rating
MDA	Maritime Domain Awareness
MEP	Marine Environmental Protection
MER	Manpower Estimate Report
METOC	Meteorological and Oceanographic
MHz	Megahertz
MIL	Military
MLDT	Mean Logistics Delay Time
MLEM	Maritime Law Enforcement Manual
MM	Maintain Mobility
mm/hr	Millimeter Per Hour
MMT	Mean Maintenance Time
MNS	Mission Need Statement
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOU	Memorandum of Understanding
MPa	Megapascal
MRD	Manpower Requirements Determination
MS	Marine Safety
MSI	Marine Safety Information
MTBM	Mean Time Between Maintenance
MYI	Multi Year Ice
NSAR	National Strategy for the Arctic Region
NSPD	National Security Presidential Directive
NSTM	Naval Ship's Technical Manual
NTNO	Navy Type/Navy Owned
OGA	Other Government Agency
OH	Observation Helicopter
OLE	Other Law Enforcement
OMF	Operational Mission Failure
OOD	Officer of the Deck
OPCON	Operational Control
OPS	Operations
OSC	On-Scene Coordinator
OT&E	Operational Test & Evaluation
OTH	Over-the-Horizon
OTSR	Optimal Track Ship Routing
P(d)	Probability (density)

PDD	Presidential Decision Directive
Pfa	Probability of False Alarm
PIB	Polar Icebreaker
PII	Personally Identifiable Information
pk	Mission Kill
PM	Program Manager
PNT	Positioning, Navigation, and Timing
PUB	Publication
PWCS	Ports, Waterways, and Coastal Security
QHSR	Quadrennial Homeland Security Review
RCC	Rescue Coordination Center
RCM	Reliability Centered Maintenance
RFP	Request for Proposal
ROV	Remotely Operated Vehicle
SAR	Search and Rescue
SCIDET	Science Detachment
sec	Second
SFA	Support Forces Antarctica
SFLC PL	Surface Forces Logistics Center Product Line
SLEP	Service Life Extension Projects
SOLAS	Safety of Life at Sea
SR	Surveillance and Reconnaissance
TA	Technical Authority
TACAN	Tactical Air Navigation
TEU	Twenty Foot Equivalent Units
TOI	Target of Interest
TRAN	Transport
UAS	Unmanned Aerial System
UH	Utility Helicopter
UHF	Ultra-High Frequency
UNCLAS	Unclassified
UNREP	Underway Replenishment
USA	United States Army
USAF	United States Air Force
USCG	United States Coast Guard
USMC	United States Marine Corps
USN	United States Navy
VERTREP	Vertical Replenishment
VHF	Very High Frequency
VHF AM	Very High Frequency Amplitude Modulated
WGS	Wideband Global Satellite
WLB	Coast Guard Seagoing Buoy Tender
XMT/RCV	Transmit/Receive

APPENDIX C. BRETSCHNEIDER SEA STATE TABLE

The following Sea State Table is based on the Bretschneider formulation.

Table C-1. Bretschneider Sea State Table

Sea State	Significant Wave Height (ft)	Modal Wave Periods Seconds (sec)	Probability Density (World-Wide)
0-1	0.0 – 0.3	0	0
2	0.3 – 1.6	3.0 – 15.0	4.1
3	1.6 – 4.1	5.2 – 15.5	16.9
4	4.1 – 8.2	5.9 – 15.5	27.8
5	8.2 – 13.1	7.2 – 16.5	23.5
6	13.1 – 19.7	9.3 – 16.5	16.3
7	19.7 – 29.5	10.0 – 17.2	9.1
8	29.5 – 45.5	13.0 – 18.4	2.2
Greater than 8	Greater than 45.5	20.0	0.1

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APPENDIX D. BEAUFORT WIND SCALE

The following table provides the speed, classification, and appearance of wind effects based on the Beaufort Wind Scale.

Table D-1. Beaufort Wind Scale Table

			Appearance of Wind Effects	
Force	Wind (Knots)	WMO Classification	On the Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light	Scaly ripples, no foam crests	Smoke drift indicated wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leave rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-19 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	High waves (23-32 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (29-41 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, tree broken or uprooted, “considerable structural damage”
11	56-63	Violent Storm	Exceptionally high (37-52 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

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APPENDIX E. GLOSSARY

Absolute Sea Ice – The total area covered by sea ice.

Bathymetry – Measurement of water depths and bottom contour lines with precise geographic locations.

Blue Forces – United States, allied or coalition operational partners.

Condition I: Full Alert/General Quarters – All personnel are continuously alert. All possible operational systems are manned and operating. No maintenance expected except that routinely associated with watch-standing and urgent repairs. Maximum crew endurance is 24 continuous hours.

Coring - Bottom sampling operations using equipment designed to penetrate the ocean floor with minimal disturbance of the layers of material or sediment on the bottom.

Embarked Personnel – All personnel onboard to include permanent crew, science teams, law enforcement teams, aviation detachments, dive teams, and any other personnel or guest onboard to facilitate operations.

Embedded Training - Embedded training capability includes any internal and/or external hardware and/or software capabilities (simulated or emulated) built into, strapped onto, plugged into, or integrated with an asset's systems in order to train, sustain, and enhance individual and team skill proficiencies necessary to operate and maintain the asset.

Fast Ice - Sea ice that is "fastened" to the coastline, to the sea floor along shoals or to grounded icebergs. Fast ice may either grow in place from the sea water or by freezing pieces of drifting ice to the shore or other anchor sites.

Hydrocast - The process of using a device consisting of several water-collection bottles, such as Nansen bottles, that are wired and clamped together and used to collect data on water characteristics at various depths.

Hydrography – Depiction of shallow water bottom features, coastline, beach, tides, and surf characteristics.

Ice Differentiation – The act or process of discerning between the various properties and characteristics of First Year and Multi Year ice.

Keying Material – In encryption, the data (e.g., keys, certificates, and initialization vectors) necessary to establish and maintain cryptographic keying relationships.

Limited Operations – Operations solely dependent upon mission critical functions.

Mapping Survey – The process of acquiring bathymetric data to produce a geo-referenced map of bottom features.

Mean Logistics Delay Time – The average time spent waiting for parts or supplies required to correct a failure or perform maintenance.

Mean Maintenance Time – The average of scheduled and unscheduled maintenance times. MMT does not include logistics delay time or administrative delay time.

Mean Time Between Maintenance – The average time between all system maintenance actions that restores operational status or prevents an Operational Mission Failure (OMF).

Measurement – The process of obtaining a quantity relative to an agreed standard where the quantity involves comparison with some precisely defined unit value of the quantity.

Mediterranean Moor – A type of mooring where the vessel moors stern to a pier or quay and the bow is secured via temporary moorings or anchoring.

Mission Critical Function – Functions which are essential to conduct or support the primary mission requirements.

Modular/Removable – A self-contained unit or system capable of being removed from the vessel depending upon anticipated operational needs.

Navigable – Able to be sailed on by ships or boats.

Observation – The active acquisition of data from a primary source. Observation involves the measuring and recording of data using instruments or the senses.

Oceanography – The study of the ocean surface, water column, and bottom features, to include the propagation of acoustic and electromagnetic energy.

Open Water - A stretch of water which is not enclosed by land, ice, or other barriers.

Operational Availability – The probability that the PIB is able to fulfill primary mission requirements at any random point during its scheduled underway deployment period.

Operational Mission Failure – Any malfunction or combination of malfunctions that prevent the PIB from achieving a mission critical function in accordance with the performance requirements.

Organic – A specialized personnel, system, or capability that is a permanent part of the PIB.

Propulsion Machine - A device (e.g., diesel engine, turbine, electrical motor), which develops mechanical energy to drive a propulsor.

Propulsor - A device (e.g., propeller, waterjet) which imparts force to a column of water in order to propel a vessel, together with any equipment necessary to transmit the power from the propulsion machinery to the device (e.g., shafting, gearing).

Reference Version (Series) - For the purpose of the PIB ORD, it shall be assumed that all reference versions used in the development of the document were the most up to date approved version at the time of the Request for Proposal (RFP) release.

Research – Activities whose purpose is to expand general scientific knowledge.

Ridged Ice - When large sheets of ice collide, ridges of ice called "pressure ridges" build up at the point of collision. The collisions are caused by pressure exerted on the ice by the force of the wind or tides, Movement of the ice by the underlying ocean currents and thermal (caused by heat) expansion. Various techniques are employed to break through ridged ice to include: back and ram, podded azimuth thruster wash, etc.

Science Van – A standardized, modular, shipping container such as those used on container ships that has been outfitted with equipment and materials to support science operations or operations of another OGA user. The science van is typically an intermodal container/conex box. The container has standardized connections for power and other shipboard systems (potable water, uncontaminated sea water, etc.).

Secured State – State where the cutter boat is made fast in its cradle.

Single-Pass Channel – The area of open water or broken ice behind the icebreaker created by one transit of the icebreaker through an area of ice. This is as opposed to a groomed channel created by multiple passes of the icebreaker through an area of ice.

Sparing – Logistical concept that maintains an adequate level of parts and materials onboard the vessel in order to effectively make repairs and maintain operations.

Steering System - A system designed to control the direction of movement of a vessel, including the rudder, and steering gear.

Strike Down – Movement of cargo/materials received during UNREP/VERTREP operations to designated top-side and internal storage areas.

Survey – Activities undertaken in the ocean and coastal (littoral) waters involving marine data collection. Surveys can include oceanographic, hydrographic, bathymetric, marine geological, chemical, biological, acoustic, non-acoustic, and related data.

Survival – The ability of the PIB to withstand significant environmental conditions (i.e. Sea State 8) and once those conditions have subsided the PIB shall be capable of resuming all mission critical functions without the need for depot level repair.

Sustained Speed - Sustained Speed for the PIB is that speed which the cutter can maintain at maximum shaft horsepower reduced by the service margin and engine margin.

Territorial Seas – A belt of sea adjacent to a coastal state measured seaward from baselines determined in accordance with international law up to a maximum breadth of 12 nautical miles. The coastal state exercises full sovereignty of water and airspace in the territorial sea.

Wintering Over – When an icebreaker becomes icebound and is required to remain in the Polar Regions through the winter season. This is to be a ship survival capability and not an operational or science/survey support capability.