New Generation Polar Research Vessel

Richard P. Voelker, U.S. Maritime Administration, Washington, DC, USA
Alexander Sutherland, National Science Foundation, Arlington, VA, USA
Harold Owen, Raytheon Polar Services Company, Centennial, CO, USA
Paul Olsgaard, Raytheon Polar Services Company, Centennial, CO, USA
Jim Holik, Raytheon Polar Services Company, Centennial, CO, USA
James W. St. John, Science and Technology Corporation, Columbia, MD, USA
Aleksandr Iyerusalimskiy, Science and Technology Corporation, Columbia, MD, USA
David B. Karnes, Science and Technology Corporation, Columbia, MD, USA

ABSTRACT

In 2003, the U.S. National Science Foundation (NSF) initiated a program to determine the national requirements for polar marine science in the Antarctic and to assess vessel characteristics for a new generation Polar Research Vessel (PRV). This paper describes the results of that investigation. Science requirements included a desire for year-round operations covering a wide range of diverse activities in geographic areas currently inaccessible. These requirements were followed by a series of technical studies that provided an assessment of vessel size, hull form, and power plant to successfully operate in 1.4 m (4.5 ft) level ice.

KEY WORDS: Research vessel; Antarctic; polar; icebreaker.

INTRODUCTION

The United States Antarctic Program (USAP) is managed by the NSF Office of Polar Programs (OPP). The focus of the USAP is the support of science and this is carried out by maintaining land and marine-based facilities. The three permanent land-based research stations are: Amundsen-Scott South Pole Station, McMurdo Station, and Palmer Station. The marine-based facilities consist of two vessels, the *Nathaniel B. Palmer* (*NBP*) and *Laurence M. Gould* (*LMG*).

NBP began operations in 1992 and is the first modern era U.S. commercially built and owned icebreaker. Classed by the American Bureau of Shipping (ABS) as an A2 Icebreaker (the bow is ABS-A3), it can break 0.91 m (3 ft) of ice at a steady 3 kts The vessel was built from the keel up as an icebreaking research vessel and is 94 m (308 ft) in length and operates year-round in all areas of the Southern Ocean. Meanwhile, the newest ship in the USAP fleet, the *LMG*, began operations in 1997 and serves a dual role of research and Palmer Station resupply. This 70 m (230 ft) vessel is classed as an ABS A1 Icebreaker with an icebreaking capability of 0.3 m (1.0 ft) at 3 kts and traditionally operates around the Antarctic Peninsula. Both of these vessels are under charter to NSF-OPP's prime support contractor Raytheon Polar Services Company. With the *NBP* charter expiring in 2012 after 20 years of service, plans are currently being developed for the acquisition of a new generation PRV that will incorporate a variety of expanded roles over that of the *NBP*.

To define the desired scientific and operational capabilities of the new generation PRV the NSF funded two community science workshops in 2002. The findings of these workshops are available at the following websites: http://www.vims.edu/admin/sponpgms/AOPWReport.pdf and http://departments.colgate.edu/geology/faculty/AMGGPWReport.pdf. Then, using these workshops as guidance the NSF employed the support of the Antarctic Research Vessel Oversite Committee (ARVOC). This committee consists of nine members who are active users of the USAP vessels and are representatives of the various scientific disciplines using the ships. (ARVOC web site is: http://www.usap.gov/conferencesCommitteesAndWorkshops/committeeMinutes/ARVOC.cfm). ARVOC subsequently formed a 15-member Special Standing Committee to provide expertise in scientific areas affecting the vessel and to work interactively with the NSF project team. As such, this committee provides a continuing opportunity to gather and incorporate input from the broad spectrum of ship users as well as to review and comment on the guidance plans and specifications of the vessel as they are developed. The results have been impressive and include a series of science workshops, "Town Hall Meetings" at large national science congresses, surveys of the polar research vessel user community in one-on-one contacts, and information collected through a public access web site where questions, comments, and opinions could be logged and archived. As of November 2005, ARVOC estimates that more than 250 individuals have provided opinions, comments, and technical information related to the next generation PRV.

SCIENCE AND OPERATIONAL REQUIREMENTS

While the *NBP* has served the science community well, there are compelling reasons to plan for a new polar research icebreaker. Specific research requirements that mandate a new vessel for future scientific exploration of the Antarctic seas are:

- Enhanced icebreaking capabilities 1.4 m (4.5 ft) at 3 kts
- Increased endurance (to 80 days) and 20,000 miles at 12 kts
- Increased accommodation and lab space (for 50 scientists)

- Moon pool for geotechnical drilling access to the water column through a controlled interface (no ice, limited surge and turbulence)
- Ability to tow nets and research instrumentation from the stern during icebreaking
- Acoustically quiet
- Hull form designed for the installation and operation of remote sensing instruments during icebreaking

The first two requirements are directed towards substantially increasing the ability of U.S. researchers to operate in a greater portion of Antarctica's ice-covered seas as well as throughout the Southern Ocean during all four seasons. Increased accommodation space will foster comprehensive and integrative approaches to Antarctic marine research. The moon pool, ice-shedding stern, and acoustic/hull properties are required to take advantage of new tools that have become important for many types of Antarctic research. Taken together, these requirements dictate that the next generation PRV will be larger and have a different hull shape than our current polar research vessels. An example of the benefits to be realized with the PRV's 50 percent increase in icebreaking capability is depicted in Figure 1. It shows the minimum and maximum sea ice extent in year 2000, first year and multiyear ice areas, and hatched areas where *NBP* vessel operations have been problematic during multiple cruises. With the increased capability of the PRV, it will have access to 90 percent of the ice covered areas of the Antarctic margin.

Some additional science and operational requirements include:

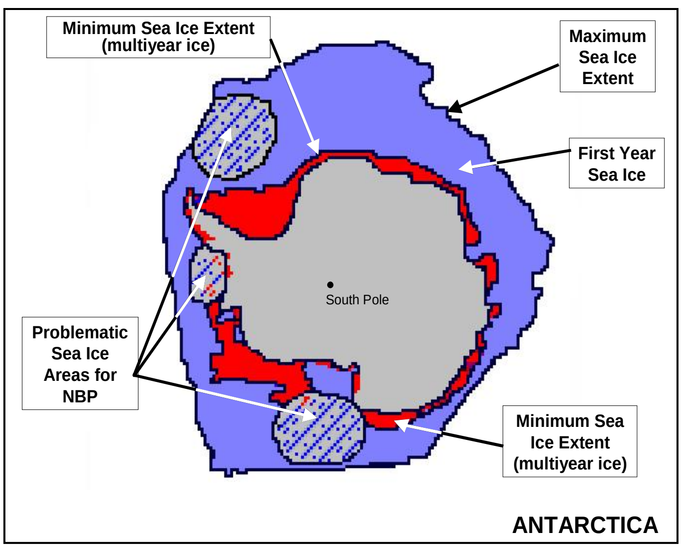

Fig. 1: Minimum and maximum sea ice extent during calendar year 2000

- Capability to conduct autonomous underwater vehicle/remotely operated vehicle (AUV/ROV) operations
- Jumbo piston coring (JPC) capacity for 50 m
- Compliance with International Maritime Organization (IMO) guidelines for Arctic vessels
- Reduced air emission from diesel engines and incinerator and other features for a "greener" ship
- Provision for a helicopter flight deck and hangar
- Space for 6 portable lab containers
- 2.4 m (8 ft) wide passageway on the Main Deck and inter-deck elevator
- Aloft, enclosed platform for science observations

Operationally, the PRV may face a wide range of environmental conditions. As such, the vessel will be designed and built for minimum winter air temperature of -46°C (-50°F) and have the capability of enduring a maximum sustained wind speed of 100 kts. Additionally, the combination of cold sea water and air temperatures with high sea states can cause severe topside icing at times. Icing rates of 1.3 cm/hr (0.5 in/hr) can be expected in extreme events.

A notional annual operating profile for the vessel is shown in Table 1 and is representative of the operations of the *NBP* during the last 14 years.

Table 1: Notional Operating Profile

Activity	Days
Transit and science operations away from port	265
In-port preparations for science operations	35
Repairs and maintenance	65
	365

DESCRIPTION OF SEVERAL SPECIAL TECHNICAL STUDIES

The hull form and propulsion plant for the PRV need to satisfy many objectives including efficient performance in level ice, operation in multiyear ice, good maneuverability in ice, excellent station keeping and sea keeping abilities, and low open water resistance. In addition, there is a desire to develop an improved ice-free channel behind the vessel and reduce or eliminate bubble sweep-down and ice pieces from passing under the acoustic array during icebreaking.

Towing in Ice A special study of existing non-conventional hull forms, as well as other various technical solutions for clearing ice from behind the icebreaker, showed it was extremely difficult to tow in ice in a manner comparable to those in open water. The most practical way of reducing the ice concentration in a broken channel is the use of an azimuthal propulsion system that can change the wake direction at the stern. However, the speed and ice thickness in which the ship is operating may limit the effectiveness of this approach. Using special devices or stern arrangements to submerge the towed equipment and minimize their interaction with ice in the ship's track also helps.

Bottom Mapping A box keel has been designed for the vessel to ensure its ability to conduct bottom mapping in open water and during most icebreaking operations. The most successful ship for swath bathymetry in ice has been Germany's Alfred Wegener Institute of Polar and Marine Research vessel *Polarstern*. The design for the PRV, therefore, used a refinement of the *Polarstern* box keel by incorporating in the fore and aft ends of the box keel a bow ice knife and stern skeg to avoid bubble sweep down and help clear ice from the acoustic arrays. Figure 2 shows this arrangement. In essence, this design will cause the ice pieces sliding down the bow or stern to divide and to move laterally.

The acoustic arrays are positioned as far forward as possible. There is potential for damage to the acoustic arrays during ramming because of their very forward location, but the ice knife should prevent the ship from riding up too high on a pressure ridge and, therefore, offer some protection to the arrays. The depth of the keel is 0.9 m (3 ft) and the width of the keel was determined from the width of the arrays. The other acoustic transducers are positioned in the box keel to port and starboard of the longitudinal array.

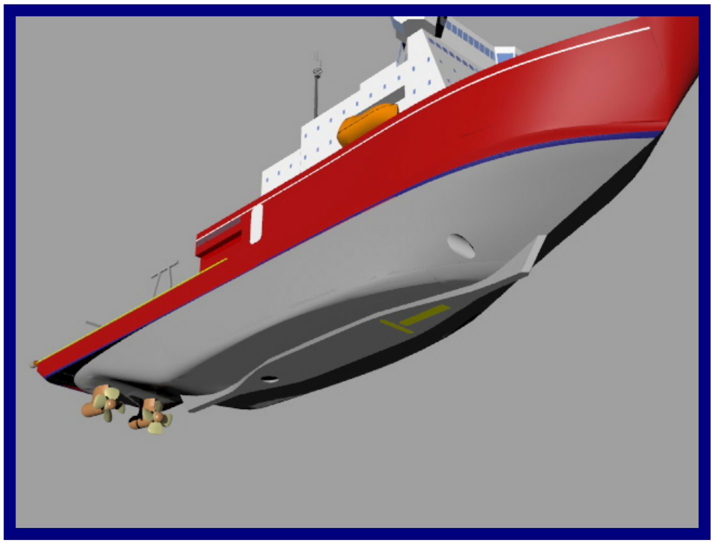

Fig. 2: Underwater view of PRV box keel with bottom mapping sensors

The cross-section of the box keel is similar to the *Polarstern's* with reverse flare on both sides as shown in Figure 3. This reverse flare side on the box keel helps prevent bubble sweep down from occurring across the face of the transducers.. The deep draft of the PRV also serves as an advantage during icebreaking operations.

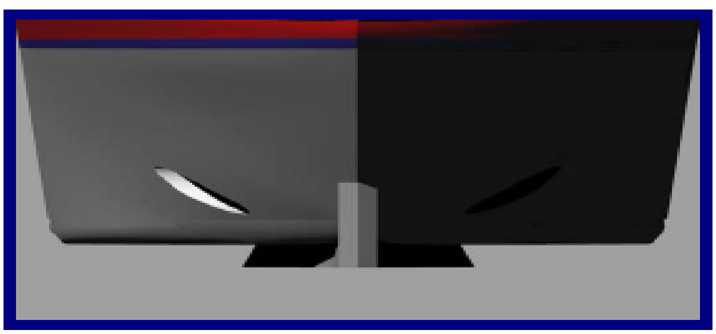

Fig. 3: View of box keel with reverse flare on the sides

Geotechnical Drilling In open water, dynamic positioning will be required to keep the ship on station during drilling operations. The selection of podded propulsors that can be rotated azimuthally was partially based on their good thrusting capability for dynamic positioning. A hull-mounted tunnel thruster was incorporated to increase maneuverability for dynamic positioning. The hull-mounted unit has been located aft and higher compared to the usual thruster mounting in the bow ice knife. This should result in fewer air bubbles sweeping down to the acoustic arrays. The thruster will be effective in open water but will fill with ice in heavy pack. Even if cleared of ice, the bow thruster cannot produce enough thrust to be useful in ice. As such, it will only be used in open water for dynamic positioning and to assist in maneuvering alongside piers.

Moon Pool Operational requirements for the moon pool initially included such diverse activities as geotechnical drilling, conduct of AUV/ROV operations, deployment of rosettes for water sampling and conductivity, temperature and depth (CTD) measurements, deployment of ocean bottom seismometers (OBS), and diving operations. This resulted in a moon pool size of 6.1 m (20 ft) by 4.9 m (16 ft), with the maximum dimensions based on ROV requirements. Subsequently, the science community decided that the primary function of the moon pool would be geotechnical drilling, but it also could be used to vertically deploy torpedo-shaped AUV's It will be re-sized to between 1.8 and 2.4 m (6 to 8 ft) in diameter, depending upon further study. The moon pool is located on the vessel centerline, close to the longitudinal center of gravity for minimal vessel motion, and it will be capable of being closed at the bottom. AUV/ROV operations can also be conducted off the stern of the vessel as necessary.

Icebreaking Capability Operational requirements include enhanced icebreaking capability, 50 percent greater than that of the *NBP*. The proposed hull form has a modified wedge-shaped bow that is fuller than conventional icebreakers. This shape has been shown to be about 25 percent more efficient than some of the ships in service now. The moderate side flare decreases resistance in ice, helps with management of besetment and improves maneuverability in ice. Increasing flare in the stern portions of the ship allows the hull to break ice while turning quickly with the podded propulsors. In addition to these features, there is also a need to deploy science equipment in landfast ice including old ice found in some bays of Antarctica. These requirements necessitated a hull and propulsion plant capable of operating in multiyear ice. As a result, the PRV will meet the requirements of the ABS ice classification A3. As such, the vessel will also have the capability for independent operation in Arctic ice along the coastal shelf and into the Arctic Basin in summer. Extended operations in the Central Arctic Basin can be accomplished when escorted by a more capable lead icebreaker.

Open Water Performance A smooth hull form reduces open water resistance and improves endurance over hull forms with knuckles below the waterline that may, however, be easier to build. A stepped shear for high bow freeboard and flare above the water improves sea keeping while keeping the working deck aft at reasonable freeboard for over-the-side operations required of a research vessel.

PRV Machinery and Propulsors An analysis of the many scientific requirements (moon pool, station keeping, towing of nets, and instruments) and operational requirements (low power open water transit and high power icebreaking) led to the selection of a diesel-electric propulsion plant with podded propulsors. The diesel-electric propulsion plant consists of four main diesel generator sets, two of 6050 kW and two of 5100 kW with a total brake power of 22,000 kW. This configuration was selected because it provides greater flexibility as it relates to the physical arrangement on the vessel as well as varying electric power demands. It also provides excellent propeller shaft torque characteristics for operations in ice. Additionally, the diesel-electric generators can be "floated" on isolation mounts for low noise/vibration, thereby reducing the ship's self-generated noise signature to improve acoustic sensor performance.

Propulsors in the current PRV configuration take the form of two azimuthal propeller pods. This system offers enhanced station keeping ability, maneuverability in ice and less ambient ship noise. Each pod contains an 8.4 MW electric motor driving a pulling propeller. They are independently steerable through 360 degrees and provide superior maneuverability in ice and open water (station keeping) without rudders. Each pod drives one stainless steel four-bladed open fixed-pitch propeller of 5.4 m (17.7 ft) diameter. This large propeller rotates at a slow speed and ensures high thrust for icebreaking and low noise in open water, further reducing the ship's self-generated noise signature. It should be noted that conventional line shafting remains an alternative while reliability studies continue on podded systems, as described above.

All electrical service loads including propulsors, bow thruster, winches, cranes, lights, and other general ship service needs are powered from a common bus/integrated electric system.

Low Diesel Exhaust Emissions Diesel engines aboard existing U.S. research vessels, such as the *NBP*, were not subject to emissions regulations when they were built. New engines such as those to be installed on the PRV, must comply with recent U.S. regulatory requirements of the Environmental Protection Agency (EPA) that limit exhaust emissions, particularly nitrogen oxides (NOx). In addition, optional emission reduction equipment employing new technology can be installed to reduce emissions further.

These technologies can be divided into two broad categories. The first category affects the basic combustion process and prevents the formation of undesirable air emissions in the engine. These technologies include fuel selection and treatment, electronic control of fuel injection and valve timing, ceramic coating of combustion parts, exhaust gas recirculation, and the injection of water into the combustion chamber, to name a few. The second category focuses on the removal of undesirable emissions from the exhaust after they form in the engine. These include the use of catalyzed reaction and filtration processes including selective catalytic reduction, diesel oxidation catalysts, and particulate traps.

Emission estimates were made for diesel engines based on various technologies and treatments for NOx, total hydrocarbons (THC), and particulate matter (PM). These estimates are for: (1) commercial "off-the-shelf" regulatory compliant engines after 2007; (2) 2007 engines with currently available, optional technology; (3) 2007 engines with optional technology that may be available in 2007. As shown in Table 2 and Figure 4 these levels are all compared with the likely emission levels from engines on vessels of the *NBP* vintage. It is clear that the new generation PRV provides an opportunity to significantly reduce diesel engine emissions. However, it is difficult to accurately predict the specific technologies that will be available when the PRV is built due to the rapid changes occurring in the industry.

Table 2: Comparison of emission estimates

Emission Estimates for Various Engine Configurations	**NOx + THC (g/kW-hr)**	**PM (g/kW-hr)**
NBP vintage (1990) engines	20	0.50
PRV-2007 engines without optional treatment	9	0.50
PRV-2007 engines with 2003 optional technology	4	0.06
PRV-2007 engines with 2007 optional technology	2	0.03

In addition to reducing diesel engine exhaust emissions, the PRV will have a number of other "green ship" attributes. Among these is the ability to "cold iron" the ship which will allow the vessel to use shore-based electrical power and shut down all ship service generators in port. By the time PRV begins operation, ultra low sulfur diesel fuel may be available worldwide in the marine market. This will result in a 99.6 percent reduction in sulfur in diesel fuel compared to today's sulfur content. Current U.S. regulations require that sulfur content of marine diesel fuel be reduced by 85 percent by 2007. International Maritime Organization (IMO) measures may also be in effect to eliminate or reduce potential harmful exchanges of ballast water and marine organisms from native to non-native habitats and seas.

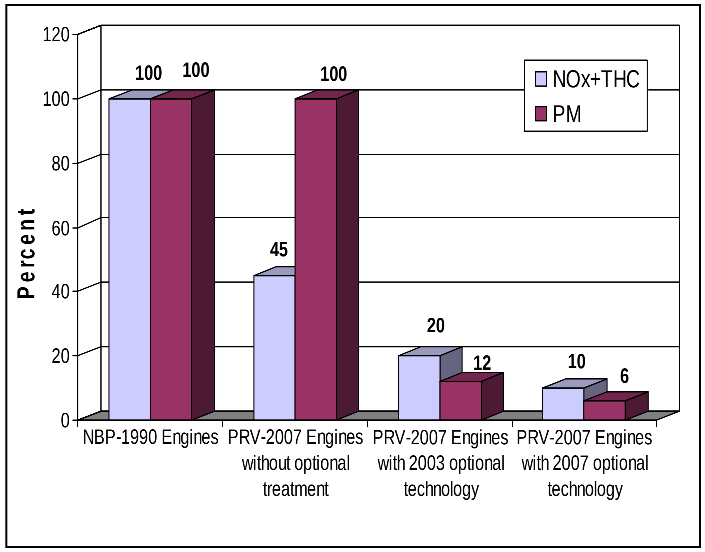

Fig. 4: Emission reduction per horsepower

Other ship requirements Naturally, the PRV will have many of the attributes of an icebreaker capable of year-round operation in the Polar Regions. These attributes include such items as low friction hull coating, heeling and trimming systems, floodlight and deck lights, and facilities for emergency personnel increase, to name a few. In addition to the traditional set of requirements, a service life of 40 years will be designed and built into the ship, taking into account the need for possible replacement of machinery and other components at various times. A preventative maintenance plan and a thorough half-life re-fit at the 20 year mark may be some of the methods used to extend the ship's life span.

PRINCIPAL CHARACTERISTICS

Having defined the mission requirements and a feasibility-level technical study of hull and machinery characteristics, the principal characteristics were determined as shown in Table 3 and a rendering of the vessel as shown in Figure 5. The vessel is configured for primary pilot house control from the starboard bridge wing, which affords a clear view of the open starboard and fantail area. There is no need for a centerline control station as the redundant station will be located in the port bridge wing.

Table 3: PRV principal characteristics

Length, Overall	115.3 m	378.4 ft
Length, Waterline	103.9 m	340.9 ft
Beam	22.7 m	74.5 ft
Draft	9.0 m	29.6 ft
Displacement	11,200 MT	11,000 LT
Propulsive, Horsepower (total, twin propellers)	16.8 MW	22,400 HP

ARRANGEMENT OF PRIMARY SCIENCE DECKS

Fig. 5: Artist's rendering of Polar Research Vessel

Considerable time and effort have been spent by ARVOC and others in the science community on the current arrangement of scientific spaces on the Main and 01 Decks. These decks are the primary work areas of the vessel and are shown in Figure 6. The arrangement is somewhat similar to the *NBP*, but incorporates changes to reflect operational experience and new needs.

The PRV must be multi-functional with modular designed components that can be mobilized or de-mobilized for specific projects. As an example, investigations in the Polar Regions require not only the ability of a vessel to enter the ice, but also to be equipped with AUVs or ROVs to facilitate investigations under the ice, in the water column and on the sea floor. There are rapid advances being made in technologies for AUVs and ROVs and it is anticipated that these instruments will become standard in all areas of marine science. Storage, deployment, operation, and recovery of modular systems and instruments need to be fully reviewed.

Similar consideration must be given to accommodate new geotechnical drilling and sediment coring. Here again, storage and deployment of drill rigs require careful analysis of their capabilities, planning of deck layout and superstructure as well as ship maneuverability. In addition, biological investigations are rapidly evolving to rely more and more on molecular-based methods for evaluation of taxonomy and physiology. Sterile lab conditions and motion sensitive instruments are routine components of many research projects.

To support the need for this flexibility, the Main Deck area aft of midships provides a significant amount of clear, unobstructed open space, with tie-down fittings to make it suitable for a wide range of investigations. It is also home to many laboratory spaces, scientific stores, storage for modular lab containers and workshops. The 01 Deck has a variety of control room spaces, winch rooms, 12 two-person staterooms, and the messroom. This latter space was relocated from the Main Deck, because of the noise generated from icebreaking at that location. Additional scientific cabins for one and two-person berthing are located on the 02 Deck.

The 2-person science cabins are approximately 16.7 sq m (180 sq ft) in area and contain the following: fore and aft berthing with an upper berth that can be folded into the bulkhead, a private bathroom, two desks facing outboard with communication and computing facilities, a sofa, spacious storage lockers for clothing and a window.

MISSION SENSITIVITY STUDY

A sensitivity study of vessel construction cost for various mission requirements was completed. Basically, a synthesis model allowed the determination of vessel characteristics and an estimate of vessel costs without going into many naval architectural calculations. A special feature of the model is that it allows both single and multiple sets of scientific and operational missions to be compared.

As shown in Figure 7, the sensitivity model was systematically varied for several different configurations of science features and icebreaking capabilities. The baseline ship accommodates 37 scientists, an endurance of 60 days, a 0.9 m (3 ft) icebreaking capability, and is comparable to the existing research vessel *NBP*. New scientific mission/capability was then examined for bottom mapping (box keel), double hull, diesel emission reduction, JPC of 50 m (164 ft) and 80 m (262 ft) capability, geotechnical drilling, 80-day endurance, AUV/ROV

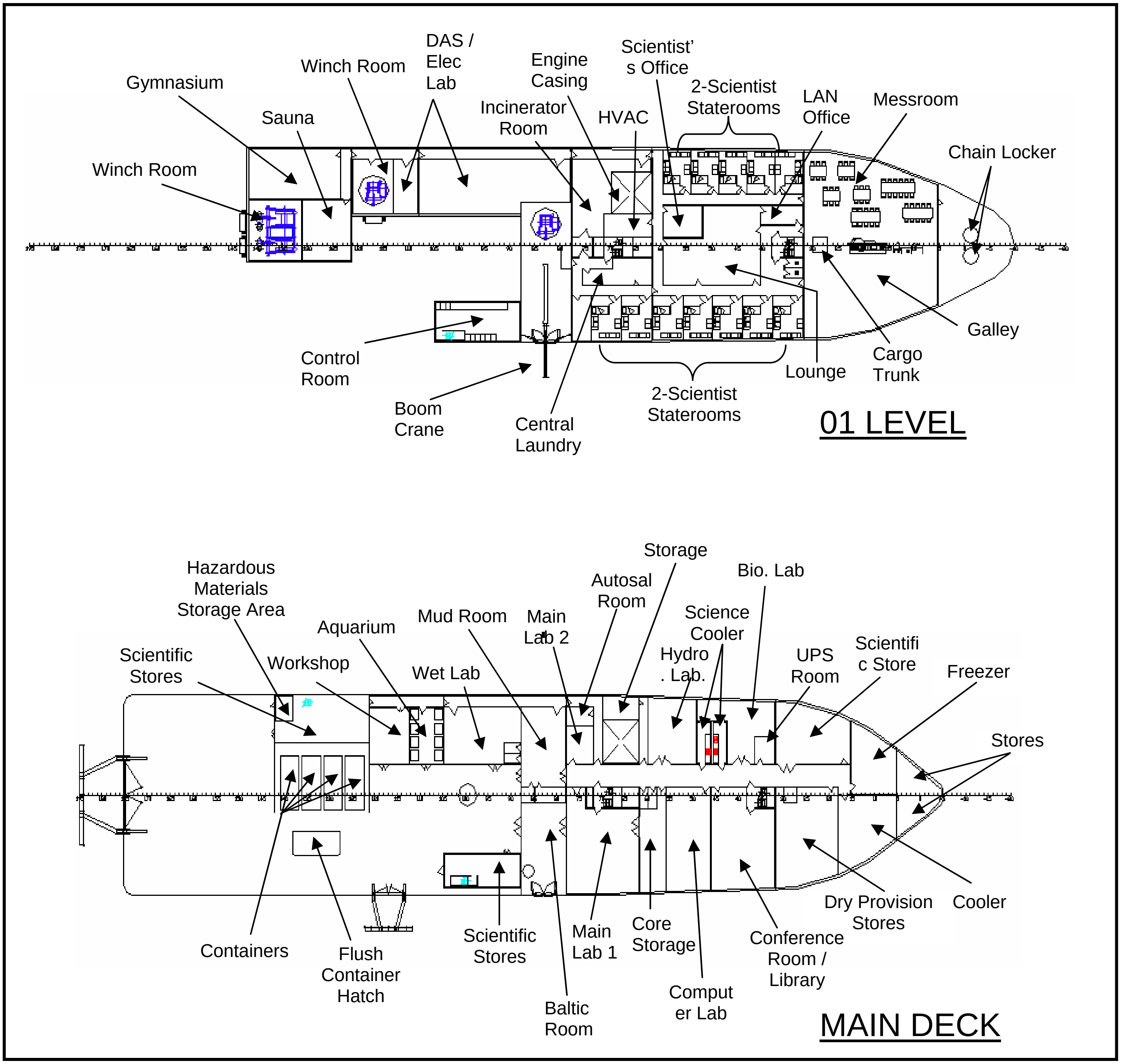

Fig. 6: PRV arrangements for the Main Deck and 01 Level

operations through a moon pool, accommodations for 50 scientists, and icebreaking capability of 1.2 m (4 ft) and 1.4 m (4.5 ft).

The sensitivity study for the PRV revealed that some of the mission requirements are associated with no significant increase in construction cost. Interestingly, a box keel for enhanced bottom mapping capability in open water and during icebreaking actually reduces the vessel construction cost by effectively providing displacement without the significant accompanying structural weight.

In contrast, the mission requirement for increasing level icebreaking capability has a significant construction cost increase. The thicker the ice a ship must break, the more expensive its construction cost. Other mission requirements such as weight allowances for geotechnical drilling capability, inclusion of a double hull and an expanded moon pool contributed little to the vessel cost. In some cases, a mission

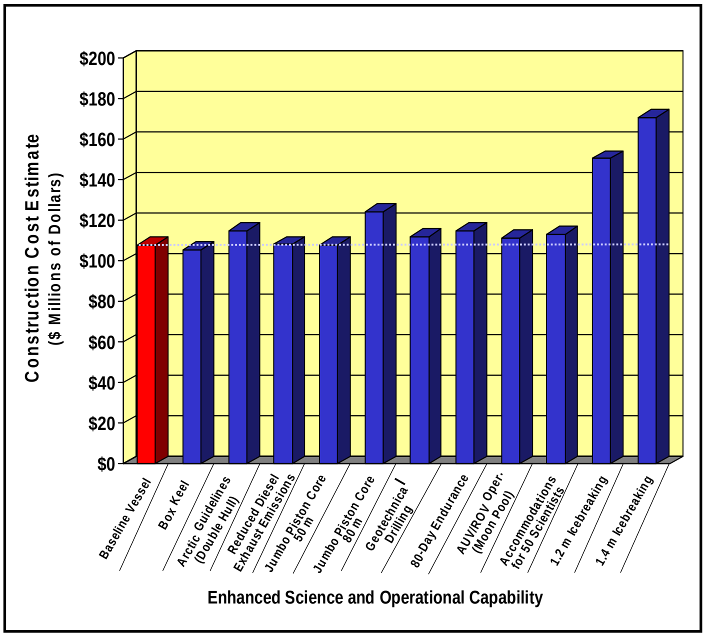

Fig. 7: Significance of individual mission requirements on construction cost

requirement can either affect the vessel construction cost significantly or not at all. The 80 m (262.4 ft) JPC is the primary example of this. For a 0.9 m (3 ft) icebreaking baseline ship, adding only the 80 m JPC requirement greatly affects the cost because the ship must be significantly longer to accommodate the capability. However, a larger ship, such as one with 1.4 m (4.5 ft) icebreaking capability, already has the length required for the 80 m (262.4 ft) JPC and has little effect on construction cost.

In addition to assessing the cost for individual requirements, many cases were examined for various feature combinations. For example, the vessel characteristics needed to satisfy 1.4 m (4.5 ft) icebreaking capability, resulted in a cost increase of less than one-half of one percent for inclusion of a double hull, a moon pool, 50 m (164 ft) JPC, a box keel, reducing diesel emissions, and geotechnical drilling.

Likewise, a cost increase of 17 percent over the single mission requirement of 1.4 m (4.5 ft) icebreaking provided a vessel that satisfied all scientific and operational needs. These and other cases were examined during the study.

ACQUISITION PLANS

Although detailed acquisition plans for the vessel must still be developed, a likely scenario is for a long-term lease similar to that presently used for the *NBP* and the *LMG*. The terms of the lease would have to be determined, but it is recognized that the longer the lease period, the less the risk to the bidder and thus the greater the competition and the lower the daily charter rate.
A lease-versus-buy study would have to be performed before a final decision could be made, similar to that required for the *NBP*. The *NBP* study, using a method prescribed by the Government’s Office of Manpower and Budget, resulted in a determination that a lease was most advantageous to the Government. This type of analysis is far from precise. It involved a number of estimates and assumptions including interest rates, discount rate, operating cost, length of lease, and ship value at the end of the lease. While a major factor in the consideration was cost, there were a number of other items that were factors in the decision.

- ✓ Risk – with a lease, the owner is financially responsible for building the vessel. Lease payments begin only upon delivery and acceptance of the vessel. Shipyard cost and time over-runs are at the risk of the owner.
- ✓ Fleet management – the maintenance of the vessel and hiring of the crew is the responsibility of the owner.
- ✓ Construction – there is the potential for diverse views between the owner and shipbuilder. The operator wants a quality ship that can be easily maintained and efficiently run, whereas the shipyard wants to provide a ship that meets specifications at the lowest cost.

It should be recognized that there are several different practices for research vessel ownership and operation in the United States and they vary considerably with the agency or institution supporting the research. The National Oceanic and Atmospheric Administration (NOAA) primarily uses a model of Government-owned – NOAA Corps-operated. The University National Oceanographic Laboratory System (UNOLS) vessels are a combination of Government (Navy and NSF)-owned vessels and University-owned vessels. They are operated by the individual Universities through funding provided primarily by NSF and other Government agencies. Each of the methods of providing research ship support to science varies considerably, and each has advantages and disadvantages; none is necessarily “better” than the other.

As has been done in the past, and prior to release of a request for proposal for the PRV, a series of public meetings with prospective bidders would be held in order to stimulate interest and thus competition. Meetings would also enable industry to provide suggestions on methods to construct the vessel more economically, and with less risk, and consequently more cost effective for the Government. Figure 8 shows an outboard profile of the PRV as a result

Fig. 8: Outboard profile of the PRV showing dual podded propulsors although traditional line shafting remains an alternative

of the feasibility stage study.

PRV TIMELINE

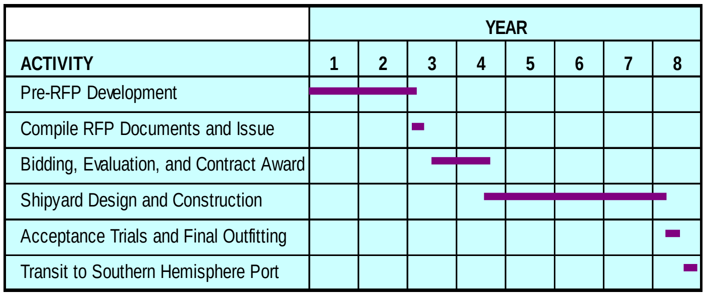

Fig. 9: PRV Timeline

A representative schedule for the PRV has been developed based on one of several possible procurement strategies. In particular, Figure 9 shows a schedule based on a strategy of using technical specifications with guidance drawings of the vessel. This approach is based on incorporating the experience, knowledge, and preferences gained from prior polar science operations while still allowing innovation on the part of the vessel owner and shipbuilder. In essence, this strategy provides a framework or guidance for the final design by the shipyard and for vessel construction.
The pre-RFP (Request for Proposal) development activities, where the project is today, requires a little over two years to complete. It is during this time period that the scientific and operational requirements are finalized; a procurement strategy is developed; construction cost sensitivity studies are performed; a number of studies related to the hull, machinery, laboratory arrangements, environmental protection, and the like are conducted; and guidance plans and specifications are developed.

Alternate procurement strategies can either lengthen or shorten the timeline with corresponding changes in risk and cost. In particular, a performance-only based technical specification would probably result in a one year shorter time frame for vessel delivery. However, a contract design technical specification with drawings would add about another two years before delivery of the vessel and severely limit changes to the design after contract award.

PROJECT WEB PAGE

A project web page has been prepared to serve a number of purposes. Foremost is the fact that the web page will provide an open means to solicit, gather, and incorporate input from the broad community of potential ship users including: scientists, technicians, operators, managers, and all who have a vested interest in the new ship. In effect, this forum will be a project management tool for developing, collecting, and organizing PRV science and technical requirements.

The web page consists of six sections

- Purpose Statement
- Background/Current Efforts
- Conceptual Design Specifications
- Science Community Participation
- Newsletters
- Multimedia Gallery

Access to the site, and the ability to enter comments, are open to all. However, access to make changes to sections and functionality of the site is controlled.

The web site address is:
www.usap.gov/vesselscienceandoperations/prvsection.cfm

NEXT PHASE

As described in this paper, most of the requirements for the feasibility stage have been completed. The PRV's basic science and operational missions have been determined as well as the vessel size, characteristics, and a construction cost estimate.

The next phase must now fine tune aspects of the vessel such that guidance plans and specifications can be developed for the PRV RFP. From a procurement perspective, some of the key activities include an analysis of the lease-versus-buy alternatives, the conduct of meetings with industry on the procurement, and a wide set of activities related to preparation of the RFP.

From a science point of view, a great deal of time and effort is needed on the arrangement of laboratory and science spaces such that there is proper integration with winches, cranes, storage, and cargo handling equipment. In addition, some of the laboratories will require a more detailed design to assure that they provide the desired flexibility of use for multiple science disciplines. All of these activities will require considerable deliberation and coordination.

From a technical perspective, there is a need to refine the hull and propulsion plant such that a series of model tests (sea keeping, icebreaking, calm water speed/power, and station keeping) can be conducted. The objective of these tests would be to demonstrate or verify, not optimize, that the guidance drawings of the hull and propulsion plant satisfy the requirements. Prospective bidders will then have the option of using this information or attempting to further optimize the configuration as they respond to the RFP. Several additional studies will need to be conducted and these include: the reliability of podded propulsors in ice, acoustic studies and general refinement of the machinery plant.

SUMMARY

The NSF has begun planning for the acquisition of a new generation PRV that is intended to serve the needs of the science community in the first half of this century. To aid in this effort, NSF employed the support of ARVOC to develop the science and operational requirements. Some of these requirements are in response to the national need to expand global climate change studies in the polar regions. Computer models point to these areas as critical components for developing forecasts.

After receiving comments and reviews from over 250 individuals, the basic requirements were established and formed the basis for generating a feasibility study to determine approximate vessel characteristics. To aid in this effort, a number of special technical studies were performed including a sensitivity study relating mission requirements to vessel construction cost. Subsequently, the issues associated with the acquisition of the PRV, as well as the overall project schedule from today's pre-RFP activities to vessel acceptance, were described. The remaining pre-RFP activities from an acquisition, science, and technical perspective were also presented. The NSF seeks to have the PRV serve as a world-class platform for future decades of research in the polar regions.

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