U.S. Polar Icebreakers: Future Needs and Possible New Policy

established a committee for the “Assessment of U.S. Coast Guard Polar Icebreaker Roles and Future Needs” and held its first fact-finding meeting on August 24 and 25, 2005. The USCG and NSF were the primary presenters. The Arctic Research Commission and the OPP Advisory Subcommittee also made presentations. The charge to NAS and the membership of the Committee may be found at the NAS web site: http://www.nationalacademies.org/ and then clicking on “Current Projects” then search for “Icebreaker”.

The NAS is scheduled to deliver a preliminary report in November 2005. If major shifts in current operating procedures are recommended, it is likely that a White House level decision (A Presidential Decision Directive (PDD)) may be made.

What does all this mean to the PRV? It means that some PRV technical studies and acquisition must await the results of the NAS study and any White House directives to be issued. These decisions and directions should be made in fiscal year 2006 (October 1, 2005—September 30, 2006).

Visit the PRV web site at: www.polar.org/prv

As always, your comments on the newsletter are welcomed.

PRV Project Team E-Mail Addresses

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Email Address</th>
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<tbody>
<tr>
<td>Al Sutherland</td>
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PRV Project Studies Continue

Mission Sensitivity Study Completed

Powerful Icebreakers Under Construction

PRV Timeline

2005 PRV Project Studies Continue

U.S. Polar Icebreakers: Future Needs and Possible New Policy

Acronyms

ARVOC Antarctic Research Vessel Oversight Committee
AUV Autonomous Underwater Vehicle
HP Horsepower
JPC Jumbo Piston Coring
MARAD Maritime Administration
MVO Magellan
NAS National Academies of Science
NBP Nathaniel B. Palmer
NSF National Science Foundation
OPP Office of Polar Programs
PDD Presidential Decision Directive
PRV Polar Research Vessel
RFP Request for Proposals
ROV Remotely Operated Vehicle
RPSC Raytheon Polar Services Company
SSC-PRV Scientific Standing Committee for PRV
STC Science and Technology Corporation
USCG United States Coast Guard

Artist’s rendering of Polar Research Vessel

New Generation Polar Research Vessel

September 2005

Highlights

This newsletter describes the 2005 project studies and includes the latest artist’s rendering of the PRV, the project schedules, and the results of a mission sensitivity study. Additionally, there are articles on the surge of new construction activity for very capable commercial icebreakers and the initiation of a study by the National Academies of Science to assess the future role of U.S. Coast Guard icebreakers.

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committee determined that some of the science and operational requirements that were originally proposed could be modified to produce a better and more useful configuration.

Some of the suggested changes that have been made include: provision for a geotechnical drilling capability external to the superstructure with a smaller moon pool; provision for a 50 m Jumbo Piston Coring capability as shown by the recess on the starboard side midship with suitable working area aft; a reconfigured port side helicopter landing deck and hangar (space for two); and scientific van storage is provided on the main deck below the helicopter deck.

Other requirements continue to be met and include an icebreaking capability of 1.4 m (4.5 ft), enhanced bathymetry in ice with a box keel (see Newsletter No. 2), reductions in ship generated noise, significantly lower emissions from diesel engines, a double hull, and a clear view aft from the starboard bridge wing control station to the main deck, to name a few.

All of the changes and original requirements continue to be accommodated on a vessel having the following characteristics:

- Length Overall: 115.3 m (378.4 ft)
- Length, Water Line: 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)
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In calendar year 2005, the science requirements will be documented and compiled in a report that justifies specific needs and uses of the vessel. These requirements will cover a wide spectrum of scientific disciplines and operational requirements. Additionally, a definition of acoustical requirements for the vessel will be determined including the frequency range and maximum tolerable noise level for all sensors including towing of seismic instrumentation. Also, the station keeping requirements for the conduct of geotechnical drilling shall be specified including the upper limit of environmental conditions and vessel movement. Clearly defined operational uses for the moon pool and support equipment as well as space requirements on all decks will be developed.

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The sensitivity study of vessel construction cost for various mission requirements was recently completed. Basically, the synthesis model allows 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 below, 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 compared to the existing research vessel Nathaniel B. Palmer. New scientific mission/capability was then examined for bottom mapping (box keel), double hull, diesel emission reduction, jumbo piston coring (JPC) of 50 m (164 ft) and 80 m (262 ft) capability, geotechnical drilling, 80-day endurance, autonomous underwater vehicle/remotely operated vehicle (AUV/ROV) 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).

U.S. Polar Icebreakers: Future Needs and Possible New Policy

A number of studies by federal agencies are examining the future need and role of U.S. polar icebreakers. One of these studies is being conducted by the National Academies of Science (NAS) with interim results scheduled for later this year. The NAS study will assess the role of the U.S. Coast Guard (USCG) polar icebreakers in supporting U.S. operations in the Antarctic and the Arctic, including scenarios for continuing those activities as well as alternative approaches.

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Powerful Icebreakers Under Construction

International shipyards are busy building very capable icebreaking vessels to support petroleum development and other commercial activity in the Russian Arctic. Many of these vessels have icebreaking capability of 1.5 m (5 ft) at 3 knot speed and have diesel-electric machinery plants with podded propulsion systems.

Several of these powerful icebreaking ships are described in the table below. They include icebreaking supply boats, icebreaking tugs, an icebreaking shuttle tanker, and an icebreaking container ship. Delivery of these vessels was scheduled as early as May 2005 and as late as 2007. As a result, there will be a significant increase in powerful commercial icebreaking ships over the next two years and it will be of great interest to learn of their operational performance in ice.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Supply Boat¹ (shown below)</th>
<th>Standby and Supply Vessel²</th>
<th>Tug³</th>
<th>Containership⁴</th>
<th>Shuttle Tanker⁵</th>
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<tr>
<td>Length, Overall</td>
<td>91.5 m</td>
<td>300 ft</td>
<td>99.9 m</td>
<td>328 ft</td>
<td>71.0 m</td>
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<td>Beam</td>
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<td>5 ft</td>
<td>1.5 m</td>
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<td>Propulsion Power</td>
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<td>11 MW</td>
<td>22 MW</td>
<td>17 MW</td>
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<td>Propulsors</td>
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Footnotes to table are on bottom of page 5

Three supply boats with 1.5 m (5 ft) icebreaking capability are being built in Norway. The UT 758 ICE was designed by Rolls Royce Marine AS

PRV Timeline

A representative schedule for the PRV has been developed based on one of several possible procurement strategies. In particular, the below schedule is 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 vessel construction.

The PRV project timeline includes the following key activities:

- **Pre-RFP Development**: Takes 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. 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.**

Additional details regarding the PRV project schedule are in the report PRV Project Master Plan and will be available on the project web site: [www.polar.org/prv](http://www.polar.org/prv).

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Footnotes:

¹Owner: Swine Pacific Offshore, Singapore; Shipyard: Aker Langston, Norway; Operating Area: Sakhalin, Russia; 3 vessels; Delivery: TBD
²Owner: Far Eastern Shipping Company (FESCO), Russia; Shipyard: Aker Finnyards, Finland; Operating Area: Sakhalin Island (Okhotsk Sea); Delivery: 2006
³Owner: Primorsk Shipping Corporation; Operator: Rieber Shipping AS; Shipyard: Aker Langsten; Operating Area: Dekastr Oil Terminal, Sakhalin; Delivery: 2006
⁴Owner: MMC Norilsk, Russia; Shipyard: Aker Finnyards, Finland; Operating Area: Northern Sea Route of Russia; Delivery: 2006
⁵Owner: ZAO Sverdlovneftegaz, Russia; Shipyard: FSVE Admiralty St. Petersburg, Russia; Operating Area: Prirazlomnoye Oil field, Arctic Ocean; 2 Ships; Delivery: 2007 and 2008
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The UT 758 ICE was designed by Rolls Royce Marine AS. The table below describes the key characteristics of these powerful icebreakers. The table includes the following columns: Purpose, Supply Boat1 (shown below), Standby and Supply Vessel2, Tug3, Containership4, Shuttle Tanker5, Length, Overall, Beam, Draft, Icebreaking @ 3 kts, Propulsion Power, No. of Propulsors, and Footnotes.

Purpose | Supply Boat1 (shown below) | Standby and Supply Vessel2 | Tug3 | Containership4 | Shuttle Tanker5
---|---|---|---|---|---
Length, Overall | 91.5 m | 300 ft | 99.9 m | 328 ft | 71.0 m | 233 ft | 168.6 m | 553 ft | 257.0 m | 853 ft
Beam | 19.0 m | 62 ft | 21.2 m | 70 ft | 17.0 m | 56 ft | 23.1 m | 76 ft | 34.0 m | 112 ft
Draft | 8.3 m | 27 ft | 7.5 m | 25 ft | 6.5 m | 21 ft | 9.0 m | 30 ft | 13.6 m | 45 ft
Icebreaking @ 3 kts | 1.5 m | 5 ft | 1.5 m | 5 ft | 1.5 m | 5 ft | 1.5 m | 5 ft | 1.2 m | 4 ft
Propulsion Power | 16.6 MW | 13 MW | 11 MW | 22 MW | 17 MW
No. of Propulsors | 2 | 2 | 2 | 2 | 2

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The pre-RFP (Request for Proposal) development activities, where the project is today, takes 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.

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The sensitivity study for the PRV revealed that some of the mission requirements are associated with no significant increase in construction cost. For example, the vessel has sufficient length for the 50 m (164 ft) JPC operations, excluding equipment cost or the impact its weight has on stability (they were not considered in this model). There is no added cost for including this requirement. 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 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 contribute less to the vessel cost. In some cases, a mission 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 JPC and has little affect 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 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 and are in a report that will be available on the PRV web site: www.polar.org/prv.

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The following characteristics and capabilities can be found at www.uscg.mil/pacarea/shipinfo.htm:

- Principal characteristics and capabilities
- USA CGC Healy (WAGB-20) underway to commence Arctic West East Summer (AWES) 2005 deployment.
- USA CGC Polar Star (WAGB-10) and USA CGC Polar Sea (WAGB-11) at McMurdo Station, Antarctica.

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U.S. Polar Icebreakers: Future Needs and Possible New Policy

established a committee for the “Assessment of U.S. Coast Guard Polar Icebreaker Roles and Future Needs” and held its first fact-finding meeting on August 24 and 25, 2005. The USCG and NSF were the primary presenters. The Arctic Research Commission and the OPP Advisory Subcommittee also made presentations. The charge to NAS and the membership of the Committee may be found at the NAS web site: http://www.nationalacademies.org/ and then clicking on “Current Projects” then search for “Icebreaker”.

It is expected that the findings and recommendations of the NAS Committee will be far reaching. The future needs for the Nation’s polar icebreaking fleet will depend heavily upon what services must be provided by this fleet. Should this fleet be dedicated to science or are there other more pressing national needs? Has the National need changed enough since the end of the cold war that maintaining a polar fleet as a National Asset is not necessary? The NAS is sorting out such issues. There are many possible options and outcomes of the NAS study.

The NAS is scheduled to deliver a preliminary report in November 2005. If major shifts in current operating procedures are recommended, it is likely that a White House level decision (A Presidential Decision Directive (PDD)) may be made.

What does all this mean to the PRV? It means that some PRV technical studies and acquisition must await the results of the NAS study and any White House directives to be issued. These decisions and directions should be made in fiscal year 2006 (October 1, 2005—September 30, 2006).

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As always, your comments on the newsletter are welcomed.

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