U.S. Department of Transportation
Maritime Administration Office of Shipbuilding and Marine Technology

New Generation Polar Research Vessel

Issue 1 June 2003

Introduction

This is the first, of a series, newsletter that is designed to keep our readers informed of recent and pending event and project activities related to the design of a new polar research vessel.

This issue contains articles on the beginning stages of design, visit by the design team to Scandivanvian icebreakers, and the current status of the program.

Your comments on the newsletter are welcomed.

This issue:

Design Studies Begin for New Polar Research Vessel for NSF

The National Science Foundation (NSF) has initiated a program to assess, and possibly implement, the leasing of a Polar Research Vessel to support science in the Antarctic as a replacement for the NATHANIEL B. PALMER. As part of that effort, the NSF established a Memorandum of Agreement (MOA) with the Maritime Administration (MARAD), through which NSF may task MARAD for various aspects of technical support related to the design of the vessel. NSF's initial tasking, under the MOA, is to conduct feasibility-level design studies for a new research vessel.

This effort includes the development of vessel design criteria from a set of science and op-

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Visit to Scandinavian Icebreakers

In mid-March 2003, a visit was made to the Finnish Maritime Administration and their icebreaker BOTNICA and the Swedish icebreaker ODEN. The purpose of the trip was to gain insight into the design and operation of some of the innovative icebreakers in the Baltic. The icebreakers have advanced hull forms, propulsion systems and specialized capabilities. These include ice shedding bow

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Some members of the Polar Research Vessel design team observing icebreaking operations aboard the Swedish icebreaker ODEN in the Gulf of Bothnia, March 2003. Left to right: Paul Olsgaard, RPSC; Al Sutherland, NSFDPP; Alex Iyerusalimsky, STC; Jim St. John, STC; Captain Anders Backman, Swedish Maritime Administration; and Dick Voelker, MARAD.

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Design Studies Begin

erational requirements that evolved from a series of recent workshops. Current requirements include, among others, the need to conduct acoustic profiling and bottom mapping during icebreaking, the towing of nets and instruments from the stern during icebreaking and the ability to conduct Autonomous Underwater Vehicle (AUV) and Remotely Operated Vehicle (ROV) operations and geotechnical drilling from a moon pool. In addition to these requirements, the vessel should be acoustically quiet, incorporate environmentally sensitive design features such as reduced air emissions from diesel engines and incinerator operations, comply with the new IMO guidelines for Arctic vessels, accommodations for 50 scientists, an 80-day endurance as well as enhanced icebreaking capabilities.

To achieve the desired science and operational requirements, several special technical studies will be performed to better understand the implications of the requirements on the vessel design and cost. The studies and project milestones are shown in the following figures.

The design effort is being per-

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Special Technical Studies

1. Towing in ice – seismics and nets. Recommend a hull form, stern arrangement, and propulsion system that improves towing in ice.
2. Bathymetry in ice – Recommend a hull form and appendages that promote improve ice management and reduce bubble sweep down over the acoustic windows for the multi-beam swath bottom mapping system, sub-bottom profilers, ADCP, fish finding sonars and other acoustic sensors.
3. Geotechnical drilling – Recommend a hull form, propulsion system, thruster system, and drilling arrangement for shallow water drilling in land, fast ice and open water.
4. Establish requirements for a moon pool to deploy and recover ROVs and AUVs in ice and consider CTD/rosette deployment through the moon pool.
5. Evaluate increased icebreaking capability and evaluate one or more propulsion concepts to satisfy mission requirements and develop recommendation.
6. Examine compliance with new IMO requirements for Arctic vessels including provision for no pollutants carried directly against the outer shell.
7. Investigate and recommend an approach to improve the ship's self-generated noise signature to improve scientific acoustic sensor performance.
8. Analyze and recommend an approach on methods to reduce emissions from diesel engines and the incinerator.

Project Milestones

Project started on March 11, 2003

1) End of April 2003
   a. Trip report on the visit to Baltic icebreakers and AWI
   b. Outline of vessel technical specification (feasibility-level design studies)
   c. Presentation of work to date at ARVOC meeting - May 1 and 2
2) End of May 2003
   a. Interim report on the special design studies
   b. Meet with RPSC and geotechnical drilling contractor
3) End of June 2003
   a. Final report on the special design studies
   b. Draft of the design arrangements and hull form
4) End of July 2003
   a. Design history
   b. Design technical specifications
   c. Design drawings
   d. Cost estimate
5) A presentation to NSF, RPSC and ARVOC is planned after July

Status of the Design Effort

Although the design effort has just begun, several initial decisions have been made and these are being incorporated in the design. One of the science requirements that has a major impact on the design is the size of the moon pool and the adjacent area for winches, supplies and support equipment. The moon pool, while originally considered for geotechnical drilling, has been expanded to include the ability to support ROV, AUV and diving operations. The size of the moon pool to satisfy these science needs is 16 ft by 20 ft with the ROV requirement being the greatest.

NATHANIEL B. PALMER (Length Overall 308 ft, Beam 60 ft, Draft 21.8 ft, Displacement 6,500 Tons and 13,200 Shaft Horsepower)

It appears that twin podded propulsors are superior for the range of science and operational requirements currently envisioned. While the exact horsepower size is still being studies, a number of other investigations will be needed in the future and these include an investigation into possible underwater electromagnetic interference and noise.

USCGC HEALY (Length Overall 420 ft, Beam 82 ft, Draft 29 ft 3 in, Displacement 16,000 Tons and 30,000 Shaft Horsepower)

Icebreaking capability and endurance are other issues that are currently being studied. Because of the need to operate in thick, landfast ice of Antarctica and with some possible missions in the Arctic, the vessel will be designed for operation in multiyear ice with approximately 4.5 ft first-year level icebreaking capability at 3 knots. This capability will be substantially more than the NATHANIEL B. PALMER (NBP) (3.5 ft) and should be similar in capability of the USCGC HEALY and CCG LOUIS S. ST. LAURENT.

Development of the parent hull form has been completed and it incorporates a box keel of 3.2 ft depth that will contain the bottom mapping transducers and

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Status of Design Efforts

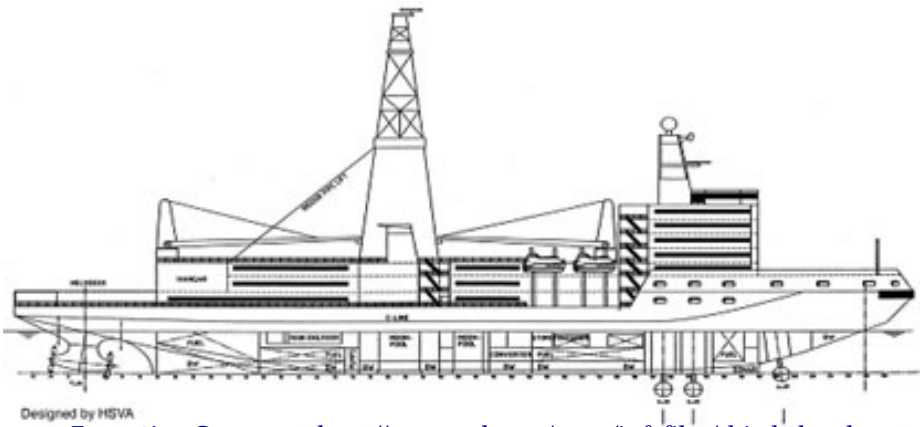
other echo sounding systems. This system has been demonstrated aboard POLARSTERN to avoid bubble sweep down over the transducer array and to permit bottom mapping during icebreaking. The bow form also reflects some very recent research performed by the U.S. Coast Guard that should improve the icebreaking capability by 20 percent over that of the NBP. As a result, the hull form with the box keep should provide superior capability for bottom mapping with an increased icebreaking capability. Current requirements also include a sea keeping performance equal to that of the NBP and the station keeping requirements for geotechnical drilling are in the process of being developed.

POLARSTERN (Length Overall 387 ft, Beam 82 ft, Draft 34 ft, Displacement 15,000 Tons and 17,000 Shaft Horsepower)

CCG LOUIS S. ST. LAURENT (Length Overall 892.5 ft, Beam 79.9 ft, Draft 32.5 ft, Displacement 14,500 Tons and 14,793 Shaft Horsepower)

European Drilling Research Icebreaker

The European Union currently has under development, with AWI leading the effort, a feasbilitiy design for a drilling vessel capable of operations in Arctic pack ice. The vessel is reported to have two moon pools of about 13 ft by 16 ft to support drilling and AUV/ROV operations. The vessel has been named AURORA BOREALIS, is expected to cost about $250 million and has the following principal characteristics, 433 ft length between perpendiculars, 118 ft beam, 28 ft draft, 23,000 ton displacement and 67,000 shaft horsepower. Additional program information can be found on the web site www.wissenschaftsrat.de/teste/5369-02.pdf



Executive Summary http://www.polar.se/assw/infofiles/thiede.html
Jörn Thiede, AWI, Bremerhaven, Germany

Finnish icebreaker BOTNICA in a broken ice channel (Length Overall 317 ft, Beam 78.7 ft, Draft 25.6 ft, Displacement 7,300 tons, and 13,500 Shaft Horsepower)

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Visit to Icebreakers

forms, podded propulsion systems and moon pools. Subsequent to these visits, a one-day meeting was held with the Alfred Wegener Institute for Polar and Marine Research (AWI), owners of the icebreaking research/supply vessel POLARSTERN, in Bremerhaven, Germany. Our objective was to learn of their experience with box keels to house bottom mapping transducers and other other echo sounding instrumention and to discuss other icebreaking research vessel issues.

Our visit to the Finnish multipurpose icebreaker BOTNICA focused on observations and discussions on the special features of this recently constructed vessel. Among the features are a 20 ft by 20 ft moon pool designed for both drilling and ROV operations, the use of twin electric podded propulsors (Azipods) built for operations in ice and station keeping and other features such as an advanced pilot house control station. While onboard a series of tests were performed in ice that demonstrated the outstanding maneuverability and performance of the podded propulsion system in the prevailing ice conditions.

The visit to the Swedish icebreaker ODEN was of equal importance and provided additional insight on ice flow around the vessel with her novel hull form, the use of reamers to improve maneuverability in ice and the effectiveness of the bow water wash system. It appeared that the broken ice channel behind ODEN and BOTNICA were similar.

At AWI, it was learned that the POLARSTERN's box keel (one meter below the vessel's keel) was very effective in minimizing the effect of bubble sweepdown on bottom mapping in open water. Furthermore, the vessel is able to continuously collect data during most icebreaking operations.

Representatives at AWI felt that all ships have the same basic distribution of broken ice behind vessels, regardless of bow form.

A more complete description of the trip, including pictures, observations and conclusions can be found in a presentation given to the Antarctic Research Vessel Operators Committee (ARVOC) on May 1, 2003, in Arlington, VA. A copy is available upon request.

View of Swedish icebreaker ODEN (Length Overall 353.7 ft, Beam 101.7 ft, Draft 26 ft, Displacement 11,900 tons and 23,500 Shaft Horsepower)

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Web Site Under Construction

Web Site for the PRV Design and Specifications

A web page for the project is under development by RPSC and MARAD and should be operational shortly. This web page will contain the technical specification for the vessel with a format suitable for review and comment by the science community. This will allow reviews and changes to be made on an on-going basis, recognizing that access to make changes will be limited to designated individuals. The web site will also contain links to other sites as well as the results of the current design effort and future editions of this newsletter.

Acronyms

ADCP
Acoustic Doppler Current Profiler
ARVOC
Antarctic Research Vessel Operators Committee
AUV
Autonomous Underwater Vehicle
AWI
Alfred Wegener Institute for Polar and Marine Research
CTD
Conductivity, Temperature, Depth
IMO
International Maritime Organization
MARAD
Maritime Administration
MOA
Memorandum of Agreement
NMREC
National Maritime Resource and Education Center
NSF
National Science Foundation
PRV
Polar Research Vessel
ROV
Remotely Operated Vehicle
RPSC
Raytheon Polar Services Corporation
STC
Science and Technology Corporation

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Design Studies Begin

formed by Science and Technology Corporation's Arctic Technology Office under contract to MARAD and in concert with Raytheon Polar Services Corporation (RPSC), who would be responsible for and manage the procurement process for a replacement vessel. The e-mail address of project team members is shown below.

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