UNOLS Polar Class Icebreaker Workshop
June 11 –12, 2003
USCG Integrated Support Center - Seattle, WA

Executive Summary

The USCG POLAR class icebreakers are fast approaching the end of their effective service life after 30 years of distinguished service. The USCG is currently considering proposals for service life extension projects (SLEP) for both the POLAR SEA and POLAR STAR. At present the possible improvements have been focused on ships systems.

A workshop was held June 11 and 12, 2003, which brought together researchers who have used the POLARS or other Icebreakers along with USCG, NSF, UNOLS, and other agency representatives. The purpose of this workshop was to identify, then roughly prioritize possible science system upgrades for the POLARS. This list of science upgrades together with preliminary recommendations was provided to the Coast Guard immediately after the workshop and is formally being reported by this document.

Some sixty areas for scientific improvements to the POLAR Class icebreakers were identified. We also include science-based justification for incorporating these improvements in the planning for Service Life Extension of these vessels. While the primary mission of the Polar Class icebreakers remains Antarctic logistic support, in the past twenty years they have been increasingly used for science. With improved scientific capacity included in the SLEP, the POLARs will also be major scientific assets in the critically important Polar Regions for the next twenty years.

The key recommendations, conclusions and caveats are:

- The Coast Guard recognizes the impending train wreck, they are seriously considering SLEP options and should be supported.
- The need to SLEP, replace POLARS or consider other options should be carefully evaluated, evaluate the costs of different options using historical data on fuel usage and other costs.
- Sooner is better, the time for decision and funding is now.
- Include upgrading science capabilities in any variation of the plan and consider various options to achieve this goal.
- Priority areas for improvement to Polar icebreakers
    - Lab space and quality
    - Deck space amount
    - Habitability
    - Station keeping
    - Systematic continuous underway data collection in all oceans and both Poles

Overview

The U.S. Coast Guard is responsible for breaking out the channel to McMurdo Station every year and for escorting the supply vessels to the station in order to ensure fuel and supplies necessary to support the operations for the coming year. The current situation is that full operations cannot be supported without this supply effort on a yearly basis. Supply by aircraft alone will not take care of the fuel and heavy equipment requirements. The entire science program would be impacted without this annual channel breakout and re-supply. For the POLAR Class Icebreakers, this mission takes precedence over all other. If necessary, it is likely that in order to fulfill this mission the Coast Guard could be required to forego support for Arctic Science operations using the HEALY. In order to prevent this unintended impact on Arctic science operations, a fully operational capability and backup for supporting the McMurdo Station breakout mission must be available.

The USCG POLAR class icebreakers are fast approaching the end of their effective service life after 30 years of distinguished service. The USCG is currently considering proposals for service life extension projects (SLEP) for both the POLAR SEA and POLAR STAR. At present the possible improvements have been focused on ships systems.

Overall science objectives for SLEP

The icebreaking and escort capabilities of the POLAR Class vessels are the primary justification for their continued reliable operation and SLEP in order to support the scientific operations at McMurdo Station and the Antarctic. In conjunction with the breakout and re-supply mission and as part of separate science missions in the Arctic and Antarctic there is ample scientific justification for including improvements to the scientific infrastructure and capabilities of the POLAR Class vessels as part of the SLEP process. The overall scientific objectives of these SLEP improvements would be as follows:

Increased availability and reliability of the POLAR Class Vessels, which would mean that availability for science would be less affected by demand and availability for logistics support. It would also mean that the time allocated for science missions would more effectively support the science operations.

Upgraded vessels should be general-purpose research vessels that can also effectively support seismic reflection work and mapping. As an alternative, planners could consider one truly general purpose research vessel and one designed to be more a more specialized seismic and mapping vessel.

High Latitude science justification

Rather than exploring scientific justification at the workshop, the group elected to draw on existing reports. The first two sections are from the Cowles/Atkinson workshop report on future facility needs. The next two sections are drawn from the NSF/OPP web page.

High-Latitude Open Ocean

In the next few decades, a major focus for oceanographic research will be on the physical and biological structure of high latitude portions of the northern and southern hemispheres and the response of these regions to climate variation and climate change. The global warming patterns evident today are predicted to have maximum impact on the northern North Atlantic Ocean. Research efforts will be motivated by the need to understand the driving forces for deep and bottom water formation and changes in the circulation patterns in response to changes in basin-scale air-sea interactions. Research will also be motivated by a need to understand the dynamics of plankton, the impacts of environmental perturbations on their distributions and abundance, their rates of growth and mortality, and their linkages to exploited fish stocks. Major internationally coordinated expeditions to these areas are now in the planning stages and will require research vessels that can withstand the rigors of the high winds and sea states typical of high-latitude regions in winter.

Ice-covered Regions

Ice-covered regions are an example of marine environments for which present ship capabilities are inadequate for future research needs. There are compelling reasons for continued, and increasing, oceanographic research in Antarctic and Arctic systems. Polar regions are of vital importance in terms of ocean circulation, sequestration of atmospheric carbon dioxide, global climate patterns, and marine resources. High latitude systems are predicted to show early and intense responses to global warming. Breakup of ice shelves on the Antarctic Peninsula, and recent decrease in extent and thickness of the Arctic ice sheet, may be indicators of global-scale warming effects. Logistical difficulties make oceanographic study of Polar Regions a challenge. This is particularly true for the Arctic Ocean, where more infrastructure in support of Arctic research is needed; currently considerably less infrastructure support is provided for Arctic research compared to support provided for Antarctic research. Research in ice-covered environments will require both large ice-breakers and ice-hardened smaller vessels able to work in regions with partial ice coverage. Considerations for ships working in these regions include the hazard of extreme cold, extended cruises of a month or more, need for easy access to the ice surface from the ship for some programs, constraints on some routine oceanographic procedures when working in dense ice, e.g. towing, and inadequate communication with home laboratories. Land stations, ice camps, moored and drifting instrument packages, observatories such as the recently initiated North Pole observatory, atmospheric sampling with airplanes or balloons, under-ice sampling with submarines or remote vehicles, and satellite remote sensing will also continue to be essential for adequate data collection in polar systems. In the future, research in polar oceans will increasingly involve multi-investigator, multidisciplinary, and multiple platform expeditionary programs. Recent examples are the JGOFS Southern Ocean Program, the 1994 Arctic Ocean Section (AOS), and the 1997-1998 Surface Heat Budget of the Arctic Ocean (SHEBA). The SHEBA project, in particular, provided a platform for sampling the central, ice-covered Arctic Ocean for an entire year, including the winter. Lack of data during winter is an ocean-wide problem; this is especially true for polar environments in which ice and weather conditions preclude operation of most existing ships. The addition of the new U.S. Coast Guard research icebreaker HEALY extends the research capabilities and scientific options for polar investigations. January 31, 2001 Ships for near-future research in polar systems thus will need to meet requirements of 1) increase in number of P.I.'s and projects, particularly in the Arctic, 2) increasing infrastructure needs, including servicing of remote moorings, observatories, and ice camps, 3) under-ice sampling and sampling during the polar winter, and 4) large, multi-disciplinary projects. The SHEBA project, in which a Canadian icebreaker frozen into the permanent Arctic ice pack served as the support hub of ice huts and instrument packages deployed around it, was a resounding success. This could be a model for future ship-ice camp expeditions. U.S. Arctic research in particular could also benefit from international cooperation in major projects, in terms of personnel and platforms, particularly with the Canadians.

Arctic science (from the NSF/OPP web page)

The goal of the NSF Arctic Research Program is to gain a better understanding of the Earth's biological, geophysical, chemical, and sociocultural processes, and the interactions of ocean, land, atmosphere, biological, and human systems. Arctic research is supported at NSF by the Office of Polar Programs (OPP) as well as a number of other disciplinary programs within the Foundation. Coordination across NSF includes the potential for joint review and funding of arctic proposals, as well as mutual support of special projects with high logistical costs.

The Office of Polar Programs offers a focused multidisciplinary and interdisciplinary research program that emphasizes the special character of the Arctic for scientific study. The arctic regions are among the most sensitive to environmental change, and have exceptionally long natural climate records, and thousands of years of human settlement. This interplay provides a unique basis for integrated research on global systems and human adaptation.

OPP disciplinary programs encompass the atmospheric sciences, biological sciences, earth sciences, glaciology, ocean sciences , and social sciences . Interdisciplinary research in the biosciences, geosciences, and social sciences is linked through the Arctic System Science Program of the U.S. Global Change Research Program. In addition to supporting research on long-term human/environment interactions, OPP encourages the study of contemporary socioeconomic, cultural, and demographic issues in the changing environment of the post-Cold War world. The Office of Polar Programs also encourages bipolar research (especially glaciology, permafrost, sea ice, ecology, conjugate magnetic field lines, and human factors studies).

The Foundation is one of twelve Federal agencies that sponsor or conduct arctic science, engineering, and related activities. As mandated by the Arctic Research and Policy Act of 1984, interagency research planning is coordinated through the Interagency Arctic Research Policy Committee (IARPC), which is chaired by NSF. In fiscal 1999, Federal agencies supported approximately $217 million in Arctic research and monitoring related to national defense, resources, science, and health. Researchers are strongly encouraged to pursue this possibility directly with OPP. Further information on other agency programs is presented in the journal Arctic Research of the United States (NSF 02-047), and the U.S. Arctic Research Plan and its biennial revisions (NSF 00-16)

Antarctic science (from the NSF/OPP web page)

Without interruption since 1956, Americans have been studying the Antarctic and its interactions with the rest of the planet. These investigators and supporting personnel make up the U.S. Antarctic Program, which carries forward the Nation's goals of supporting the Antarctic Treaty, fostering cooperative research with other nations, protecting the Antarctic environment, and

developing measures to ensure only equitable and wise use of resources. The program comprises research by scientists selected from universities and other research institutions and operations and support by a contractor and other agencies of the U.S. Government. The National Science Foundation (the U.S. Government agency that promotes the progress of science) funds and manages the program. Approximately, 3,000 Americans are involved each year.
The research has three goals: to understand the region and its ecosystems; to understand its effects on (and responses to) global processes such as climate; and to use the region as a platform to study the upper atmosphere and space. Antarctica's remoteness and extreme climate make field science more expensive than in most places. Research is done in the Antarctic only when it cannot be performed at more convenient locations.
The program has three year-round research stations. In summer (the period of extensive sunlight and comparative warmth that lasts roughly October through February) additional camps are established for glaciologists, earth scientists, biologists, and others. Large, ski-equipped LC-130 airplanes, which only the United States has, provide air logistics. Air National Guard crews operate these planes. Helicopters, flown by a contractor, provide close support for many research teams. Tracked or wheeled vehicles provide transport over land and snow; small boats are used in coastal areas.

Workshop outcomes

From this point forward the report highlights what was accomplished at the workshop.

Possible missions or science themes for the next decade

Basic science (NSF and other agencies)

In considering the scientific justifications for supporting the Service Life Extension Program (SLEP) for the POLAR STAR and POLAR SEA the participants looked beyond the logistics support mission for these vessels. In particular, the science outfitting changes that might be considered when planning and designing the modifications to these vessels should take into account the type of science that might be supported. Examples of programs and types of scientific operations that might be better served with some basic modifications to the science outfitting, infrastructure and machinery include:

- Exploration of the Gakkel Ridge and the seafloor spreading fabric
- Paleoclimate of the Arctic and global change
- Study of Environmental Arctic Change (SEARCH)
- BEST, Land shelf interactions (LSI) - ARCs programs - Winter work in the arctic, multipurpose science programs
- Interdisciplinary projects in Polynya and leads
- Surface heat budget studies
- Physical oceanography, Arctic ocean circulation, ice physics, Arctic biological systems, marine mammal surveys, Deep water mooring capability
- Support for drilling, site surveys, etc.

- Projects that need helicopter support, access to ice and shore for ecology and geology, support for dive operations, Support for instrumented arctic survey boat for work in shallow water areas
- Support for AUV (including large ones), ROV, Glider and Autonomous aircraft operations

Other National requirements and programs

In addition to basic science missions, other national interests in the Arctic could be supported by enhance science capabilities for the POLAR Class vessels, such as:

- Interagency Arctic research policy - multiple agency interest in Arctic research
- Arctic energy resources, gas hydrates, Law of the Sea claims, site survey support for drilling and general understanding of the Arctic geology: Geology of the Arctic Ocean, depth of sedimentary rocks, structure, etc. - small science parties, but continuous trackline, sampling for seismics, coring, mapping.
- Understanding of Arctic Natural resources, NMFS and others, fisheries research support
- Satellite validation studies
- Underwater archaeology - under ice, shelf work on smaller vessels
- Ocean Exploration

International collaborations

- Improved science capabilities will enhance our nations ability to support international collaborations and to participate in world wide programs that include the Polar regions.
- U.S. North pole expeditions have always been international collaborations.
- Integrate Arctic and Antarctic into global ocean observing systems
- Joint expeditions

Priority areas for improvement to Polar icebreakers

- Lab space and quality
- Deck space amount
- Habitability
- Station keeping
- Systematic continuous underway data collection in all oceans and both poles

Specifics of needed improvements

(organized around UNOLS Science Mission Requirements (SMR) for Ocean Class Research Vessels)

The UNOLS Ocean Class and Global Class SMRs should be used during the planning process to identify applicable requirements for a high latitude oceanographic research vessel. In addition the SMRs for the Alaska Region Research Vessel would serve as a useful guide. Some recommendations for improvements that should be considered during design of SLEP upgrades follow and are organized according to the requirements in the UNOLS SMRs.

Note: The sections, which remain blank are areas that are addressed by the UNOLS SMR but were not covered at the workshop.

Accommodations and habitability

Accommodations

- Keep 20 science berths while improving habitability of berthing areas (get rid of triple bunks)

Habitability

- Joiner bulkheads and suspended overheads - habitability improvements
- False overheads and joiner bulkheads can create maintenance obstacles, which should be avoided through good design
- Common head on the main deck and elsewhere
- Icing on deck and lighting for safe passage
- HVAC, sewage, temperature control, noise levels, lighting levels

Operational characteristics

Endurance

Range

Speed

Sea keeping

- Enhance to the extent possible with improved station keeping.
- Anti-roll tanks or other methods that won't affect icebreaking capability

Station keeping

- Bow thruster for station keeping in ice or open water ops
- Improve station-keeping capabilities for operations such as mooring ops, CTD, ROV ops, etc.

Track line following

- Sufficient for mapping and seismic work.

Ship control

- Improve command and control during over the side operations

Icebreaking capability

- Maintain as much as possible, consider the ramifications of decreased power, but increased availability on icebreaking mission requirements

Over-the-side and weight handling

Over the side handling

- Nodding boom cranes for roll damping
- Docking head for the CTD system
- Full on Baltic room for CTD operations
- CTD deployment from enclosed area, directly overboard (baltic room)
- Reinforced bolt down pattern in the deck to mount science system handling equipment such as nodding boom cranes, frames, Biomapper launching system, etc.
- Maximize the ability to launch, recover and handle AUV's, gliders, rovs, etc. (Space, handling equipment, services, etc.)
- Capability to take VERY LONG CORES

Winches

- Ability for better access to winches in upper winch room for replacement and repair.
- Reduce number of sheaves for wire trains on all winch systems.

Wires

- Add Fiber-Optic cable capability for aft winch.
- Keep 9/16 inch wire capability

Cranes

- Crane access to top of wheelhouse

Towing

Science working spaces

Working deck area

- CTD launching deck area is too small for safe handling when the ship is rolling/in bad weather
- Add deck space in the aft deck area for winches, buoys, etc.
- Remove one stack and move flight deck and hanger forward for more aft deck space
- Availability of high power and other ship's services to working decks, consider increasing what is currently available.
- Make forward deck useable for science work or vans

- Heated decks that go all the way to the edge.
- Wooden decks instead of heated
- Access to and from the ship to the ice
- Van locations that can be accessed by ship's cranes, self-service vans and reconfigure van locations
- Tow bitt designed to be re-locatable.
- Multiple power outlets on the bridge, flying bridge and foredeck for science systems
- Flowing seawater, freshwater and hot water on deck for rinsing nets, cleaning equipment etc.

Laboratories

Labs - Type & number

- Additional lab spaces - forward, aft and portside
- Climate control chambers or space for climate control van.
- Consider eliminating boiler room for additional science working space.
- Triple main deck lab space
- Need approximately 400 sq ft of temperature controlled lab space. Comparable to KNORR space
- Keep lab space as flexible as possible.
- Improve meteorology lab space and equipment, modernize
- Larger science lounge/conference room.
- Core locker and/or space for core splitter
- Cold room for minus thirty work

Labs - Layout & construction

- At least some of the lab spaces contiguous or close to each other and to the working decks
- Enhance access to lab spaces and winch rooms in order to install and remove equipment.
- fume hoods and clean hoods (hepa filter) in at least some lab space.

Labs - Electrical

- Science cableways
- More power outlets and clean, uninterruptible power in the labs from a well designed power distribution system.

Labs - Water & air

- Distilled water in the labs

Vans

Storage

- Spare parts for oceanographic instrumentation (storage, work bench, etc.)
- Increased science storage space in the labs, drawers, cabinets, etc.
- Improved access to storage holds to move science equipment to and from storage area and labs. Remedy for obstructions (tie downs) on the deck in hold.

Science load

Workboats

- Ice strengthened boat for leaving the ship.

Masts

- Power and cable routing to the top of the bridge and masts for met sensors
- Met/aerosol sensor mast forward

On deck incubations

- Ambient seawater (not frozen) for incubators at proper (ambient surface temperature) with adequate flow to maintain proper temperatures for incubators.

Marine mammal & bird observations

Science and shipboard systems

Navigation

- Science cruise track and position planning station and system that allows science party planning and transmittal of waypoint info to ship control.
- Keep terrascan capability
- Upgrade ice imagery, ice condition information and make sure data and images are available to labs and ship control station.

Data network and onboard computing

- Maintain cabling from antennas and other systems to the labs, Decks, bridge, instrumentation spaces, winch rooms, staterooms.

Real time data acquisition system

- Improve integrated ship's/science data network

Communications - internal & external

- Location at the top of the mast for satellite communications antenna.
- Provide reliable on and off ship data transmission and communications.
- Continuous infinite bandwidth with redundancy and no cost
- Closed circuit TV system to labs, deck areas, etc.

U/W data collection & sampling

- Flow through seawater systems needs to be upgraded, operational in ice, sensors upgraded, temperature control
- Hull mounted Gravimeter & magnetometer

Acoustic systems

- Need ADCP (may require cutting hole in hull)
- One option is an ADCP on a strut
- Sonar systems
- Multibeam system (may require cutting hole in hull)
- Autonomous vehicles for multibeam mapping systems as option
- Minimize the acoustic impacts of new propulsion systems

Project science system installation and power

Discharges

- Ship discharges all on one side, away from normal sampling side and ability to hold discharges if necessary during certain science operations

Maintainability and Operability

- Ability for better access to winches in upper winch room for replacement and repair.
- Get rid of the need for hub purifying or other engineering requirements that take away from science mission or icebreaking time.
- Maximize the ability to do helo ops with minimum impact on science operations

Specific recommendations:

- The need to SLEP, replace POLARS or consider other options should be carefully evaluated, evaluate the costs of different options using historical data on fuel usage and other costs.
- Include upgrading science capabilities in any variation of the plan, consider various options to achieve this goal.
- Develop an SMR for upgraded POLAR Class vessel
- Develop an SMR for additional Arctic science icebreaker

- Review the Franklin conversion for lessons learned

Conclusions and caveats

- Sooner is better, time for decision and funding is now.
- Coast Guard recognizes the impending train wreck, seriously considering SLEP options
- This is an opportunity to also improve the science capabilities.

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Appendices

Appendix I. Charge to committee

The USCG POLAR class icebreakers are fast approaching the end of their effective service life after 30 years of distinguished service. The USCG is currently considering proposals for service life extension projects (SLEP) for both the POLAR SEA and POLAR STAR. At present the possible improvements have been focused on ships systems.

Participants in this workshop have been identified as researchers who have used the POLARS in either the Arctic or Antarctic in recent years. The purpose of this workshop will be to identify, then prioritize, possible science system upgrades for the POLARS. There is some urgency to getting a list of science upgrades together and provided to the Coast Guard.

The workshop will begin with a few presentations highlighting the current challenges facing the POLARS, followed by a tour of one of the POLARS, and possibly a tour of the HEALY. The remainder of the day will be spent identifying and prioritizing science upgrades. During the next morning we will finish identifying and prioritizing our recommendations.

Appendix II. Workshop Participants

Polar Class Icebreaker Workshop
June 11 –12, 2003
USCG Integrated Support Center - Bear Room
Pier 36 - 1519 Alaskan Way South, Seattle, WA
ATTENDEES

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Appendix III. Workshop Minutes

Appendices

I. Agenda
II. Attendees
III. AICC Chair Report (PDF)
IV. NAS/PRB Polar Status Brief (PDF)

0840 Welcome and Introductions around the room

Phil McGillivary gave an overview of the climate and ice conditions in Antarctic. He showed results of models for the Polar Wave of climate cycles around the continent. The models were not used with the advent of the two large icebergs. Predictions for 2003/2004 show an average ice thickness year. He also showed the movement of Icebergs C-19 and B-15. Predictions for the last four miles of thick multiyear ice is that it will get 18 inches thicker to about 14 – 15 feet. The rate of accretion is slowing as the ice gets thicker. Indications are that the ice is thicker than it has ever been based on a few measurements.

Garrett Brass gave an update on PRB activities. Garry stated that at this point he has no idea what the best approach will be in the long run, because there are so many options.

NSF report by Simon Stephenson – icebreaker support is critical for NSF activities in the Polar Regions and the POLAR class is particularly important to the Antarctic program. The South Pole station can not operate without the tanker refueling every year. NSF is very supportive of this workshop and the idea that we can come up with good ideas at this stage is exciting. Budget numbers are still to be developed and they anticipate that most of the funding will be in the Coast Guard's budget, but that NSF could contribute for science systems, etc.

Robin Muench mentioned the real opportunities for using European Arctic vessels and this should be considered as part of integrated planning for future needs, particularly in the Arctic. Simon mentioned that we will be working to identify the points of contact, availability, scheduling, and capabilities of all arctic research vessels and assets to help coordinate their use.

POLAR Icebreaker Status Report

LCDR Neil Meister, USCG, provided a presentation on the challenges for meeting High Latitude missions with the POLAR class vessels. The presentation is available as an appendix to this report and includes the following points.
History of the POLAR Class icebreakers
Problems with the POLAR class
Hulls are in good shape and the machinery needs help
For icebreakers the hull is the more expensive and risky element, which is not the norm for other types of ships.
SLEB recommendations

Near term (1 – 5 yrs) double the annual support from $7M/yr to 14M/yr. This will reduce the impact on other ships that lose their repair money to overruns in POLAR repairs.

Long term (5 – 30 yrs): SLEP. Utilize existing hulls with new propulsion systems. Must begin this program immediately.

Analysis of the Alternatives

- Keep existing configuration
  - Finish RIP
  - New GTs and Propeller Hubs
  - Positives
    - Low technical risk
    - Less costly than integrated electric drive
    - Maintenance and operations well understood
  - Negatives
    - CPP remains
    - Burdensome maintenance requirements and remail
- Hybrid configuration
  - Replace/reduce diesels (9 down to 5)
  - New Gas Turbines
  - Common electrical bus for propulsion and ship service
  - Positives
    - Lowest capital cost
    - Fewer engines
  - Negatives
    - Still have CPP
- Integrated Electric Drive (HEALY Style)
  - Replaces all prime movers
  - AC motor propulsion w/Fixed Pitch propellers
  - All New Electrical Distribution System
  - Positives
    - NO CPP!!!
    - Fewest engines w/max flexibility and scalability of power
    - Possible lifecycle $$ savings w/fewer personnel & maintenance req.
    - Potential for lesser horsepower.
  - Negatives
    - Highest Capital Cost
    - Most technical risk
- Analysis of Alternatives
  - Sticker Shock
    - $400M for both ships
    - Need to lock in money very soon
    - Competes against sea change in CG
      - DHS move
      - Deepwater ($20B)/Rescue 21 ($800M)
  - Mitigating Factors
- Reduce Power (75K SHP down to 45 – 60K SHP)
- SLEP only one ship

HEALY into DF mix on a regular basis
Sooner rather than later decision on SLEP would allow biggest bang for buck in existing maintenance $$ use.
The viability of the McMurdo program relies on the refueling every year and this is greatly at risk without a standby vessel or two vessels in support of Deep Freeze.

Lisa Clough presentation on impacts to science

Antarctic and Arctic impacts

Icebreaker schedules based on a straw man SLEP schedule

Vernon thinks that some additional thought should be given to getting the broken ice out of McMurdo Sound.   Innovative methods should be explored.

Discussion about the need for re-supply every year. Fuel is key and would need a two-year supply, but getting other equipment in would result in compromises.

Tours of POLAR SEA and HEALY were conducted

Constraints from Neil Meister

Have to stay inside the basic fundamental size constraints of the ship and the basic configuration of the ship will probably stay the same. Otherwise possibilities are open. Also can set aside space for systems.

Ideas for adding science capability:

Phil McGillivary: Ideas that have already been presented through feedback from users.

CTD launching deck area is too small for safe handling when the ship is rolling/in bad weather

Ability for better access to winches in upper winch room for replacement and repair.

Fiber-Optic cable capability for aft winch. (one quote for $350K)

Reduce number of sheaves for wire trains on all winch systems.

ADCP – requires cutting hole in hull

    One option is an ADCP on a strut

Multibeam system – requires cutting hole in hull

    Autonomous vehicles for multibeam mapping systems as option

Add deck space in the aft deck area for winches, buoys, etc.

Nodding boom cranes for roll damping on Polars

Docking head for the CTD system

Brainstorming session developed around sixty items of potential improvement.

Science justification for High Latitude facilities, in particular in the Arctic:

From the Cowles/Atkinson workshop:

Workshop Report

High-Latitude Open Ocean

In the next few decades, a major focus for oceanographic research will be on the physical and biological structure of high latitude portions of the northern and southern hemispheres and the response of these regions to climate variation and climate change. The global warming patterns evident today are predicted to have maximum impact on the northern North Atlantic Ocean. Research efforts will be motivated by the need to understand the driving forces for deep and bottom water formation and changes in the circulation patterns in response to changes in basin-scale air-sea interactions. Research will also be motivated by a need to understand the dynamics of plankton, the impacts of environmental perturbations on their distributions and abundance, their rates of growth and mortality, and their linkages to exploited fish stocks. Major internationally coordinated expeditions to these areas are now in the planning stages and will require research vessels that can withstand the rigors of the high winds and sea states typical of high-latitude regions in winter.

Ice-covered Regions

Ice-covered regions are an example of marine environments for which present ship capabilities are inadequate for future research needs. There are compelling reasons for continued, and increasing, oceanographic research in Antarctic and Arctic systems. Polar regions are of vital importance in terms of ocean circulation, sequestration of atmospheric carbon dioxide, global climate patterns, and marine resources. High latitude systems are predicted to show early and intense responses to global warming. Breakup of ice shelves on the Antarctic Peninsula, and recent decrease in extent and thickness of the Arctic ice sheet, may be indicators of global-scale warming effects. Logistical difficulties make oceanographic study of polar regions a challenge. This is particularly true for the Arctic Ocean, where more infrastructure in support of Arctic research is needed; currently considerably less infrastructure support is provided for Arctic research compared to support provided for Antarctic research. Research in ice-covered environments will require both large ice-breakers and ice-hardened smaller vessels able to work in regions with partial ice coverage. Considerations for ships working in these regions include the hazard of extreme cold, extended cruises of a month or more, need for easy access to the ice surface from the ship for some programs, constraints on some routine oceanographic procedures when working in dense ice, e.g. towing, and inadequate communication with home laboratories. Land stations, ice camps, moored and drifting instrument packages, observatories such as the recently initiated North Pole observatory, atmospheric sampling with airplanes or balloons, under-ice sampling with submarines or remote vehicles, and satellite remote sensing will also continue to be essential for adequate data collection in polar systems. In the future, research in polar oceans will increasingly involve multi-investigator, multidisciplinary, and multiple platform expeditionary programs. Recent examples are the JGOFS Southern Ocean Program, the 1994 Arctic Ocean Section (AOS), and the 1997-1998 Surface Heat Budget of the Arctic Ocean (SHEBA). The SHEBA project, in particular, provided a platform for sampling the central, ice-covered Arctic Ocean for an entire year, including the winter. Lack of data during winter is an ocean-wide problem; this is especially true for polar environments in which ice and weather conditions preclude operation of most existing ships. The addition of the new U.S. Coast Guard research icebreaker Healy extends the research capabilities and scientific options for polar investigations. January 31, 2001 Ships for near-future research in polar systems thus will need to meet requirements of 1) increase in number of P.I.'s and projects, particularly in the Arctic, 2) increasing infrastructure needs, including servicing of remote moorings, observatories, and ice camps, 3) under-ice sampling and sampling during the polar winter, and 4) large, multi-disciplinary projects. The SHEBA project, in which a Canadian ice-breaker frozen into the permanent Arctic ice pack served as the support hub of ice huts and instrument packages deployed around it, was a resounding success. This could be a model for future ship-ice camp expeditions. U.S. Arctic research in particular could also benefit from international cooperation in major projects, in terms of personnel and platforms, particularly with the Canadians.

Discussion about over arching goals, prioritization and justification:

Science justification for science upgrades to the POLARs. Provide SMRs and list of needed improvements as a target for SLEP. Iterative process to determine what can be accomplished. This can be refined during the design spiral. Start with the requirements and science justification and then respond to proposals.

Formal report structure outlined as follows:

Executive Summary
Overview
- Arctic science justification
- Antarctic logistics justification and impact on science
- Antarctic science

Missions or Science themes
- NSF science
- Other National requirements and programs
- International collaborations
  - (U.S. North pole expeditions have always been international collaborations)

Overall science objectives for SLEP
Should be a general-purpose ship that can do seismic work and mapping or consider one truly general purpose and one more specialized (?).
Increased Availability/Reliability of the POLAR Class Vessels (Availability for science is determined by availability for logistics support among many other things)
Lab space and quality
Deck space amount
Habitability
Station keeping
Systematic continuous underway data collection in all oceans and both poles
Wish List (edited and organized around SMRs)
Recommendations:

- The need to SLEP, replace POLARS or consider other options should be carefully evaluated, evaluate the costs of different options using historical data on fuel usage and other costs.

- Include upgrading science capabilities in any plan, consider various options to achieve this goal.
- Develop an SMR for converted POLAR Class vessel
- Develop an SMR for additional Arctic science icebreaker
- Review the Franklin conversion for lessons learned

Conclusions and Caveats

- Sooner is better, time for decision and funding is now.
- Coast Guard recognizes the impending train wreck, seriously considering SLEP options and this is an opportunity to also improve the science capabilities.

Appendix IV. References

Tim Cowles, Larry Atkinson, " Assessment of Future Science Needs in the Context of the Academic Oceanographic Fleet". Proceedings of An NSF-sponsored Workshop, Oregon State University, Corvallis, OR., August 2000. Online: http://www.unols.org/fic/

NSF/OPP web site, 2003, http://www.nsf.gov/od/opp/

Presentations from Workshop, Online: June 2003, http://www.unols.org