National Science Foundation

Office of Polar Programs Advisory Committee

Subcommittee on U.S. Antarctic Program Resupply

James Swift, Chair
Ed Link, co-Chair
Sridhar Anandakrishnan
Sam Feola
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(report was submitted August 2005)

USAP is healthy; producing good science; meeting objectives.

Well-honed logistics network successfully supports USAP.

Present logistics system is reaching its limits; e.g., annual energy expenditure is now near maximum annual delivery by one tanker.

Offload 25,000,000 liters at McMurdo

USAP McMurdo Fuel Use

11% used at South Pole Station

12% used to support remote field sites

19% used by icebreakers

22% used for flights to/from South Pole

36% used at or near McMurdo Station

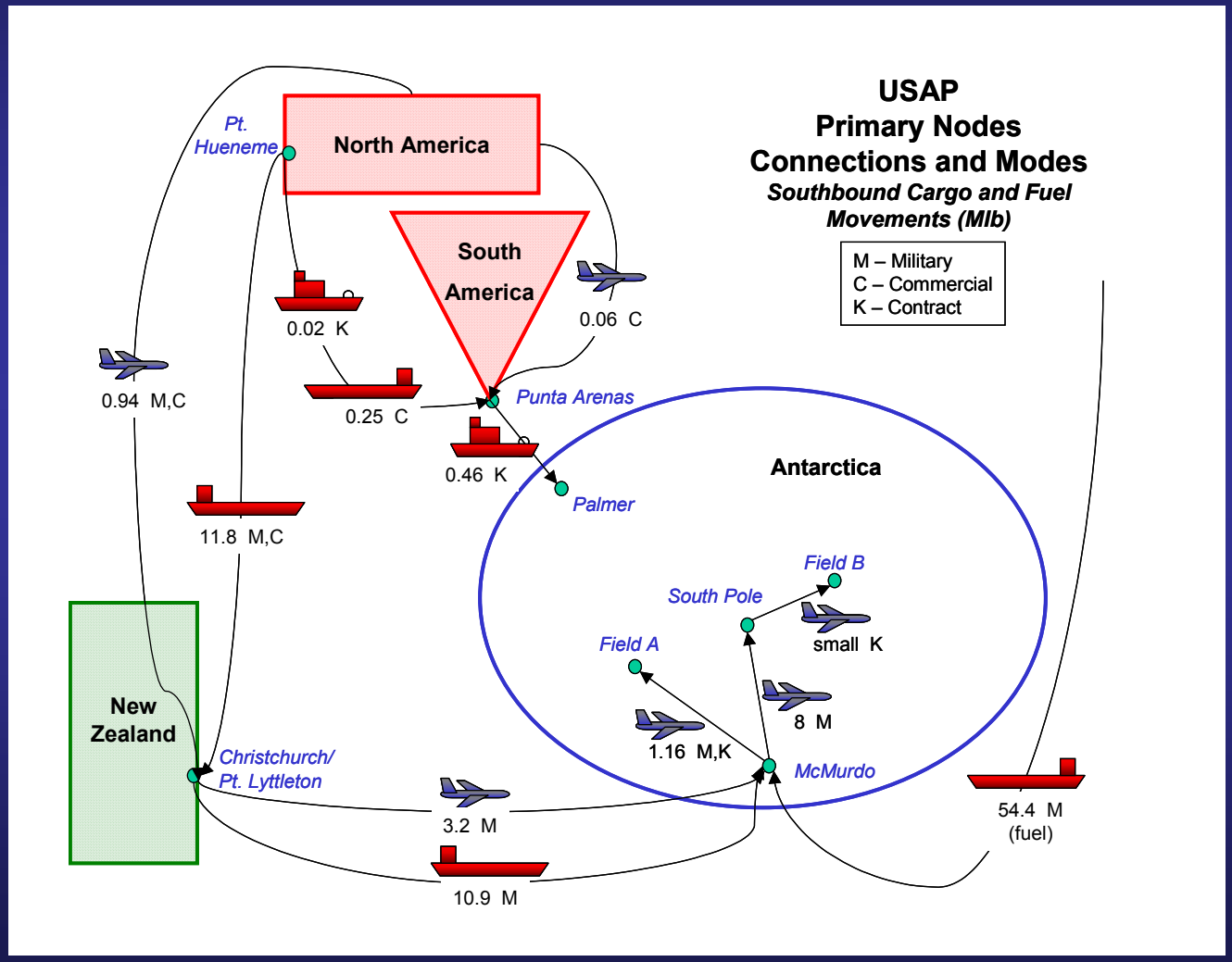
Only 36% of the fuel delivered to McMurdo Station is used directly by McMurdo Station and in support of McMurdo-area science, with an additional 12% supporting remote sites.

22% goes to deliver 11% of the fuel (plus cargo and people) to South Pole Station.

19% is used by icebreakers which must refuel at McMurdo.

Note that 52% of the fuel delivered to McMurdo Station each year is not literally required to be delivered for use there.

There is a now a complete dependence of South Pole Station on resupply through McMurdo Station. Annual delivery of large amounts of materials are presently required there, without fail, to maintain the US Antarctic Program.



Present-day USAP deliveries of cargo and fuel.

Wake-Up call #1:

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TIFF (LZW) decompressor
are needed to see this picture.

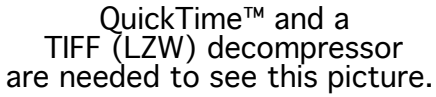
Wake-Up Call #2:

The only US ships able to support the McMurdo break-in under the heaviest conditions are USCGC Polar Star (1976) and Polar Sea (1978)

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

The Polar class icebreakers were designed to guarantee access to McMurdo every year. (Assisted by Healy in 2003 and Krasin in 2005.)

But the Polars require extensive maintenance to carry out a rapidly dwindling remaining number of McMurdo break-in missions.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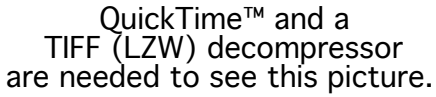
USCGC Healy is not ideal for McMurdo break-in support.

Also it is not yet clear if Healy's operations tempo can be enhanced to support both Antarctic break-in and 200+ days of Arctic science.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Instead of focusing only on potential problems, what if we envision the resupply system which might best support some future USAP?

Support field work in locations remote from bases.

"Just in time" logistics tuned to current needs.

Move people and cargo to where they are needed, from outside Antarctic where feasible.

Continued robust science at South Pole Station and continued support from McMurdo and Palmer stations.

Increase the availability of energy for science without additional fuel, personnel, etc. on Continent.

OPP Advisory Committee Report (continued)

Recommendation #1: Develop a comprehensive systems approach to Antarctic icebreaking in order to alleviate the single point of failure inherent in the current mode, and to reduce operating, maintenance, and fuel costs.

In the near term this should include commercial sources, backed up by the US Coast Guard icebreakers, which are at present to be maintained by NSF.

A *new McMurdo-capable icebreaker may be required* to meet future logistical needs of the USAP.

Commercial business models should be examined (possibly involving the private sector) considering procurement and/or operation of that icebreaker.

OPP Advisory Committee Report (continued)

Recommendation #2: Study the feasibility of constructing a *wheeled-aircraft capable runway at South Pole Station* to support direct flights to the South Pole from off-Continent.

50 C-17 missions from New Zealand would accomplish South Pole resupply at 20-25% of the current cost. Also reduces McMurdo fuel requirement and makes LC-130 flights available for direct science support.

Recommendation #3: Continue to develop traverse capability.

Recommendation #4: *Improve ability of McMurdo Station to operate with one missed ship-borne delivery*. Increase fuel storage, improve efficiency, move some services off-Continent.

Definitions of Ships Operating on Ice-covered Waters

- *Ice Strengthened—Vessel able to operate in very open pack ice (less than 3/10 concentration) and first-year ice less than 50 centimeters thick; ship structurally strengthened around the waterline with a conventional or non-icebreaking bow form; safe navigation possible only under escort by an icebreaker.*
- *Ice-capable—Vessel able to operate in first-year pack ice up to 8/10 concentration and 1 meter thick; ship structurally strengthened around the waterline, has an icebreaking bow and has more horsepower than required for transit through ice-free waters; usually designed with adequate power to break continuously 30 centimeters of first-year level ice.*
- *Polar Research Vessel—An ice-capable vessel specifically designed for and dedicated to research; areas of operations include the marginal ice zone and unconsolidated pack ice of the summer melt season; most ships can continuously break up to 50 centimeters of first-year level ice.*
- *Polar Icebreaker—Vessel designed specifically to operate independently in the polar regions in both first-year and multi-year ice; ship structurally strengthened throughout, has an icebreaking bow and has greatly increased horsepower and displacement for continuous icebreaking in 10/10 concentration; polar icebreakers can continuously break a range of ice thicknesses between 1 and 2.5 meters; the estimated world fleet in 1985 is 34 ships.*
- *Subarctic Icebreaker—Vessel designed for icebreaking operations on seasonally ice-covered coastal seas and lakes; ship structurally strengthened around the waterline, has an icebreaking bow and can operate in areas of first-year ice up to 1.5 meters thick; areas of operations include the Great Lakes, Baltic Sea, and coastal regions of Canada, Alaska, and the USSR.*
- *Polar Research Icebreaker—Vessel that incorporates the ice capabilities of a polar icebreaker and the science capabilities of a polar research vessel; has extensive facilities to support oceanographic, meteorological and ice research in the Arctic and Antarctic; capable of continuously breaking a minimum of 1 meter level ice; West Germany's* Polarstern *is the sole example.*

Polar Icebreaker Roles and U.S. Future Needs: A Preliminary Assessment

Committee on the Assessment of U.S. Coast Guard Polar Icebreaker Roles and Future Needs

Polar Research Board
Division on Earth and Life Studies

Marine Board
Transportation Research Board

National Research Council of the National Academies

The National Academy Press <www.nap.edu>

Committee on the Assessment of U.S. Polar Icebreaker Roles and Future Needs

Project Scope

Polar icebreakers capable of operating in ice are essential for the United States to conduct operations in the Antarctic and the Arctic regions. This study will assess the role of Coast Guard polar icebreakers in supporting United States operations in the Antarctic and the Arctic, including scenarios for continuing those operations and alternative approaches, the roles of polar icebreakers in the support of and conduct of programs that support various national priorities, and potential changes in the roles of Coast Guard icebreakers in the Arctic that may develop due to environmental change.

Committee on the Assessment of U.S. Polar Icebreaker Roles and Future Needs

STUDY SCHEDULE

April – June	**Committee Nominations and Selection Process**
August 25-26 2005	**1st meeting**: Orientation. Discuss statement of task and plan study strategy. Briefings from sponsor and sources of information. Outline interim report content.
Oct 6-7	**2nd meeting:** Briefings from stakeholders. Further identify important sources of information. Begin drafting interim report with preliminary findings.
Nov 3-4	**3rd meeting:** Continue briefings. Writing session.
November	Interim Report compiled. Committee review. External review. Response to review
November 30	***Interim Report Delivery***
Jan – Feb 2006	**4th meeting**: Committee continues with addressing Statement of Task issues in full. Outline final report. Information gathering; writing assignments; solicit stakeholder input.

STUDY SCHEDULE (continued):

March - April 2006	**5th meeting**: Information gathering; writing assignments; draft preliminary conclusions and recommendations
May – June	**6th meeting:** Information gathering; writing assignments; finalize preliminary conclusions and recommendations
July	Final Report complied. Committee review; finalize findings. Committee sign-off that report is ready for review.
July - August	**External Review:** Final Report prepared, cleared by NAS, and sent to external review (2 weeks).
August	**Response to Review:** Committee response to review comments (email and teleconferences). Final editing. Academy RRC approval that final report is acceptable for release. Preparation of prepublication copies.
September 2006	***Final Report Delivery.*** Report conveyed to Congress, US Coast Guard, and public release. Dissemination activities as needed.
December 2006	Published volume available. Additional dissemination as needed.

Committee on the Assessment of U.S. Polar Icebreaker Roles and Future Needs

Anita Jones - Chair - professor, computer science (U Virginia); former Director of Defense Research and Engineering

VAdm Albert Baciocco Jr. -former head, Department of the Navy research and technology development

RAdm Jeffrey Garrett - US Coast Guard; first captain of USCGC Healy

Julie Brigham-Grette - Professor of Geosciences (Amherst)

Rita Colwell - former Director, National Science Foundation

Hajo Eicken - Associate Professor (sea ice physics), Univ. of Alaska

Jackie Grebmeier - Research Professor (U Tennessee); PRB; former U.S. Arctic Research Commission

Chuck Kennicutt - Director of Sustainable Development (TAMU), vice president of SCAR

Ron Kiss - President Emeritus of Webb Institute; involved with DARPA and Maritime Administration

Doug MacAyeal - professor, Geophysical Sciences (U. Chicago); Antarctic ice shelves

RAdm Robert North - former USCG; consultant, international and domestic maritime safety, security and environmental protection regulatory issues; Healy acquisition

Capt. Ray Pierce - Canadian Coast Guard - various roles, including Regional Director Ship Safety, Regional Director General of the Northern Central and Arctic Regions

Steve Scalzo - private sector (Marine Resources Group); past member of the NRC Marine Board

Dave St.Amand - maritime industry consultant; economics of petroleum shipping, incl. Alaskan North Slope

Jim Swift - Research Oceanographer (UCSD/SIO); former AICC (founding Chair)

NAS Staff: Maria Uhle, Bev Huey, Liz Galinis

Statement of Task

1. Assess the roles of U. S. Coast Guard icebreakers in supporting United States operations in the Antarctic and the Arctic and provide an analysis of the overall demand for icebreaking services, including:

a. Describe present uses of polar icebreakers with respect to the relevant missions in the Antarctic and Arctic, including national defense, homeland security, support of economic activity, law enforcement, search and rescue, environmental protection, and the support of and conduct of science;

b. Describe expected future needs for polar icebreakers, such as where and when the polar icebreakers will be expected to operate and what capabilities will be needed in order to accomplish all missions in the polar regions.

c. Determine the approximate number and types of Coast Guard polar icebreakers needed in the future and when and where they might be expected to operate to meet national priority concerns in the polar regions.

Statement of Task (continued)

2. Present and analyze a small number of feasible scenarios for continuing polar icebreaker operations in the polar regions, including service life extension of existing Coast Guard icebreakers, replacement of existing Coast Guard icebreakers, and alternate methods of meeting identified needs (e.g., re-supply of McMurdo Station and availability of platforms for marine research) including use of ice-strengthened vessels, foreign vessels, and other options that do not use Coast Guard services.

Statement of Task (continued)

3. Describe potential changes in the roles and missions of Coast Guard polar icebreakers in support of future marine operations in the Arctic that may develop due to environmental change, including the amount and kind of icebreaking support that may be required in the future to support marine operations in the Northern Sea Route and the Northwest Passage and the type of polar icebreakers that might be needed for these new roles.

4. Review existing laws governing Coast Guard polar icebreaking operations and present recommended changes based upon potential missions and new operating regimes.

US Interests and Needs discussed by OPP/AC, ARVOC and AICC (not from NRC Icebreaker Panel):

Need polar icebreaker support for USAP resupply (McMurdo).

Need one Gould-like ship to maintain Palmer Station.

Antarctic marine research fully uses two ice-capable ships (Gould and Palmer), with some overflow onto Polar-class (& foreign?). Future US Antarctic marine research may require a 'super-Palmer' (better icebreaking & winter capabilities and much more science oriented than Polar-class).

US Arctic break-in requirement (Thule) is currently met by Canada.

US Arctic marine research currently uses one polar icebreaker (Healy) plus some foreign icebreakers; will fully utilize the ARRV.

Two polar icebreakers, working together, are required for central Arctic Ocean research missions.

(Submarines can provide valuable but limited data.)

"Recommendation #1: The United States should reliably control (by ownership or other means) at least one heavy icebreaker that is available and capable of breaking a channel into McMurdo Station."

"Recommendation #2: The United States should maintain dedicated, year-round icebreaker capability for the Arctic to support national security interests as well as science."

"Recommendation #3: In the short term, the required maintenance should be performed to make at least one Polar Class ship mission capable over the next 4 to 8 years."

"Recommendation #4: In the short-term, the management of the U.S. polar icebreakers should reside with the U.S. Coast Guard, and it should have the appropriate operational and maintenance budget to fulfill Coast Guard missions that require icebreaking."

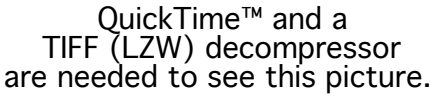
"Recommendation #5: In the short-term, the NSF should revert to being a user and should continue to negotiate financial agreements to pay for icebreaker services when U.S. Coast Guard ships are employed."

"The Committee will investigate the mix of icebreaking capabilities and numbers of icebreaking ships that are required to meet [US] needs over the *long-term*."

"The Committee will investigate whether multipurpose or single purpose assets are required to efficiently meet the nation's long-term icebreaking needs and identify a range of options to efficiently manage and operate these ships over the next several decades."

"The Committee will investigate the options for acquiring icebreaking capabilities including, but not limited to, a full service life extension program for one or both existing heavy icebreaking ships, construction of one or more new ship(s), and alternate methods of meeting identified needs (e.g., use of ice-strengthened vessels, hiring foreign vessels, and other options that do not use Coast Guard services)."

"The Committee will specifically investigate the future needs for polar icebreaking to support national security issues, especially in the light of the potential environmental and economic changes in the Arctic."



What icebreaker fleet is required to meet US needs?