United States General Accounting Office

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Report to the Ranking Minority Member, Subcommittee on VA, HUD, and Independent Agencies, Committee on Appropriations, U.S. Senate

May 1995

NATIONAL SCIENCE FOUNDATION

Need for Additional Icebreaking Research Vessel Not Demonstrated

GAO/RCED-95-77

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-259759

May 12, 1995

The Honorable Barbara Mikulski
Ranking Minority Member
Subcommittee on VA, HUD,
and Independent Agencies
Committee on Appropriations
United States Senate

Dear Senator Mikulski:

The Arctic Ocean is one of the least explored regions of the world. Furthermore, this region is believed to play a key role in global climate systems, world fishery production, and other natural phenomena. The U.S. Coast Guard currently provides and operates icebreakers in support of the nation's Arctic research program.

The National Science Foundation (NSF) received funds in fiscal year 1993 to begin design work on an icebreaking research ship (the proposed vessel) and subsequently sought funds to acquire the vessel. As agreed with your office, this report examines the justification for the proposed vessel. Also, as requested, we are providing you with information on NSF's analysis of the costs of buying versus leasing the proposed vessel. (See app. I.)

Results in Brief

NSF has not adequately justified the need for the proposed $120 million icebreaking vessel. A 1990 interagency study of national icebreaker needs called for a fleet of four icebreakers, three of which are currently in operation. The fourth icebreaker is being built for the Coast Guard to serve primarily as an Arctic research vessel and was designed with input from the scientific community. Although research needs in the Arctic have evolved since 1990, NSF and the scientific community have not demonstrated a net increase in icebreaker requirements sufficient to justify a fifth icebreaker. Currently, the existing icebreaker fleet is underutilized, and no research cruises in the Arctic region are planned for 1995 or 1996, primarily because of funding constraints. Recognizing the need to update requirements for Arctic research and icebreaker support, NSF contracted with the National Research Council of the National Academy of Sciences to study this issue. A report on the study's findings is expected during the summer of 1995.

Many Arctic scientists justify the acquisition of the proposed vessel on the grounds that the Coast Guard is unwilling and unable to provide efficient and reliable support to research activities in the Arctic region. While these criticisms have merit, they are not convincing, given recent improvements in the Coast Guard's commitment and ability to support research in the region.

Background

Awareness of the environmental and economic importance of the Arctic region is growing. The Arctic region is a very harsh operating environment, making research expensive and risky. NSF is the largest federal provider of funds for research in this region.[1] The U.S. Coast Guard, part of the Department of Transportation, is charged with providing and operating icebreakers to meet U.S. military, logistic, and research needs in the Arctic and Antarctic regions. From 1966 to 1991, the U.S. Coast Guard operated the nation's icebreakers.[2] The mission of the Coast Guard's Ice Operations Division, Office of Navigation Safety and Waterways Services, includes assisting other governmental and scientific organizations in scientific research and supporting national interests in the polar regions. Investigators representing or sponsored by universities, private institutions, and government agencies—including the Office of Naval Research, the U.S. Geological Survey, and the National Oceanic and Atmospheric Administration—conduct research aboard the Coast Guard icebreakers.

The Arctic Research and Policy Act of 1984, as amended, calls for coordination among agencies over the use of logistics resources, including icebreakers, in the conduct of research. The act established the Arctic Research Commission to promote research in the Arctic region and to recommend Arctic research policy. Also under the act, responsibility for promoting the coordination of all Arctic research activities among agencies, including logistics (e.g., icebreaker support), rests with the Interagency Arctic Research Policy Committee. The Committee is headed by NSF and includes the Coast Guard among its members. Furthermore, in a 1987 agreement aimed at minimizing conflict and serving national interests, NSF and the Coast Guard pledged "to plan together, to the maximum extent possible, for the use of U.S. [Coast Guard] icebreakers in the support of polar research."

[1]NSF's mission is to promote and advance scientific progress.

[2]In 1991, NSF funds were used to lease the newly constructed Antarctic icebreaking research vessel, the Nathaniel B. Palmer. The vessel is operated for the oceanographic research community by a private contractor under a long-term lease.

The Arctic research community has sought a vessel dedicated to Arctic research for many years. The Arctic Research Commission recommended that such a vessel be acquired. The Interagency Arctic Research Policy Committee echoed this recommendation. Beginning in 1987, the scientific community, through the University National Oceanographic Laboratory System (UNOLS),[3] used funds from NSF to study the requirements for, and possible designs of, an Arctic research vessel. Comments from the Arctic scientific community from 1990 to 1992, discussions in the Interagency Arctic Research Policy Committee, and other forums were used to define the characteristics of the vessel. From 1990 to the present, NSF and UNOLS, working with a private engineering firm, developed preliminary designs for Arctic research vessels of increasing size and icebreaking capability. The first design called for a 200-foot vessel with modest icebreaking capability whose estimated cost was about $40 million. After the Arctic scientific community reviewed and commented on this design, it was agreed that a larger vessel with greater icebreaking capacity was needed. Accordingly, a 340-foot vessel was designed with significant icebreaking capability and the capacity to perform 90-day missions in the Arctic region. This vessel is expected to cost about $120 million.

Need for Proposed Vessel Not Demonstrated

Acquisition of the proposed vessel is not supported by a quantified analysis of the nation's requirements for icebreakers or by the scientific community's criticism of the Coast Guard's support for research. Moreover, records of actual and projections of future icebreaker use suggest that a fifth icebreaking vessel may not be needed.

Proposed Vessel Not Justified by Quantified Analysis of Icebreaker Needs

A 1990 interagency study of national polar icebreaker requirements (PIRS),[4] the most recent such quantified study, did not call for the construction of the proposed vessel. NSF justifies the proposed vessel on the grounds that (1) Arctic research needs are increasing and (2) the United States does not have a vessel dedicated to Arctic research. However, NSF has not demonstrated that another icebreaker is required to meet research needs.

The study documented the nation's icebreaker requirements and recommended a fleet of four icebreakers. These are the

- Polar Sea and Polar Star (currently operating Coast Guard icebreakers);

[3]An association of organizations with ocean science research programs.

[4]"Polar Icebreaker Requirements," October 1990. The study is a collaborative effort by the Departments of Transportation and Defense, NSF, and the Office of Management and Budget.

- Nathaniel B. Palmer (an Antarctic icebreaking research vessel); and
- Michael A. Healy (a planned Coast Guard icebreaker).

The proposed vessel would be the fifth U.S. icebreaker, one more than recommended by the 1990 study. Funds for the Healy have been approved, and the vessel is scheduled to begin duty in 1998. According to Coast Guard officials, the Healy will serve primarily as an Arctic research vessel except when circumstances require its use elsewhere.[5]

To determine icebreaker requirements, the 1990 study quantified operational and research mission needs. To quantify needs, the number of days icebreakers were required to accomplish the missions was totaled. Operational missions consisted of the annual resupply of the Thule Air Force Base in Greenland[6] and the McMurdo Antarctic research station (an NSF mission), as well as treaty inspection duties in the Antarctic. Research requirements for icebreaker support were also quantified and used in the study. However, these requirements do not reflect subsequent changes in users' needs, such as the military's reduced needs for icebreaker services resulting from the end of the Cold War and other agencies' increased needs attributed to higher priorities for Arctic research. Areas of increased research emphasis include Arctic fisheries, because of concern over fluctuating fish catches, and Arctic water quality, because of concern over radionuclide and other contamination originating in the former Soviet Union.

The scientific community has produced several reports recommending the acquisition of an icebreaking vessel dedicated to Arctic research. None of these reports attempts to justify the proposed vessel by comparing the realistic demand for icebreakers to be used for research with the availability of existing and planned Coast Guard icebreakers. Reports of the Polar Research Board of the National Academy of Sciences, the U.S. Arctic Research Commission, and the Interagency Arctic Research Policy Committee justify an additional vessel on the basis of (1) the increasing (although not quantified) needs for research in the Arctic and (2) the observation that the United States does not possess a vessel dedicated to Arctic research. These reports do not balance the increased needs for icebreakers to support research with the decreased needs for icebreakers

[5]For example, the Coast Guard told us that if its other icebreakers were unexpectedly unavailable, it would send the Healy to resupply McMurdo Station, Antarctica.

[6]The Coast Guard has arranged with the Canadian government to have the Canadian Coast Guard provide support for resupplying the Thule Air Force Base. However, the Coast Guard must be prepared to resume this duty on 1 year's notice. In the meantime, this arrangement makes an icebreaker available for about 60 days per year, potentially for assignment to research missions.

to support defense missions. Nor do the reports state why existing and planned Coast Guard icebreakers, whose missions include supporting Arctic research, cannot meet these needs. Finally, the reports do not consider where the additional funding for research will be obtained to fully employ a five-icebreaker fleet.

To address these shortcomings, NSF requested that the National Research Council, which is affiliated with the National Academy of Sciences, examine the scientific community's needs for icebreaker support and how they can best be met. Neither the NSF program manager nor the study's director is certain whether the study will attempt to quantify the needs for icebreakers to support research in the Arctic. Planning for the study began in November 1994, and the final results are expected in the summer of 1995.

The potential for underutilizing existing and planned Coast Guard icebreakers has led that agency to oppose the construction of the proposed vessel. Both the actual use of Coast Guard vessels for research in the Arctic over the past 4 years and the projected use in 1995 and 1996 are lower than estimated in the 1990 study. Coast Guard records for 1994 show 83 days of icebreaker use for the Arctic research of NSF and others, compared with the 143 days of use projected for NSF's research in the 1990 PIRS. Furthermore, no use of Coast Guard vessels for research in the Arctic region is scheduled, or likely, for 1995. Prospects for a scientific mission in 1996 are not good, according to Coast Guard and NSF officials, because of funding constraints.

Coast Guard's Shortcomings Not Compelling Justification for Vessel, Given Recent Improvements

Many in the Arctic scientific community justify the acquisition of the proposed vessel on the grounds that the Coast Guard, because it has multiple missions, does not possess the desire, skills, or facilities to provide adequate support for Arctic science. However, this justification is not convincing, given improvements in the Coast Guard's commitment and ability to support research in the region.

Some Arctic scientists assert that the Coast Guard values its other missions over supporting science. As a result, say these scientists, the Coast Guard lacks the desire to ensure the successful completion of scientific cruises to the Arctic. For example, supporting the U.S. military is a significant and traditional Coast Guard mission. The Coast Guard's adherence to this mission may result in approaches and goals on cruises that differ from those of the scientists on board. For instance, the strict

chain of command on Coast Guard vessels has made communication between the chief scientist and the Captain of the vessel cumbersome, limiting flexibility in the accomplishment of research. Scientists, on the other hand, are generally not accustomed to seeking authorization for minor changes in the conduct of research projects.

In recent years, the Coast Guard has placed greater emphasis on its role in supporting science. This increased priority is evidenced by an agreement between the Coast Guard and NSF on support for polar research, Coast Guard directives concerning such research, and a decline in the military mission for the Coast Guard's icebreaker fleet. The Coast Guard's operating authority includes supporting oceanographic research as a Coast Guard mission. In addition, in 1987, the Coast Guard pledged in an agreement with NSF to maintain trained personnel and icebreakers with adequate facilities to support polar research. Also, following an unsuccessful and contentious scientific cruise in 1991, high-ranking Coast Guard officials, including the Commandant, issued several directives stressing the importance of supporting Arctic science as a Coast Guard mission. Finally, Coast Guard officials in the Division of Ice Operations observed that the scientific mission has taken on added importance for the Coast Guard icebreaker fleet as emphasis on the military mission for these vessels has declined. Arctic scientists who participated in scientific cruises aboard Coast Guard icebreakers have noted significant improvements in the willingness of Coast Guard personnel to work with and support scientists.

However, many Arctic scientists have maintained that Coast Guard personnel lack the skills necessary to adequately support research in the Arctic. Furthermore, some of the scientists believe that acquiring the proposed vessel would allow them to employ a crew that is highly skilled in supporting research. Scientists also point to Coast Guard rotation policies that prevent personnel from acquiring and maintaining skills in planning scientific cruises, navigating and maneuvering in ice, and maintaining and operating scientific equipment, such as oceanographic winches.

The Coast Guard recognizes these shortcomings and has taken steps to address them. First, to represent the needs of scientists before the Coast Guard, the agency created a position for a liaison with the civilian scientific community at the icebreakers' home port of Seattle, Washington. This representation includes ensuring that scientists' needs are met when the vessels are prepared for scientific cruises. Second, the Coast Guard

arranged with the Canadian Coast Guard for an informal officer exchange/training program to improve the officers' skills and began sending new officers on trips aboard the icebreakers to familiarize them with icebreaker operations. In addition, the liaison has arranged training for Coast Guard technicians with equipment manufacturers on the proper use of scientific equipment found aboard the icebreakers.

Some Arctic scientists believe that the two currently operating Coast Guard icebreakers are unreliable and lack necessary scientific facilities. The scientists cite mechanical failures that have hindered or prevented the completion of research projects. Scientists also cite poor laboratory facilities and research equipment as limiting research opportunities.

The Coast Guard has taken steps to enhance the reliability of its two icebreakers and boost their basic scientific capabilities. First, the Coast Guard strengthened and rebuilt the faulty propeller hubs on the icebreakers to improve their reliability.[7] From 1987 to 1992, the two icebreakers underwent the Polar Science Upgrade Project to improve the scientific capabilities of both vessels. This project upgraded laboratory spaces, oceanographic instrumentation, and communication equipment and provided new oceanographic and trawling winches. These upgrades improved the vessels' ability to support Arctic research. In addition, beginning in the spring of 1995, the Coast Guard plans to conduct midlife refits of its two existing icebreakers as part of the Reliability Improvement Project, which is designed to correct original design flaws and replace deteriorated and outdated equipment, although it will not result in further significant upgrades of scientific equipment and facilities.

In addition to improving its two existing icebreakers, the Coast Guard is acquiring another icebreaker with significant research support capabilities. The Healy was justified and designed, in part, to support polar research. Coast Guard officials told us that the Healy will be used primarily as an Arctic research vessel. Compared with the two existing Coast Guard icebreakers, this icebreaker will provide significantly improved facilities for supporting science. Although the Healy was justified largely as a research vessel, the Coast Guard requires that it be capable of supporting other Coast Guard missions, namely, annually breaking the channels to allow the resupply of Thule Air Force Base,

[7]Despite the Coast Guard's efforts to redesign the propeller hubs, a propeller failed during a research trip to the north pole over the summer of 1994. This breakdown contributed to the failure to complete one of the research projects planned for that trip. The Coast Guard noted that such failures are not uncommon when propellers are operating in the high Arctic in heavy ice.

Greenland,[8] and McMurdo Station, Antarctica. Accordingly, the Healy was designed with greater icebreaking and seakeeping capabilities than the vessel proposed by NSF.[9]

The Arctic scientific community is largely dissatisfied with the design compromises the Coast Guard made to the Healy. As a result, some scientists believe that the vessel's overall design does not adequately reflect the scientific community's needs and suggestions for changing the vessel's design. The scientists point to factors such as an outdated hull design, poor fuel efficiency (high costs), and an inefficient deck layout resulting from the engines' placement as areas that the scientists had rejected. The Coast Guard maintains that the hull's design is not outdated and that, while it may not be the most efficient icebreaking design, it is necessary to ensure the Healy's open-ocean transit capability. The Coast Guard conferred with leading Arctic scientists when designing the scientific facilities for the Healy through a survey and during several meetings. Some of the scientists' suggestions were incorporated into the vessel's design. For example, the arrangement of laboratory spaces was changed, and hatch sizes were increased to accommodate scientific equipment. However, the scientific community was not consulted on the vessel's basic design. According to Coast Guard officials, the procurement of the Healy involved the use of performance-based specifications that were defined in consultation with the user community. The officials said that the shipbuilder relied heavily on consultants who had designed and built the majority of the world's icebreakers.

Conclusions

NSF and the Arctic scientific community have not demonstrated that the proposed vessel is needed. The most recent (1990) quantified assessment of national icebreaker requirements did not support a need for the proposed vessel. Reports identified by NSF as justifying the acquisition of the proposed vessel cite only increasing research needs and the lack of a dedicated research icebreaker without quantifying those needs and explaining why the current arrangement with the Coast Guard is inadequate. NSF recognizes the deficiencies in its justification for the proposed vessel, as evidenced by its recently contracting with the National Research Council, affiliated with the National Academy of Sciences, to study the need for icebreakers to support polar research. Furthermore, the

[8]The Coast Guard has arranged with the Canadian Coast Guard to perform this task in return for the United States' agreeing to help protect Canadian shipping interests in the western Arctic.

[9]Seakeeping refers to the stability and motion of a vessel traveling across open, and potentially rough, stretches of ocean. This quality is important for the Healy because of the requirement that it be capable of steaming to Antarctica—a roughly 35-day open-ocean passage from Seattle, Washington.

Coast Guard improved its responsiveness to the needs of the scientific community, enhanced the capabilities of existing vessels, and is building a vessel whose primary mission is to support Arctic research. Further cooperation between the Coast Guard and the scientific community should facilitate more cost-effective research and the achievement of other national goals in the Arctic region.

Agency Comments and Our Evaluation

NSF provided written comments on a draft of this report. (See app. III for NSF's comments and our evaluation of them.) NSF had three general comments: (1) the agency does not agree with our conclusion that NSF and the scientific community have not demonstrated the need for the proposed vessel; (2) the agency believes that final judgment on the need for a dedicated Arctic research vessel should be deferred until the National Academy of Sciences has completed its study of this issue; and (3) the agency recognizes that interagency communication must be improved.

We disagree with NSF's assessment that adequate need for the proposed vessel has been demonstrated. In our view, though scientific needs are important, fiscal constraints and the capacity of existing and planned icebreakers with scientific capability have not been taken into account when justifying an Arctic research vessel. We agree with NSF that the National Academy of Sciences' study is important. We note that our report is not, nor does it purport to be, the final judgment on the acquisition of an Arctic research vessel. We also support NSF's efforts to improve interagency cooperation in order to increase the effective use of resources for Arctic research.

We discussed a draft of this report with Department of Transportation officials, who generally agreed with our findings and conclusions. On the basis of NSF's comments and our discussion with Transportation officials, we have made changes to our report, where appropriate.

In examining the justification for the proposed vessel, we reviewed the Arctic Research Policy Act, as amended, and other relevant laws, regulations, and publications. We also reviewed the 1984 and 1990 Polar Icebreaker Requirements studies; relevant congressional testimony; correspondence from and for NSF and the Coast Guard; Coast Guard policies and procedures; design reports for the proposed Arctic research vessel and the planned Coast Guard icebreaker Healy; and data on the use of icebreakers. We interviewed officials from the Coast Guard, NSF, the

U.S. Geological Survey, and the U.S. Navy's Naval Sea Systems Command and Office of Naval Research. We also interviewed officials from the University of Alaska and other universities and research institutions. Finally, we interviewed officials from the Arctic Research Commission, the University National Oceanographic Laboratory System, and the Polar Research Board of the National Academy of Sciences. Appendix II contains a more detailed discussion of our objectives, scope, and methodology. We conducted our review between June and December 1994 in accordance with generally accepted government auditing standards.

We will send copies of this report to the Director, National Science Foundation; the Secretary of Transportation; the Commandant of the Coast Guard; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

If you have any questions or need additional information, please contact me at (202) 512-3841. Major contributors to this report are listed in appendix IV.

Sincerely yours,

Victor S. Rezendes
Director, Energy and
Science Issues

Contents

Abbreviations

FOFCC	Federal Oceanographic Fleet Coordinating Committee
GAO	General Accounting Office
NAS	National Academy of Sciences
NSF	National Science Foundation
OMB	Office of Management and Budget
PIRS	1990 Polar Icebreaker Requirements Study
UNOLS	University National Oceanographic Laboratory System

NSF's Lease-Buy Analysis for the Proposed Vessel

The Ranking Minority Member, Subcommittee on VA, HUD, and Independent Agencies, Senate Committee on Appropriations, asked us to examine the National Science Foundation's (NSF) analysis of options for buying and leasing the proposed Arctic research vessel.[10] We found that NSF's analysis closely follows the Office of Management and Budget's (OMB) guidelines and shows buying as the best option. However, because the analysis is necessarily preliminary, NSF plans to solicit both purchase and lease proposals, should it proceed in acquiring the proposed vessel.

As required by OMB Circular A-94, NSF compared the cost to the federal government of two different methods of financing the proposed vessel: (1) full purchase of the vessel and (2) long-term leasing from a private builder/operator, covering its 20-year expected life.[11] This analysis, which took into account both construction and operating costs, found that the federal government would have the least cost if it purchased the proposed vessel. However, because the design phase is preliminary, the cost estimates represent only rough approximations of the proposed vessel's costs. Moreover, in order to compare the expected costs of leasing and buying, NSF needed to make several simplifying assumptions.[12]

While NSF's analysis conforms reasonably well to the OMB guidelines for lease-purchase comparisons, the analysis is based on preliminary cost estimates and relies on a variety of assumptions for which alternative hypotheses might be reasonable as well. In addition, assumptions also needed to be made for key variables, such as private sector borrowing costs on maritime loans. Moreover, because of the difficulty of determining a unique methodology for analyzing more complex forms of financing, such as a lease with an option to buy, or some cost sharing that might be offered by the state of Alaska, NSF's analysis does not include all relevant options.

[10]We reviewed the methodology NSF used to compare the relative costs of the proposed vessel under the buy and lease options. However, we did not independently verify or validate the cost estimates NSF used in its analysis. Appendix II contains additional details on our scope and methodology.

[11]Two other financing methods that have been considered but were not included in NSF's cost analysis are (1) a lease with an option to buy and (2) the procurement of the vessel with cost sharing by the state of Alaska. NSF officials told us that these additional financing methods could be structured in many different ways—for example, different years in which the buy could be exercised in the lease with an option to buy, or a variety of ways that the state could share the costs of the vessel—and thus, a straightforward methodology for comparing these financing options was not clear.

[12]These assumptions include, for example, that the building and basic operating costs of the vessel are the same under both the lease and the buy scenarios and that if the vessel is leased, the private sector firm finances all of the building costs through debt and none through raising equity.

The cost advantage of government purchase over long-term leasing of the vessel is related to two factors. First, under a lease arrangement, the costs of private sector financing—which are higher than the government's borrowing costs—are passed on to the federal government in lease payments, thereby increasing the vessel's financing costs over what they would be under outright government purchase.[13] Second, NSF assumed that the cost of building the vessel is the same under both the buy and the lease scenarios, but that under the lease arrangement, an additional profit accrues to the lessor for services related to its retained ownership of the vessel. Under the base-case analysis, roughly half of the cost advantage of purchasing over leasing is related to the gap in federal and private sector borrowing costs, and the remainder is related to the assumption of an additional profit stream to the lessor.

NSF's base-case estimates use a 5.8-percent government borrowing rate because that was the federal Treasury rate on 20-year bonds (a time horizon equal to the expected life of the vessel) as of early 1994. The cost of private sector capital was assumed to be 8.5 percent.[14] In this case, NSF found the advantage of purchase over lease to be $55.7 million in present-value terms. NSF also looked at the sensitivity of the advantage of purchase over lease by using alternative interest rates for both the government and private sector borrowing costs. Throughout these analyses, government purchase was favored over leasing, but the range by which purchase was advantageous ranged from $22.9 million to $99.6 million, each in terms of present value.[15]

[13]Because a shipbuilder/lessor will have a long-term lease arrangement for the vessel with the federal government, it may be able to obtain private sector borrowing at a rate not much higher than the federal Treasury rate. Moreover, if some degree of construction or ownership risk is transferred to the shipbuilder/lessor and managed efficiently, the effective economic cost of the lease to the government could fall below that of outright purchase—even though private sector borrowing is more expensive than public sector borrowing. While OMB's guidelines are sufficient for budgetary purposes, the difficulty of valuing risk and of valuing it under different sharing arrangements between the government and private entities, makes the economic evaluation of lease-buy analyses less certain.

[14]Both of these rates are as of early 1994. NSF officials told us that they assumed the private sector borrowing costs to be the prime rate plus 200 basis points. Although the prime rate has risen considerably since NSF did this analysis, the government borrowing cost has risen as well. Since the important conclusions derive largely from the relationship of these two rates, the basic conclusion of the analysis should generally not change as interest rates rise or fall.

[15]While NSF's analysis uses three alternative private-sector interest rates, its final results for the lease/purchase cost comparison were based only on the midpoint of these rates. At the same time, NSF used a range of government borrowing rates (3.8 to 7.8 percent) in producing its final results. The numbers presented here are based on the full range of private sector interest rates NSF examined (7.5 to 9.5 percent). As a result, the range by which purchasing the proposed vessel was advantageous to the government was broader.

NSF's decision to delay choosing a method of financing the proposed vessel until after bids are solicited from shipbuilders for any of several financing options is appropriate. After bids are solicited, NSF will need to perform a financial analysis similar to the one it has performed, but it will then have the advantage of performing such an analysis on more detailed data derived from the bid solicitation.

Objectives, Scope, and Methodology

To determine whether the proposed vessel has been justified, we reviewed the Arctic Research Policy Act, as amended; other relevant laws and regulations; findings and recommendations of the Arctic Research Commission and the Interagency Arctic Research Policy Committee; the University National Oceanographic Laboratory System (UNOLS) Fleet Improvement Plan Update; and several other publications. We also reviewed the 1984 and 1990 Polar Icebreaker Requirements studies; relevant congressional testimony; correspondence from and for NSF, the Coast Guard, and UNOLS; Coast Guard policies, procedures, and Arctic research cruise reports; design reports for the proposed Arctic Research Vessel and the planned Coast Guard icebreaker Healy; and icebreaker usage and research cost data. We also obtained written statements from NSF and the Coast Guard on the appropriateness of agencies other than the Coast Guard acquiring and operating icebreakers.

In addition, we interviewed officials at Coast Guard headquarters in Washington, D.C.; Seattle, Washington; and Alameda, California. We also interviewed NSF officials from the Office of Polar Programs, Oceanographic Centers and Facilities Section, Budget Division, and officials from the U.S. Geological Survey, the U.S. Navy's Naval Sea Systems Command, and Office of Naval Research.

We interviewed officials from the University of Alaska, the University of Washington, Texas A&M University, the Lamont Dougherty Earth Observatory, and companies that conduct Arctic research. In addition, we interviewed officials from the Arctic Research Commission, the University National Oceanographic Laboratory System, and the Polar Research Board of the National Academy of Sciences.

In order to evaluate NSF's analyses of leasing versus buying the proposed vessel, we reviewed OMB Circular A-94 and NSF's own analysis of the lease-buy option. We did not independently verify and validate the cost data that NSF used in the analyses, but rather, given NSF's cost estimates for building and operating the vessel, we reviewed the methodology NSF used to compare the costs of leasing with the costs of buying. In addition, we talked with OMB officials.

Comments From the National Science Foundation

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

OFFICE OF THE
DEPUTY DIRECTOR

February 17, 1995

Mr. Victor S. Rezendes
Director, Energy and Science Issues
Resources, Community, and Economic Development Division
General Accounting Office
Washington, DC 20548

Dear Mr. Rezendes:

This letter and enclosures are the response of the National Science Foundation to the proposed report entitled *National Science Foundation: Need for Additional Icebreaking Research Vessel Not Demonstrated* (GAO/RCED-95-77). With respect to the examination of our analysis of the costs and benefits associated with various acquisition strategies for an Arctic research vessel, we are pleased to note that Appendix I of your report states that NSF's analysis closely follows Office of Management and Budget (OMB) guidelines. The report also states that NSF's decision to delay choosing a method of financing from a range of financing options until after bids are solicited from shipbuilders is appropriate.

See p. 9.

We disagree with the report's conclusion regarding the need for a new vessel to be used for Arctic research as expressed in the proposed title of the report, as well as with the assessment of a number of factors leading to that conclusion. We continue to believe that scientific merit and need should drive the discussion about the appropriate ocean-going platform for the conduct of research. In our view, a scientifically outfitted research vessel has superior capabilities to icebreakers designed for other purposes. Our concerns are stated in enclosures accompanying this letter.

Arctic ocean science research has been identified as warranting the highest priority by the Arctic Research Commission and the Interagency Arctic Research Policy Committee, which I chair. The National Academy of Sciences currently is conducting a review and evaluation of the scientific requirements for an Arctic research vessel in the context of national research needs in the Arctic Ocean regions. The report of this review is expected late in 1995. We expect that all issues of concern for national planning by NSF, the U.S. Coast Guard, and other federal agencies will be addressed in this study. While many previous reviews have substantiated the need for a vessel, we believe that final judgments regarding the need for a dedicated Arctic research vessel should be deferred until that study is complete.

See p. 9.

See p. 10.

We recognize that interagency communication must be improved, and we are committed to strengthening our partnerships with other agencies. In doing so, we will continue our efforts improving the way that we actively cooperate in Federal government efforts to serve the nation. We therefore intend to renew efforts to develop effective means for coordination among agencies like NSF and the U.S. Coast Guard and the scientific community in order to facilitate more cost-effective planning and achievement of research and other national goals in the Arctic region.

Sincerely,

Neal Lane

Neal Lane
Director

Enclosures

Enclosure 1

General Comments Regarding the GAO Report on a Proposed Arctic Research Vessel

Analysis of Acquisition Strategies

In language accompanying the FY 1994 appropriation for the National Science Foundation, Congress called for "a report from the General Accounting Office on the costs and benefits associated with various acquisition strategies including lease, purchase, debt financing and other mechanisms which could be pursued by the NSF or its institutional operator." This charge is addressed in Appendix I of the report. We are pleased to note that the report found that NSF's analysis closely follows Office of Management and Budget (OMB) guidelines and that NSF's decision to delay choosing a method of financing from a range of financing options until after bids are solicited from shipbuilders is appropriate.

GAO Analysis of the Demonstration of Need for a Dedicated Arctic Research Vessel

Arctic oceans research is necessary to provide a sound basis for developing national and international policy on Arctic resources and for understanding the role of the Arctic region in global environmental change. The Arctic Ocean is a unique environment, characterized by a deep, permanently ice-covered central ocean basin surrounded by seasonally ice-covered shelves and marginal seas. The Arctic Ocean and adjacent seas play a key role in global climate systems and are very sensitive to environmental change. The vast continental shelves of the Arctic marginal seas have enormous impacts on the biology, chemistry, and physics of the ocean. The Arctic shelves contain some of the richest commercial fisheries in the world as well as large populations of birds and marine mammals. The full extent of the natural resources of the Arctic is poorly known, because the Arctic Ocean is critically undersampled.

The most severe limitation to accomplishing the research is limited access to the ice-covered Arctic Ocean and seasonally ice-covered marginal areas. Although the U.S. Coast Guard has allowed its icebreakers to be used for research purposes, the United States has no dedicated Arctic research vessel. In an extensive series of studies and reports, Arctic research scientists have repeatedly stated that the absence of a properly configured vessel that can conduct research at times dictated by scientific needs has seriously inhibited the advancement of our understandings of this critical environment. A research vessel providing all-season access to the Arctic region is essential for many proposed studies and is an indispensable component of a modern and efficient academic research fleet required to maintain U.S. leadership in polar sciences.

The needs, priorities and capabilities required for an Arctic research vessel have been examined in National Academy of Sciences studies in 1982, 1989, and 1991 and in the University-National Oceanographic Laboratory System (UNOLS) academic fleet requirement studies of 1990 and 1995. In several reports, the U.S. Arctic Research Commission emphasizes the need for an Arctic research vessel. Long-range science plans developed by both the Directorate for Geosciences and

See comment 1.

Office of Polar Programs at NSF have identified an Arctic research vessel as a facilities priority. An expanded list of studies and recommendations by national advisory groups is attached (Enclosure 2). This list demonstrates the comprehensive endorsement and involvement of the research community with the NSF planning process. We are unaware of any comparable studies addressing U.S. Coast Guard military icebreaker programs.

See comment 2.

We believe the report misinterprets the roles of the U.S. Coast Guard and the National Science Foundation with respect to the acquisition and operation of research vessels for use in Arctic settings. The National Science Foundation Act of 1950 (42 USC δ1861 et seq.) gives NSF broad authority to support scientific activities and to acquire and lease or loan "real and personal property of all kinds." Under that authority, NSF has acquired research vessels and provided funding to NSF awardees for research vessels. An example of this exercise of authority was the recent support for chartering of the *Nathaniel B. Palmer*, a research vessel with ice-breaking capability dedicated to Antarctic research.

See comment 3.

We believe that substitution of the term "icebreaker" for "Arctic research vessel" in the report's title and throughout the text of the report may have lead to incorrect conclusions. The report appears to imply that any ship capable of breaking through ice can be considered a research vessel and that any time when an icebreaker is not being used for some other purpose, it is available for research. Neither conclusion is justified, however. In order to conduct the broad range of scientific inquiries identified by leading Arctic scientists, a vessel must have adequate instruments, equipment, and performance capabilities. To simply cut through ice to get to a research site is inadequate if the vessel is unable to serve as a platform for the planned scientific research. The report noted that scientists were dissatisfied with the design and projected operating costs of the Coast Guard's proposed new icebreaker, the *Michael A. Healy*, but the report discusses that proposed vessel and the existing Coast Guard icebreakers as if they were equally acceptable research platforms to a vessel designed expressly for the conduct of Arctic research.

See comment 4.

The inability of scientists to be able to schedule their work with any kind of certainty seriously inhibits the conduct of many important projects. Some scientists have planned research that can be accomplished whenever Coast Guard vessels are available, but many important projects require that vessels be available at specific times. These kinds of projects often fail to proceed beyond the early planning stages because uncertainty about the availability of an adequate research vessel makes them too risky. The lower-than-expected number of days that Coast Guard icebreakers were used for research in recent years and their limited expected scientific use in 1995 and 1996 does not reflect a reduced need as is implied in the report. With a dedicated vessel, scientists and NSF staff could make plans and allocate funds for specific projects with much greater certainty.

See comment 5.

Taken together, the design limitations of the current and planned Coast Guard icebreakers and the difficulty of the Coast Guard to provide vessels for scientific research on a scheduled basis for research provide strong evidence of the need for a research vessel dedicated to Arctic research. The benefits of having a comparable vessel in the oceans surrounding Antarctica are becoming apparent as the results of studies conducted during its initial voyages are published. Inadequately configured icebreakers that may or may not be available when needed cannot serve a comparable role in support of Arctic research.

Enclosure 1, Page 2

See comment 6.

We believe the most relevant study for assessing the needs and requirements for an Arctic research vessel is the 1993 revision of the *U.S. Arctic Research Plan*. This plan, which was mandated by the Arctic Research and Policy Act, recognizes the need for both Coast Guard icebreakers and an Arctic research vessel. Section 4 of that plan indicates that Coast Guard icebreakers serve a role in support of Arctic research, but the plan also describes a need for a ship specifically designed for the conduct of Arctic oceanographic research. The two Coast Guard icebreakers currently operating are general-purpose icebreakers and were designed primarily to support military operations. Because of their configuration, age, and the ever-present potential for diversion to non-scientific missions, the existing Coast Guard icebreakers do not meet the needs stated in the plan for a dedicated Arctic research vessel. The vessel currently planned for construction by the Coast Guard is not well designed to serve as a dedicated, year-round Arctic research vessel. What the Arctic Research Plan implicitly recognizes is that some science missions, particularly those in the central Arctic, will require two ships with ice-breaking capabilities for safety reasons. One of these would be the more powerful Coast Guard icebreaker and the other would be the Arctic research vessel. For research conducted in less-dangerous Arctic waters, however, the Arctic research vessel would be the ship of choice.

The Utility of the Current National Academy of Sciences Study

See comment 7.

We agree that careful consideration of current scientific needs and resources is warranted. As part of our ongoing planning process, the National Academy of Sciences is conducting a review and evaluation of the scientific requirements for an Arctic research vessel in the context of national research needs in the Arctic Ocean regions. The NAS study, which is being jointly conducted by the Ocean Studies Board and Polar Research Board, includes a reassessment of past studies, a comprehensive analysis of all Arctic facilities and their roles in meeting science requirements, and recommendations for national planning and coordination. The structure and timeframe of the review calls for an interim report to NSF in August 1995, with a final report available by October 1995. This study will provide a current assessment of science needs, the roles of NSF and other agencies, the resources available and needed for research programs, including evaluations of their operating costs, and management options. We believe that all issues of concern for national planning by NSF, the U.S. Coast Guard, and other federal agencies will be addressed in this study. We believe that final judgments regarding the need for a dedicated Arctic research vessel should be deferred until that study is complete and its results are published.

Enclosure 1, Page 3

Enclosure 3

Discussion of Specific Statements in the GAO Report Regarding the Arctic Research Vessel

- " A 1990 interagency study of national polar icebreaker requirements, the most recent such study, did not call for the construction of the proposed vessel."

  Response: The 1990 "Polar Icebreaker Requirements" report was based on a 1988 Federal Oceanographic Fleet Coordination Council (FOFCC) report. The focus was specifically on the U.S. Coast Guard, because funds for an additional icebreaker were included in the 1990 Defense Appropriations Act.

  The most recent report on Federal Oceanographic Fleet requirements was published in August 1990 by FOFCC. The report identifies requirements for 395 days per year for an Arctic research vessel from NSF, NOAA, ONR and the Naval Oceanographic Office. U.S. Coast Guard icebreaker requirements for the Arctic are 167 days from NOAA, NSF, ONR, USGS, USCG and the Naval Oceanographic Office. The NSF requirements are for 180 days of Arctic research vessel time and 30 days of USCG icebreaker time in an average year.

  The 1990 FOFCC report included the recommendation for NSF to construct a vessel capable of supporting oceanographic research in the Arctic.

See comment 8.

- "The potential for underutilization of existing and planned Coast Guard icebreakers has led that agency to oppose the construction of the proposal vessel".

  Response: The US Coast Guard participated as member of the Arctic research vessel design study. Coast Guard officials have not indicated to NSF management in any formal manner, either through direct communication or during discussions of the Interagency Arctic Research Policy committee, their opposition to the acquisition of the Arctic research vessel

See comment 9.

- "The Coast Guard has taken steps to enhance the reliability of its two icebreakers...."

  Response: In addition to the 1991 and 1994 breakdowns, both of the Polar-class icebreakers had major propulsion and shaft problems during the 1995 Antarctic deployment in ice conditions less severe than a central Arctic basin deployment.

See comment 10.

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- "The Coast Guard conferred with leading Arctic scientists when designing the science facilities for the *Healy* through a survey and during several meetings.... The science community was not consulted on the vessel's basic design.... They point to factors such as outdated hull design, poor fuel efficiency (high costs), and an inefficient deck layout... as areas where their suggestions were rejected".

  Response: Consultation with the science community by the Coast Guard was minimal, with only two or three *ad hoc* meetings. The science community was not consulted on the basic design, and major comments and concerns regarding the scientific spaces and requirements appear to have been ignored. It is our understanding the *Healy* design does not meet the minimum scientific requirements specified for the Arctic research vessel.

See comment 11.

In summary, NSF believes that the GAO report conclusion that "while these criticisms had merit, they are not convincing, given recent improvements in the Coast Guard's commitment and capability to support research in the region" dismisses a set of serious issues that should be resolved prior to the construction of a new military icebreaker by the U.S. Coast Guard.

See comment 12.

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The following are GAO's comments on the National Science Foundation's letter dated February 17, 1995, in addition to the comments discussed on page 9 of this report.

1. We have reviewed many relevant studies, including those written by the Interagency Arctic Research Policy Committee, the Arctic Research Commission, the Polar Research Board, the University National Oceanographic Laboratory System, and NSF. As we note on pages 4-5 in the report, these studies do not take into consideration the two existing and one planned icebreaker—each of which possesses some research support capabilities. In fact, the planned Coast Guard vessel Healy was partially justified as a research vessel. In addition, according to the Coast Guard, the Healy will serve primarily as an Arctic research vessel. The observation that the United States does not possess a dedicated Arctic research vessel is insufficient justification for spending $120 million to construct the proposed vessel, as well as committing substantial funds to operate and maintain it. NSF also needs to consider fiscal constraints and the availability of existing and planned U.S. Coast Guard icebreakers in assessing icebreaker needs.

2. We disagree with NSF's statement that "the report misinterprets the roles of the U.S. Coast Guard and the National Science Foundation with respect to the acquisition and operation of research vessels for use in Arctic settings." We do not dispute NSF's authority to acquire or lease icebreakers. In our view, the issue is not whether NSF has the authority to acquire the proposed vessel but whether NSF has demonstrated the need for an additional icebreaker.

3. The proposed vessel is an icebreaker. Special consideration was given to the proposed vessel's icebreaking capabilities. For example, the icebreaking requirements for the proposed vessel were increased twice between 1990 and 1994. Our report does not imply that any ship capable of breaking through ice can be considered a research vessel. However, we do state that the two existing Coast Guard icebreakers and the planned vessel Healy, while capable of breaking ice, also have been upgraded or were specifically designed to support research. We agree that none of the three Coast Guard vessels represent the ideal research platform.

We disagree with NSF's view that we discuss the proposed vessel and the existing Coast Guard icebreakers as if they were equal research platforms. On page 7, we state that equipment and other facilities necessary to support science have been added and improved. The largely successful

1994 scientific mission to the Arctic confirms that the existing Coast Guard vessels are capable of supporting the accomplishment of a significant body of Arctic research.

4. We disagree that we imply a reduced need for scientific research in the Arctic. Rather, on page 5 we state that funding constraints have contributed to underutilization of existing Coast Guard vessels.

5. As we note on pages 4-5, neither the design of the Healy nor the availability of Coast Guard vessels are explicitly put forth, with supporting analysis, in the various studies NSF cites in this letter as supporting acquisition of the proposed vessel.

6. The 1993 U.S. Arctic Research Plan mentions the Coast Guard role of supporting Arctic research and describes an Arctic research vessel (the proposed vessel) but does not demonstrate a need for the vessel. NSF states in its comments that the planned vessel Healy is not suited for year-round dedicated research. However, the Coast Guard has stated its intent to make the Healy available for Arctic research 144 days a year. We also note that, according to the 1990 Polar Icebreaker Requirements Study, NSF approved the design of the Healy as a member of the Polar Icebreaker Users Council (an interagency group of icebreaker users that includes NSF). With three Coast Guard icebreakers available, it should be easier to schedule two vessels for central Arctic missions. Again, while it might be ideal to have a dedicated vessel available for research in the less hazardous Arctic waters, the acquisition (about $120 million), maintenance, and operations costs (at least $34,000 per day)—coupled with the costs of maintaining underutilized Coast Guard icebreakers in a state of readiness—raise doubts as to the net benefit to the nation of acquiring the proposed vessel.

7. While it appears that NSF has concluded that the proposed vessel is justified, NSF also states that final judgment should be withheld pending the National Academy of Science's (NAS) study. We believe that our report points to significant issues that must be addressed before any final judgment is made. The report does identify weaknesses in the justifications found in previous studies and will, in our opinion, help to guide the current NAS effort. Accordingly, we are encouraged that the NAS study commissioned by NSF will include an assessment of the roles of NSF and other agencies and the resources available to support Arctic research programs, including evaluations of their operating costs and management options.

8. The 1990 Federal Oceanographic Fleet Coordinating Committee (FOFCC) report that NSF cites is not a study of national icebreaker requirements, of which research is a significant part, as is the 1990 PIRS study we refer to in this report. While NSF criticizes the 1990 Polar Icebreaker Requirements Study (PIRS), NSF, as well as the Departments of Transportation and Defense and OMB, developed that report. The 1990 PIRS study points to a broader scope of national needs and research community needs and not specifically to the Coast Guard vessel. We found the quantitative assessment of icebreaker needs in the 1990 PIRS study persuasive while the 1990 FOFCC study focuses on fleet requirements for a variety of vessel types.

9. Coast Guard officials told us that the agency is opposed to the acquisition of the proposed vessel because of funding constraints that would likely lead to underutilization of existing and planned Coast Guard vessels.

10. We do not dispute the fact that the Coast Guard icebreakers have experienced reliability problems. As we note on page 7, the Coast Guard is continuing efforts to improve the reliability of its two existing icebreakers.

11. As we note on pages 7-8, the Coast Guard surveyed the scientific community and held meetings that included officials from NSF and UNOLS. Although the Healy will primarily be used to support Arctic research, it is a multipurpose vessel. So while significant scientific capabilities were designed into the vessel, it is not surprising that it does not meet every scientific requirement laid out by the scientific community for the proposed vessel.

12. We agree that the ability of Coast Guard icebreakers to support Arctic science is a serious issue and the report treats them as such. Referring to the Healy as a military icebreaker is misleading given the multiple missions for which the vessel was designed and the research for which the Coast Guard states the Healy will be used. The Coast Guard stated that the funding for the Healy is in place, the contract for construction of the Healy has been let, and assembly of component parts has begun in several locations. As noted on page 8, the Coast Guard solicited, and, in some cases, implemented input from the scientific community.

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