

CRS Report for Congress

Coast Guard Polar Icebreaker Modernization: Background, Issues, and Options for Congress

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Prepared for Members and
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Summary

Of the Coast Guard's three polar icebreakers, two — Polar Star and Polar Sea — have exceeded their intended 30-year service lives. The Polar Star is not operational and has been caretaker status since July 1, 2006. The Coast Guard has begun initial studies on replacements for Polar Star and Polar Sea. Under the Coast Guard's current schedule, the first replacement ship might enter service in 8 to 10 years.

A 2007 report from the National Research Council (NRC) on the U.S. polar icebreaking fleet states that "U.S. [polar] icebreaking capability is now at risk of being unable to support national interests in the north and the south." Congress, in the explanatory statement for the FY2008 Consolidated Appropriations Act (H.R. 2764/P.L. 110-161 of December 26, 2007), expressed concern about the Coast Guard's ability to meet its polar operations mission requirements and directed the Coast Guard to submit a comprehensive report on the issue.

The Coast Guard estimates that new replacement ships might cost \$800 million to \$925 million each in 2008 dollars, and that the alternative of extending the service lives of Polar Sea and Polar Star for 25 years might cost about \$400 million per ship.

Potential policy issues for Congress regarding Coast Guard polar icebreaker modernization include the numbers and capabilities of polar icebreakers the Coast Guard will need in the future; whether to provide these icebreakers through construction of new ships or service life extensions of older ships; whether to accelerate the Coast Guard's current schedule for acquiring replacement ships; whether new ships should be nuclear powered; whether new ships should be funded in the Coast Guard budget or the Department of Defense (DOD) budget; and whether, as an interim measure, the Polar Star should be repaired and placed back into service.

Congress's options regarding Coast Guard polar icebreaker modernization include but are not limited to the following: approving the Coast Guard's current plan; holding hearings to solicit additional information on the issue; directing the Coast Guard to include the option of nuclear power in its studies of requirements for future icebreakers; directing the Coast Guard to pursue a particular acquisition strategy for icebreaker modernization; accelerating the procurement of new icebreakers relative to the Coast Guard's current plan; funding the procurement of new icebreakers in the DOD budget rather than the Coast Guard budget; and directing the Coast Guard to reactivate Polar Star. This report will be updated as events warrant.

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Coast Guard Polar Icebreaker Modernization: Background, Issues, and Options for Congress

Introduction

Polar icebreakers can operate in the extreme conditions of, and break through the thick ice found in, the Arctic Ocean and the waters surrounding Antarctica. Of the Coast Guard's three polar icebreakers, two — Polar Star and Polar Sea — have exceeded their intended 30-year service lives. The Polar Star is not operational and has been caretaker status since July 1, 2006.¹ The Coast Guard's third polar icebreaker — Healy — is much younger and in operational condition, but has less icebreaking capability than the other two ships.

The Coast Guard has begun initial studies on replacements for Polar Star and Polar Sea. Under the Coast Guard's current schedule, the first replacement ship might enter service in 8 to 10 years. Until then, the Coast Guard plans to continue operating Polar Sea and Healy while keeping Polar Star, for the time being at least, in caretaker status as a reserve asset.

A 2007 report from the National Research Council (NRC) on the U.S. polar icebreaking fleet states that “Over the last decade, some routine maintenance on [Polar Star and Polar Sea] has been deferred due to a lack of funds and no major life extension program has been planned; as a consequence, U.S. [polar] icebreaking capability is now at risk of being unable to support national interests in the north and the south.”²

Congress, in the explanatory statement for the FY2008 Consolidated Appropriations Act (H.R. 2764/P.L. 110-161 of December 26, 2007), expressed concern about the Coast Guard's ability to meet its polar operations mission requirements in light of the condition of the Coast Guard's polar icebreaker fleet, and directed the Coast Guard to submit a comprehensive report on polar operations.

The issue for Congress that is addressed in this report is whether to approve or modify the Coast Guard's plans for modernizing its polar icebreakers. Congressional decisions on this issue could affect the Coast Guard's ability to perform its polar missions, Coast Guard funding requirements, and the U.S. shipbuilding industrial base.

¹ Source for July 1, 2006, date: U.S. Coast Guard email to CRS on February 22, 2008.

² National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, p. 2.

The issue of polar icebreaker modernization comes at a time of

- increased interest and activities in polar regions, particularly the Arctic, due to melting of Arctic ice;
- emerging debates over Arctic sovereignty and exclusive economic zones (EEZs) in the Arctic;
- concerns about the Coast Guard's ability to perform all of its various missions within available resources; and
- concerns for the U.S. shipbuilding industrial base.

Regarding the first two items above, many observers anticipate that the melting of Arctic ice in coming years will open up potentially important sea transportation routes through the Arctic and make it possible (or easier) to explore for oil and other resources in the region. Emerging debates over Arctic sovereignty and EEZs in the Arctic stem to a large degree from these anticipated developments. Russia, Canada, Denmark, and the United States in the last few years, and particularly since the summer of 2007, have been taking various actions to either assert their claims regarding Arctic sovereignty and EEZs, or to gather evidence to support potential claims.³

The scope of this CRS report is limited to the question of Coast Guard polar icebreaker modernization. Other CRS reports over other issues relating to the polar regions.⁴

³ For additional discussion, see, for example, Scott G. Borgerson, "Arctic Meltdown, The Economic and Security Implications of Global Warming," *Foreign Affairs*, March/April 2008; Caitlin Harrington, "Eyeing Up the New Arctic," *Jane's Defence Weekly*, January 16, 2008: 22-27; Richard Burgess, "The New Cold War?," *Seapower*, October 2007: 14-16, 18; David Pugliese, "Wake Up Call?," *Seapower*, October 2007: 19-20, 22; Deborah Zabarenko, "U.S. Resumes Mapping Of Arctic Seabed," *Washington Times*, August 15, 2007; Ian Austen, "Canada Announces Plans For 2 New Bases In Its Far North," *New York Times*, August 11, 2007; "Canada To Strengthen Arctic Claim," *BBC News*, August 10, 2008; C. J. Chivers, "Russians Plant Flag on the Arctic Seabed," *New York Times*, August 3, 2007; and Fred Weir, "As Icecaps Melt, Russia Races For Arctic's Resources," *Christian Science Monitor*, July 31, 2007.

⁴ See, for example, CRS Report RL33941, *Polar Bears: Proposed Listing Under the Endangered Species Act*, by Eugene H. Buck, CRS Report RL32838, *Arctic National Wildlife Refuge (ANWR): Legislative Actions Through the 110th Congress, First Session*, by Anne Gillis, M. Lynne Corn, and Beth A. Roberts, CRS Report RL34266, *Climate Change: Science Update 2007*, by Jane A. Leggett, and CRS Report RS21890, *The U.N. Law of the Sea Convention and the United States: Developments Since October 2003*, by Marjorie Ann Browne.

Background

Missions of U.S. Polar Icebreakers

The missions of U.S. polar icebreakers can be summarized as follows:

- conducting and supporting scientific research in both the Arctic and Antarctic;
- defending U.S. sovereignty in the Arctic by maintaining a presence in the region;
- defending other U.S. interests in polar regions, including economic interests relating to the U.S. exclusive economic zone (EEZ) north of Alaska;
- monitoring sea traffic in the Arctic, including ships bound for the United States; and
- conducting other typical Coast Guard missions (such as search and rescue, law enforcement, and protection of marine resources) in Arctic waters, including U.S. territorial waters north of Alaska.

The mission of conducting and supporting scientific research includes, among other things, an important annual mission to break through the Antarctic ice so as to resupply McMurdo Station, the large U.S. Antarctic research station located on the shore of MucMurdo Sound, near the Ross Ice Shelf.

Although polar ice is melting due to climate change, observers generally expect this development will not eliminate mission demands for U.S. polar icebreakers, and in some respects might increase them. Even with the melting of polar ice, there are still significant ice-covered areas in the polar regions. Melting of polar ice could lead in coming years to increased commercial ship, cruise ship, and naval surface ship operations, as well as increased exploration for oil and other resources, in and through the polar regions — activities that could require increased levels of support from polar icebreakers. Changing ice conditions in Antarctic waters have made the McMurdo resupply mission more challenging since 2000.⁵

Current U.S. Polar Icebreakers

The U.S. polar icebreaker fleet currently includes four ships — three Coast Guard ships and one ship operated by the National Science Foundation. The ships are described briefly below, and then summarized in **Table 1**.

⁵ National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, pp. 6-7, 14, 63.

Three Coast Guard Ships. The Coast Guard's three polar icebreakers are multimission ships that can break through ice, support scientific research operations, and perform other missions typically performed by Coast Guard ships.

Polar Star and Polar Sea. Polar Star (WAGB-10) and Polar Sea (WAGB-11),⁶ sister ships built to the same general design, were procured in the early 1970s as replacements for earlier U.S. icebreakers. They were designed for 30-year service lives, and were built by Lockheed Shipbuilding of Seattle, WA, a division of Lockheed that also built ships for the U.S. Navy, but which exited the shipbuilding business in the late 1980s.

The ships are 399 feet long and displace about 13,300 tons.⁷ They are the world's most powerful non-nuclear-powered icebreakers, with a capability to break through ice up to 6 feet thick at a speed of 3 knots. In addition to a crew of 134, each ship can embark a scientific research staff of up to 20 people.

Polar Star. Polar Star was commissioned into service on January 19, 1976, and consequently is now beyond its intended 30-year service life. The ship currently is not in operational condition due to worn out electric motors and other problems. The Coast Guard placed the ship in caretaker status on July 1, 2006. Under caretaker status, the Coast Guard is retaining the ship as a non-operational asset with a potential for being reactivated. The ship is assigned a reduced crew of 34, and the ship's major mechanical problems are not being repaired.⁸ As discussed later in this report, the ship would require millions of dollars of maintenance and repair work to be returned to service.

A March 24, 2008 press report stated:

Time is running out for the Coast Guard to maintain its full fleet of three polar-capable icebreakers under the government's two-headed funding system for the ships, Coast Guard Commandant Adm. Thad Allen said Monday [March 24, 2008], as top officials in the lifesaving service prepare to make a case for what they need to operate in the "new" warmer Arctic.

The Coast Guard splits responsibility for its icebreakers with the National Science Foundation, which under a 2006 law pays to run and maintain the ships, albeit with Coast Guard crews, after they were designated as primarily for research purposes. But starting next year, the NSF doesn't plan to continue paying to maintain the oldest ship, the Polar Star, which has been in reserve

⁶ The designation WAGB means Coast Guard icebreaker. More specifically, W means Coast Guard ship, A means auxiliary, G means miscellaneous purpose, and B means icebreaker.

⁷ By comparison, the Coast Guard's new National Security Cutters — its new high-endurance cutters — are about 418 feet long and displace roughly 4,000 tons.

⁸ The Coast Guard's official term for the ship's current status is "In Commission, Special."

status since 2006. With no funding, the Polar Star would lose its skeleton crew and its capability to become operational with about 12 months' notice.⁹

Polar Sea. Polar Sea was commissioned into service on February 23, 1978, and thus recently exceeded its intended 30-year life. The ship is in operational condition but due to its age requires increasing amounts of maintenance to remain in operation.

Healy. Healy (WAGB-20) was procured in the early 1990s as a complement to Polar Star and Polar Sea, and was commissioned into service on August 21, 2000. The ship was built by Avondale Industries, a shipyard located near New Orleans, LA, that has built numerous Coast Guard and Navy ships, and which now forms part of Northrop Grumman Shipbuilding.

Healy is a bit larger than Polar Star and Polar Sea — it is 420 feet long and displaces about 16,200 tons. Compared to Polar Star and Polar Sea, Healy has less icebreaking capability, but more capability for supporting scientific research. The ship can break through ice up to 4½ feet thick at a speed of 3 knots, and embark a scientific research staff of up to 50. The ship is used primarily for supporting scientific research in the Arctic.

One National Science Foundation Ship. The nation's fourth polar icebreaker is Nathaniel B. Palmer, which was built for the National Science Foundation (NSF) in 1992 by North American Shipbuilding, of Larose, LA. The ship, called Palmer for short, is owned by Edison Chouest Offshore (ECO) of Galliano, LA, a firm that owns and operates research ships and offshore deepwater service ships.¹⁰ NSF uses a contractor, Raytheon Polar Services Company (RPSC), to lease the ship from ECO.¹¹ Palmer is considerably smaller than the Coast Guard's three polar icebreakers — it is 308 feet long and has a displacement of about 6,500 tons. It is operated by a crew of about 22, and can embark a scientific staff of 27 to 37.¹²

Unlike the Coast Guard's three polar icebreakers, which are multimission ships, Palmer was purpose-built as a single-mission ship for conducting and supporting scientific research in the Antarctic. It has less icebreaking capability than the Coast Guard's polar icebreakers, being capable of breaking ice up to 3 feet thick at speeds

⁹ Philip Ewing, "CG Steps Up Bid to Rescue Icebreaker Funding," *Navy Times*, March 24, 2008.

¹⁰ For more on ECO, see the firm's website at [<http://www.chouest.com/>].

¹¹ For more on RPSC, see the division's website at [<http://rpsc.raytheon.com/>]

¹² Sources vary on the exact number of scientific staff that can be embarked on Palmer. For some basic information on the ship, see:

[<http://www.nsf.gov/od/opp/support/nathpalm.jsp>],

[<http://www.usap.gov/vesselScienceAndOperations/contentHandler.cfm?id=22>],

[http://www.usap.gov/vesselScienceAndOperations/documents/prvnews_june03.pdf],

[<http://nsf.gov/od/opp/antarct/treaty/pdf/plans0607/15plan07.pdf>],

[<http://www.nsf.gov/pubs/1996/nsf9693/fls.htm>], and

[<http://www.hazegray.org/worldnav/usa/nsf.htm>].

of 3 knots. This capability is sufficient for breaking through the more benign ice conditions found in the vicinity of the Antarctic Peninsula, to resupply Palmer Station, a U.S. research station on the peninsula. Some observers might view Palmer not so much as an icebreaker as an oceanographic research ship with enough icebreaking capability for the Antarctic Peninsula. Palmer's icebreaking capability is not considered sufficient to perform the MucMurdo resupply mission.

Summary. In summary, the U.S. polar icebreaking fleet currently includes one ship that is used primarily for scientific research in the Arctic (Healy), one ship that is used for scientific research in the Antarctic (Palmer), one ship that can operate in either polar area and is capable of performing the challenging McMurdo resupply mission (Polar Sea), and a fourth ship with similar capabilities that is not in operational condition and is in caretaker status (Polar Star).

Table 1. U.S. Polar Icebreakers

	Polar Star	Polar Sea	Healy	Palmer
Operator	USCG	USCG	USCG	NSF
U.S.-Government owned?	Yes	Yes	Yes	No ^a
Currently in operational condition?	No (caretaker status)	Yes	Yes	Yes
Entered service	1976	1978	2000	1992
Length (feet)	399	399	420	308
Displacement (tons)	13,300	13,300	16,200	6,500
Icebreaking capability (ice thickness in feet) at 3 knots	6 feet	6 feet	4.5 feet	3 feet
Crew (when operational)	134 ^b	134	67	22
Additional scientific staff	20	20	50	27-37

Sources: Prepared by CRS using data from U.S. Coast Guard, National Research Council, National Science Foundation and (for Palmer) additional online reference sources.

a. Owned by Edison Chouest Offshore (ECO) of Galliano, LA, and leased to NSF through Raytheon Polar Services Company (RPSC).

b. Currently assigned a caretaker crew of 34.

2007 National Research Council Report

The most recent major study relating to Coast Guard polar icebreakers is the 2007 National Research Council (NRC) report, *Polar Icebreakers in a Changing World: An Assessment of U.S. Needs*, which assessed roles and future needs for Coast

Guard polar icebreakers.¹³ The NRC is a part of the National Academies. The study was completed in 2006 and published in 2007. Some sources refer to the study as the 2006 NRC report.

Origin of Study. The study was required by report language accompanying the FY2005 Department of Homeland Security (DHS) appropriations act (H.R. 4567/P.L. 108-334).¹⁴ A hearing on the report was held by the Coast Guard and Maritime Transportation subcommittee of the House Transportation and Infrastructure Committee on September 26, 2006.

Conclusions and Recommendations. The NRC report makes the following conclusions and recommendations:

The [study] committee finds that both operations and maintenance of the polar icebreaker fleet have been underfunded for many years, and the capabilities of the nation's icebreaking fleet have diminished substantially. Deferred long-term maintenance and failure to execute a plan for replacement or refurbishment of the nation's icebreaking ships have placed national interests in the polar regions at risk. The nation needs the capability to operate in both polar regions reliably and at will. Specifically, the committee recommends the following:

¹³ National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, 122 pp.

¹⁴ H.R. 4567/P.L. 108-334 of October 18, 2004. The related Senate bill was S. 2537. The Senate report on S. 2537 (S.Rept. 108-280 of June 17, 2004) stated:

The Committee expects the Commandant to enter into an arrangement with the National Academy of Sciences to conduct a comprehensive study of the role of Coast Guard icebreakers in supporting United States operations in the Antarctic and the Arctic. The study should include different scenarios for continuing those operations including service life extension or replacement of existing Coast Guard icebreakers and alternative methods that do not use Coast Guard icebreakers. The study should also address changes in the roles and missions of Coast Guard 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; the suitability of the Polar Class icebreakers for these new roles; and appropriate changes in existing laws governing Coast Guard icebreaking operations and the potential for new operating regimes. The study should be submitted to the Committee no later than September 30, 2005.

The conference report on H.R. 4567 (H.Rept. 108-774 of October 9, 2004) stated:

As discussed in the Senate report and the Coast Guard authorization bill for fiscal year 2005, the conferees require the National Academy of Sciences to study the role of Coast Guard icebreakers.

The earlier House report on H.R. 4567 (H.Rept. 108-541 of June 15, 2004) contained language directing a similar report from the Coast Guard rather than the National Academies. (See the passage in the House report under the header "Icebreaking.")

- The United States should continue to project an active and influential presence in the Arctic to support its interests. This requires U.S. government polar icebreaking capability to ensure year-round access throughout the region.
- The United States should continue to project an active and influential presence in the Antarctic to support its interests. The nation should reliably control sufficient icebreaking capability to break a channel into and ensure the maritime resupply of McMurdo Station.
- The United States should maintain leadership in polar research. This requires icebreaking capability to provide access to the deep Arctic and the ice-covered waters of the Antarctic.
- National interests in the polar regions require that the United States immediately program, budget, design, and construct two new polar icebreakers to be operated by the U.S. Coast Guard.
- To provide continuity of U.S. icebreaking capabilities, the POLAR SEA should remain mission capable and the POLAR STAR should remain available for reactivation until the new polar icebreakers enter service.
- The U.S. Coast Guard should be provided sufficient operations and maintenance budget to support an increased, regular, and influential presence in the Arctic. Other agencies should reimburse incremental costs associated with directed mission tasking.
- Polar icebreakers are essential instruments of U.S. national policy in the changing polar regions. To ensure adequate national icebreaking capability into the future, a Presidential Decision Directive should be issued to clearly align agency responsibilities and budgetary authorities.¹⁵

Coast Guard Perspective. The Coast Guard states it “generally supports” the NRC report, and that the Coast Guard “is working closely with interagency partners to determine a way forward with national polar policy that identifies broad U.S. interests and priorities in the Arctic and Antarctic that will ensure adequate maritime presence to further these interests. Identification and prioritization of U.S. national interests in these regions should drive development of associated USCG [U.S. Coast Guard] capability and resource requirements.” The Coast Guard also states: “Until those broad U.S. interests and priorities are identified, the current USG [U.S. Government] polar icebreaking fleet should be maintained in an operational status.”¹⁶

¹⁵ National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, pp. 2-3.

¹⁶ Source: Coast Guard point paper provided to CRS on February 12, 2008, and dated with the same date, providing answers to questions from CRS concerning polar icebreaker modernization.

Current Coast Guard Plan

As mentioned earlier, the Coast Guard has begun initial studies on replacements for Polar Star and Polar Sea. Under the Coast Guard's current schedule, the first replacement ship might enter service in 8 to 10 years. Until then, the Coast Guard plans to continue operating Polar Sea and Healy while keeping Polar Star, for the time being at least, in caretaker status as a reserve asset. Regarding its current plan for modernizing its polar icebreaker fleet, the Coast Guard states that it:

is awaiting the identification and prioritization of U.S. national policy in the Polar Regions in order to identify and develop the appropriate capability. In the meantime, the CG is proceeding with pre-acquisition activities, starting with project identification, to assess current capability gaps in Coast Guard mission performance in the high latitudes regions.¹⁷

A March 24, 2008 press report states:

[Coast Guard] Commanders in Alaska plan to conduct an unprecedented expedition to the Arctic this summer, including a trip already underway by the Healy, to get a clear sense of their capabilities and problems operating above the Bering Strait. When that survey is finished, probably by August, [Coast Guard Commandant Admiral Thad] Allen and the commander of District 17, Rear Adm. Arthur "Gene" Brooks, will be able to make their case to Congress for funding and new gear, Allen said.¹⁸

Cost Estimates for Certain Modernization Options

The Coast Guard has provided CRS with cost estimates for four potential options for modernizing the Coast Guard's polar icebreaker fleet:¹⁹

New Replacement Ships. The Coast Guard estimates that new replacement ships for the Polar Star and Polar Sea might cost between \$800 million and \$925 million per ship in 2008 dollars to procure. The Coast Guard says that this estimate:

is based on a ship with integrated electric drive, three propellers, and a combined diesel and gas (electric) propulsion plant. The icebreaking capability would be equivalent to the POLAR Class Icebreakers [i.e., Polar Star and Polar Sea] and research facilities and accommodations equivalent to HEALY. This cost includes all shipyard and government project costs. Total time to procure a new icebreaker [including mission analysis, studies, design, contract award, and construction] is eight to ten years.²⁰

¹⁷ Source: Coast Guard point paper provided to CRS on February 12, 2008, op cit.

¹⁸ Philip Ewing, "CG Steps Up Bid to Rescue Icebreaker Funding," *Navy Times*, March 24, 2008.

¹⁹ Source for information and quotations in this section: Coast Guard point paper provided to CRS on February 12, 2008, op cit.

²⁰ The Coast Guard states further that the estimate is based on the procurement cost of the Mackinaw (WAGB-30), a Great Lakes icebreaker that was procured a few years ago and
(continued...)

The Coast Guard further states that this notional new ship would be designed for a 30-year service life.

25-Year Service Life Extensions. One alternative to procuring new replacement ships would be to extend the service lives of Polar Star and Polar Sea. The Coast Guard states that performing the extensive maintenance, repair, and modernization work needed to extend the service lives of the two ships by 25 years might cost roughly \$400 million per ship. This figure, the Coast Guard says, is based on assessments made by independent contractors for the Coast Guard in 2004. The service life extension work, the Coast Guard says, would improve the two icebreakers' installed systems in certain areas. Although the work would be intended to permit the ships to operate for another 25 years, it would not return the cutters to new condition.

Reactivate Polar Star for 7 to 10 Years. The Coast Guard estimates that it would cost \$56.6 million to perform the maintenance and repair work needed to reactivate Polar Star and extend its service life by 7 to 10 years, which is the approximate amount of time that would transpire under the Coast Guard's plan before a new replacement ship enters service. The work would include system upgrades that have been installed in recent years on the Polar Sea but not the Polar Star. An additional cost would be incurred to create and train a full 134-person crew for the ship.

Reactivate Polar Star for a Single Deployment. The Coast Guard estimates that it would cost \$8.2 million to perform the maintenance and repair work needed to reactivate the Polar Star and make it ready for a single Deep Freeze deployment, meaning a deployment to Antarctica, such as the McMurdo resupply mission. The \$8.2 million in work, the Coast Guard says, would require between 12 months and 18 months to perform. Roughly half of the cost, the Coast Guard says, would be to rebuild the ship's worn out electric motors. As with the previous option, an additional cost would be incurred to create and train a full 134-person crew for the ship.

U.S. Shipbuilding Industrial Base

The status of the U.S. shipbuilding industrial base, particularly the part that builds military ships for the U.S. government, has been a concern in Congress and elsewhere since the early 1990s, following the end of the Cold War, when the rate of Navy shipbuilding declined substantially. Concern has focused on, among other things, whether the total amount of work being received by shipyards is sufficient to

²⁰ (...continued)

commissioned into service with the Coast Guard in June 2006. The Mackinaw is 240 feet long, displaces 3,500 tons, and can break ice up to 2 feet, 8 inches thick at speeds of 3 knots, which is suitable for Great Lakes icebreaking. The Coast Guard says it scaled up the procurement cost for the Mackinaw in proportion to its size compared to that of a polar icebreaker, and then adjusted the resulting figure to account for the above-described capabilities of the notional replacement ship and recent construction costs at U.S. Gulf Coast shipyards.

maintain their financial health and to preserve key design and construction skills.²¹ Other things held equal, construction of one or more new polar icebreakers for the Coast Guard could increase workloads at the yard or yards involved in their construction for a period of a few or several years.

Issues for Congress

The issue of Coast Guard polar icebreaker modernization presents several potential policy issues for Congress, including but not necessarily limited to those discussed below.

Number and Capabilities of Future Polar Icebreakers

One potential policy issue for Congress concerns how many polar icebreakers, with what capabilities, the Coast Guard will need in the future. Specific questions within this issue include the following:

- Will the Coast Guard need two polar icebreakers (the number it currently has in operational condition), three polar icebreakers (the number it currently has in inventory), or some higher number?
- Should new icebreakers be designed to cut through ice up to six feet thick, like Polar Star and Polar Sea, or less than six feet thick (like Healy and many foreign icebreakers), or more than six feet thick (like certain Russian icebreakers)?²²
- Should new icebreakers be designed with the scientific research capabilities less than, greater than, or about equal to those of Healy?

In assessing this issue, factors that Congress may consider include, but are not limited to, the following:

- current and projected mission demands for polar icebreakers, including an assessment of how those demands might be affected in coming years by changing ice conditions;

²¹ In addition, certain shipyards on the U.S. Gulf Coast, including shipyards that build or have built ships for the Navy and the Coast Guard, sustained damage to their production facilities and workforces as a result of Hurricane Katrina in August 2005. The affected yards have since recovered or are now completing their recovery from this damage.

²² A recently completed Russian nuclear-powered icebreaker called 50 Let Pobedy that is 524 feet long and displaces about 25,000 tons is reportedly capable of breaking through ice up to 2.8 meters (about 9.2 feet) thick, though not necessarily at a speed of 3 knots. Somewhat smaller nuclear-powered Russian icebreakers of the Arktika class, such as Yamal, reportedly can break through ice up to 2.3 meters (about 7.5 feet) thick at a speed of 3 knots. Yamal displaces about 23,500 tons. (Sources: [<http://sr.se/cgi-bin/euroarctic/amnessida.asp?programID=2460&Nyheter=0&grupp=2604&artikel=1219680>], [<http://en.rian.ru/russia/20070131/59989100.html>], and [http://www.coolantarctica.com/Antarctica%20fact%20file/ships/Yamal_ice_breaker.htm].)

- the potential for these mission demands to be met by non-Coast Guard icebreakers, including leases or charters of icebreakers owned by foreign governments or private firms; and
- the Coast Guard's overall missions-vs.-resources situation, which includes the Coast Guard's requirements to perform many non-polar missions and the Coast Guard's desire to fund programs, such as the Deepwater acquisition program, for performing these non-polar missions.²³

Advocates of a Coast Guard polar icebreaker fleet that included two ships — that is, Healy and one other ship — might argue that the Coast Guard has been able to operate with such a force since the Polar Star went into caretaker status on July 1, 2006, and that a force with Healy and one other ship would cost less than a larger icebreaker fleet and thereby permit the Coast Guard to better fund programs for performing its various non-polar missions.

Advocates of a Coast Guard fleet that included three ships — Healy and two other icebreakers — might argue that the current force of Healy and one other operational ship has made it more difficult for the Coast Guard to perform the McMurdo resupply mission using its own assets, that a force that included Healy and two other ships would provide the Coast Guard with more flexibility for responding to contingencies or dealing with mechanical problems on one of the icebreakers, and that it would still be sufficiently affordable to permit the Coast Guard to adequately fund programs for performing non-polar missions.

Advocates of a Coast Guard fleet that included Healy and three or more other icebreakers might argue that such a fleet would provide additional capability for responding to potentially increased commercial and military activities in the Arctic, and more strongly signal U.S. commitment to defending its sovereignty and other interests in the region. They might argue that although this option would be more expensive than a smaller fleet, the added investment would be justified in light of the growing focus on U.S. polar interests.

Regarding the potential for leasing icebreakers owned by foreign governments or private firms, issues to consider would include, among other things, the potential availability of ships for lease, leasing costs, regulatory issues relating to long-term leases of capital assets for the U.S. government, and the ability of leased ships to perform the missions in question, including the mission of defending U.S. sovereignty in Arctic waters north of Alaska, the challenging McMurdo resupply mission, or missions that emerge suddenly in response to unexpected events.²⁴

²³ For more on the Deepwater program, see CRS Report RL33753, *Coast Guard Deepwater Program: Background, Oversight Issues, and Options for Congress*, by Ronald O'Rourke.

²⁴ The potential for using leased ships, and the possible limitations of this option, are discussed at several points in the 2007 NRC report. The report argues, among other things, that the availability of icebreakers for lease in coming years is open to question, that leased
(continued...)

The 2007 NRC report provided one perspective on the issue of required numbers and capabilities for U.S. polar icebreakers, stating:

Based on the current and future needs for icebreaking capabilities, the [study] committee concludes that the nation continues to require a polar icebreaking fleet that includes a minimum of three multimission ships [like the Coast Guard's three current polar icebreakers] and one single-mission [research] ship [like Palmer]. The committee finds that although the demand for icebreaking capability is predicted to increase, a fleet of three multimission and one single-mission icebreakers can meet the nation's future polar icebreaking needs through the application of the latest technology, creative crewing models, wise management of ice conditions, and more efficient use of the icebreaker fleet and other assets. The nation should immediately begin to program, design, and construct two new polar icebreakers to replace the POLAR STAR and POLAR SEA.

Building only one new polar icebreaker is insufficient for several reasons. First, a single ship cannot be in more than one location at a time. No matter how technologically advanced or efficiently operated, a single polar icebreaker can operate in the polar regions for only a portion of any year. An icebreaker requires regular maintenance and technical support from shipyards and industrial facilities, must reprovision regularly, and has to effect periodic crew changeouts. A single icebreaker, therefore, could not meet any reasonable standard of active and influential presence and reliable, at-will access throughout the polar regions.

A second consideration is the potential risk of failure in the harsh conditions of polar operations. Despite their intrinsic robustness, damage and system failure are always a risk and the U.S. fleet must have enough depth to provide backup assistance. Having only a single icebreaker would necessarily require the ship to accept a more conservative operating profile, avoiding more challenging ice conditions because reliable assistance would not be available. A second capable icebreaker, either operating elsewhere or in homeport, would provide ensured backup assistance and allow for more robust operations by the other ship.

From a strategic, longer-term perspective, two new Polar class icebreakers will far better position the nation for the increasing challenges emerging in both polar regions. A second new ship would allow the U.S. Coast Guard to reestablish an active patrol presence in U.S. waters north of Alaska to meet statutory responsibilities that will inevitably derive from increased human activity, economic development, and environmental change. It would allow response to emergencies such as search-and-rescue cases, pollution incidents, and assistance to ships threatened with grounding or damage by ice. Moreover, a second new ship will leverage the possibilities for simultaneous operations in widely disparate geographic areas (e.g., concurrent operations in the Arctic and Antarctic), provide more flexibility for conducting Antarctic logistics (as either the primary or the secondary ship for the McMurdo break-in), allow safer multiple-ship operations in the most demanding ice conditions, and increase

²⁴ (...continued)

ships are not optimal for performing sovereignty-related operations, and that some foreign icebreakers might be capable of performing the McMurdo resupply mission. See, for example, pages 80-81 of the NRC report.

opportunities for international expeditions. Finally, an up-front decision to build two new polar icebreakers will allow economies in the design and construction process and provide a predictable cost reduction for the second ship.²⁵

The position expressed in the NRC report, which is consistent with the report's recommendations, is one perspective on this issue; other perspectives are possible. As mentioned earlier, the Coast Guard, while generally agreeing with the NRC report, is currently studying requirements for future polar icebreakers. It is possible that the Coast Guard's eventual position on required numbers and capabilities of Coast Guard polar icebreakers will differ in some respects from those of the NRC report. It is also possible that third parties might come to positions that differ from those of both the NRC report and the Coast Guard.

New Construction vs. Modernization

A second potential policy issue for Congress is whether requirements for polar icebreakers over the next 25 to 30 years should be met by building new ships, by extending the service lives of the Polar Star and Polar Sea, or by pursuing some combination of these options. In assessing this question, factors to consider include the relative costs of these options, the capabilities that each option would provide, the long-term supportability of older ships whose service lives have been extended, and industrial-base impacts.

Regarding relative costs, as discussed in the Background section, the Coast Guard estimates that new icebreakers with a 30-year design life might cost \$800 million to \$925 million per ship, while a 25-year service life extension of Polar Star and Polar Sea might cost about \$400 million per ship. These estimates, however, should be compared with caution. As discussed earlier, the estimate for building new ships depends in part on the capabilities that were assumed for those ships, while the estimate for the service-life-extension option dates to 2004 and might consequently need to be reassessed. Estimates for service-life extension work, moreover, can be very uncertain due to the potential for discovering new things about a ship's condition once the ship is opened up for repair work.

Regarding capabilities provided by each option, the new-construction option would provide entirely new ships with extensive use of new technology, while the service-life-extension option would provide ships that, although modernized and reconditioned, would not be entirely new and would likely make less extensive use of new technologies. Among other things, new-construction ships might be able to make more extensive use of new technologies for reducing crew size, which is a significant factor in a ship's life cycle operating and support costs.

Regarding long-term supportability of older ships, the Coast Guard has expressed concern about the ability to support ships whose service lives have been

²⁵ National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, p. 2.

extended after FY2014, because some contracts that currently provide that support are scheduled to end that year.²⁶

Regarding potential impact on the industrial base, 25-year service life extensions would likely provide shipyards and supplier firms with less work, and also exercise a smaller set of shipyard construction skills, than would building new ships.

Acceleration of Current Schedule

A third potential policy option for Congress, if it is determined that one or more new ships should be built, is whether to accelerate the Coast Guard's current schedule for building those ships. One option for accelerating the schedule would be to shorten the current phase for studying the requirements for the new ships and move directly to procurement of the first new ship. Another acceleration option, if the Coast Guard contemplates procuring two or more replacement ships, would be to fund a second ship (and any subsequent ships) sooner than the Coast Guard might propose. Both of these options could be combined. In the case of a two-ship procurement, for example, one highly accelerated profile would be to procure both ships as part of the FY2009 budget, rather than the first ship in a year after FY2009, and the second ship one or more years after that.

Advocates of accelerated procurement might argue the following:

- It could reduce the total cost over the next several years of operating the Polar Sea and maintaining the Polar Star in caretaker status by reducing the number of years that those costs would be incurred before the replacement ships enter service.
- Accelerating procurement of at least the first replacement ship to FY2009 would ensure that at least one replacement ship would be funded prior to the approaching change in Administration — an event, advocates might argue, that could lead to delays in acquisition programs for which major procurement funding has not yet been provided.
- Shortening the period for studying requirements for new icebreakers would be acceptable because these requirements are already well understood due to extensive past operational experience, an understanding of current mission demands, and studies on current and potential future demands such as the 2007 NRC report.
- Any remaining uncertainties about required capabilities, such as, perhaps, the extent of the new ships' scientific research facilities, could be addressed in an accelerated program by reserving space and weight in the design for accommodating such facilities.

²⁶ Source: CRS discussion with Coast Guard officials, January 30, 2008.

- Accelerating the procurement of the second ship and any subsequent ships could reduce the total procurement cost of the ships by allowing contractors to achieve better economies of scale in terms of things like ordering materials, manufacturing components, and achieving optimal learning-curve benefits in moving from one ship to the next.

Opponents of this option might argue the following:

- The cost over the next several years for operating the Polar Sea and maintaining the Polar Star in caretaker status is relatively modest, so shortening the period during which these costs are incurred by a year or two will consequently produce only modest savings. These modest savings are not worth the risk that a shortened period for studying new requirements might overlook important issues or considerations that, if left unaddressed, could lead to the construction of new icebreakers that are less operationally effective or cost-effective than they could be.
- The best way to ensure that the icebreaker modernization program is not delayed by the approaching change in Administration is to show that the issue has been thoroughly studied and that the recommended course of action is thus well-founded.
- Although past operational experience, an understanding of current mission demands, and previous studies can inform an understanding of future mission requirements, that understanding might not be complete, particularly given changing conditions in the polar regions and the need to take the views of U.S. government agencies other than the Coast Guard into account.
- Uncertainties about the ships' required capabilities cannot be completely mitigated by reserving space and weight for certain features, and reserving such space and weight might result in a design that is larger and more expensive than needed.
- Accelerating the program is not necessary to achieve a procurement profile that permits the ships to be constructed in an efficient and manner.

Nuclear Power

A fourth potential policy option for Congress, if it is determined that one or more new ships should be built, is whether those ships should be nuclear-powered, as are 7 of Russia's 20 polar or Baltic icebreakers.²⁷ Some interest has been

²⁷ Source: National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, p. 59 (Table 6.4). These figures include a (continued...)

expressed in Congress in using nuclear power on a wider array of U.S. Navy surface ships in the future, and Section 1012 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181) makes it U.S. policy to build certain future classes of U.S. Navy surface combatants with nuclear power unless the Secretary of Defense submits a notification to Congress that using nuclear power for a given new ship class is not in the national interest. The issue of nuclear power for U.S. Navy surface ships is discussed in detail in another CRS report.²⁸

Advocates of building new Coast Guard polar icebreakers with nuclear power might argue the following:

- Nuclear power would provide the icebreakers with operational advantages in terms of virtually unlimited cruising endurance at any speed. Such endurance could permit the ships, for example, to make high-speed sprints from one polar region to the other, so as to respond to sudden contingencies, without needing to stop or slow down along the way to be refueled. These operational advantages are one reason why Russia has built some of its polar icebreakers with nuclear power.
- If oil costs in the future remain relatively high, and if the icebreakers consume significant total amounts of energy over their 30-year lives to perform their missions, then much or perhaps even all of the additional procurement cost of nuclear power could be offset over the ships lives by avoided fossil-fuel costs.
- Building icebreakers with nuclear power could improve economies of scale in the production of nuclear propulsion components for U.S. Navy nuclear-powered ships, reducing the costs of those Navy ships, which would further offset, from a national standpoint, the additional procurement cost of nuclear power for the icebreakers.
- Due to the additional up-front costs and increased operational capabilities of building a ship with nuclear power, building U.S. nuclear-powered icebreakers could send a strong signal to Russia or other countries of U.S. commitment to defending its polar interests, particularly in the Arctic.

Opponents of building new Coast Guard polar icebreakers with nuclear power might argue the following:

²⁷ (...continued)

nuclear-powered icebreaker named 50 Let Pobedy that reportedly entered service in early 2007, and two conventionally powered Russian icebreakers that, at the time of the 2007 NRC study, were leased to the Netherlands.

²⁸ CRS Report RL33946, *Navy Nuclear-Powered Surface Ships: Background, Issues, and Options for Congress*, by Ronald O'Rourke.

- Although nuclear power provides operational advantages in terms of unrefueled cruising endurance, conventional power has proven sufficient for performing U.S. polar icebreaker missions. Russia's requirements for its icebreakers differ from U.S. requirements for its icebreakers, so Russia's decision to build some of its icebreakers with nuclear power does not necessarily imply that the United States should do the same.
- Based on data in a 2006 Navy report to Congress on nuclear power for Navy surface ships, building a U.S. icebreaker with nuclear power rather than conventional power might increase its procurement cost by several hundred million dollars.²⁹ That additional cost might not loom very large for a Navy surface combatant that might cost \$2 billion to \$3 billion even when conventionally powered, but it might increase by as much as two-thirds the procurement cost of an icebreaker that might otherwise cost \$800 million to \$925 million to procure. In a situation of constrained budget resources, such an increase in procurement cost could easily result in the procurement of one replacement icebreaker rather than two. A single icebreaker, even one with nuclear power, might not be enough to meet future U.S. needs.
- The Coast Guard has not operated nuclear-powered ships and consequently does not have a maintenance or training infrastructure in place to support the operation of such ships. The Coast Guard would need to either create this infrastructure (which would require time and money) or pay the Navy to use its infrastructure.
- The U.S. can send a sufficiently strong signal of its commitment to defending its polar interests by building new, highly capable, conventionally powered polar icebreakers.

Funding Ships in Coast Guard or Defense Budget

A fifth potential policy option for Congress, if it is determined that one or more new icebreakers should be built, is whether those ships should be funded through the Coast Guard's Acquisition, Construction, and Improvements (AC&I) account, or the Navy's shipbuilding account, called the Shipbuilding and Conversion, Navy (SCN) account, or the National Defense Sealift Fund (NDSF), which is a Department of Defense (DOD) budget account where DOD sealift ships and Navy auxiliary ships are funded. There is precedent for funding Coast Guard icebreakers in the DOD

²⁹ As discussed in CRS Report RL33946, the 2006 Navy report concluded, among other things, that in constant FY2007 dollars, building a Navy surface combatant or amphibious ship with nuclear power rather than conventional power would add roughly \$600 million to \$800 million to its procurement cost. A nuclear power plant for a polar icebreaker might be smaller and consequently cost somewhat less than the nuclear power plant in the Navy surface combatant.

budget: The procurement of Healy was funded in the FY1990 in the DOD budget — specifically, the SCN account.³⁰

Advocates of funding new icebreakers in the SCN account or the NDSF might argue that this could permit the funding of new icebreakers while putting less pressure on other parts of the Coast Guard's budget. They might also argue that it would permit the new icebreaker program to benefit from the Navy's experience in managing shipbuilding programs. Opponents might argue that funding new icebreakers in the SCN account or the NDSF might put pressure on these other two accounts at a time when the Navy and DOD are facing challenges funding their own shipbuilding and other priorities. They might also argue that having the Navy manage the Coast Guard's icebreaker program would add complexity to the acquisition effort, and that it is unclear whether the Navy's recent performance in managing shipbuilding programs is better than the Coast Guard's, since both services have recently experienced problems in managing shipbuilding programs — the Coast Guard with the procurement of new cutters under the Deepwater program, and the Navy in the Littoral Combat Ship (LCS) program and the LPD-17 class amphibious ship program.³¹

Reactivating Polar Star as Interim Measure

A sixth potential policy option for Congress, if it is determined that one or more new icebreakers should be built, is whether, as an additional interim measure, Polar Star should be reactivated for either one additional deployment or for multiple deployments over the next 7 to 10 years. In assessing this issue, factors to consider would include the following, among others:

- the cost to reactivate Polar Star for either a single additional deployment or for an additional 7 to 10 years of operations;
- the additional time and cost needed to create and train a full 134-person crew for Polar Star;
- the ability of the Coast Guard to perform its polar missions in coming years with Polar Sea and Healy; and

³⁰ The FY1990 DOD appropriations act (H.R. 3072/P.L. 101-165 of November 21, 1989) provided \$329 million for the procurement of Healy in the SCN account. (See pages 77 and 78 of H.Rept. 101-345 of November 13, 1989). The NDSF was created three years later, in FY1993, as a fund for procuring DOD sealift ships, among other purposes, and since FY2001 has been used to fund Navy auxiliary ships as well.

³¹ For more on the Deepwater, LCS, and LPD-17 programs, see CRS Report RL33753, *Coast Guard Deepwater Program: Background, Oversight Issues, and Options for Congress*, by Ronald O'Rourke, CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Background, Oversight Issues, and Options for Congress*, by Ronald O'Rourke, and CRS Report RL32513, *Navy-Marine Corps Amphibious and Maritime Prepositioning Ship Programs: Background and Oversight Issues for Congress*, by Ronald O'Rourke.

- the likelihood that a major mechanical breakdown or some other event could put Polar Star or Healy temporarily out of operation.

With regard to the first item above, as discussed in the Background section, the Coast Guard estimates that it would cost \$8.2 million to reactivate Polar Star and make it ready for a single additional deployment, or \$56.6 million to reactivate Polar Star and make it ready for 7 to 10 additional years of operation. There would be an additional cost to create and train a full 134-member crew for Polar Star, and additional operational costs to undertake deployments, such as costs for fuel.

Options for Congress

Potential options for Congress, several of which arise out of the policy issues discussed in the previous section, include but are not limited to those listed below. Some of the options could be combined. The options are as follows:

- approve the Coast Guard's current plan to study requirements for future icebreakers and then derive an acquisition strategy based on the results of these studies — a plan that might result in an initial replacement icebreaker entering service 8 to 10 years from now;
- hold hearings to solicit additional information on the issue of polar icebreaker modernization;
- direct the Coast Guard to include the option of nuclear power in its studies of requirements and design options for future icebreakers;
- direct the Coast Guard to pursue a particular acquisition strategy for icebreaker modernization, such as new construction, 25-year service life extension, or some combination of these two approaches;
- accelerate the procurement of new icebreakers relative to the Coast Guard's current plan by shortening the study period, procuring multiple ships in a single fiscal year, or both;
- fund the procurement of new icebreakers in the SCN account or the NDSF rather than in the Coast Guard's budget; and
- as a risk-mitigation measure, direct the Coast Guard to reactivate Polar Star and make it ready for either a single additional deployment or for another 7 to 10 years of operations.

Recent Legislative Activity

FY2008 Consolidated Appropriations Act (H.R. 2764/P.L. 110-161)

FY2008 funding for the Department of Homeland Security (DHS), which includes the Coast Guard, was provided in the FY2008 Consolidated Appropriations Act (H.R. 2764/P.L. 110-161 of December 26, 2007). The explanatory statement for H.R. 2764/P.L. 100, which is intended to be the equivalent of a conference report for the bill, states the following in its discussion of Division E (the FY2008 DHS appropriations act):

National Interests in the Polar Regions

The Committees on Appropriations are concerned about Coast Guard's ability to meet its polar operations mission requirements and provide the United States with the capability to support national interests in the polar regions. These mission requirements include, but are not limited to: global reach to the North and South poles; monitoring of U.S.-bound vessel traffic transiting international waterways in the far north; support of the International Ice Patrol; and support of other governmental and scientific organizations in pursuit of marine and atmospheric science activities in the polar regions. The Committees on Appropriations are specifically concerned whether Coast Guard's aging polar icebreaking fleet can meet current mission performance goals and whether this fleet and the service's small cadre of specialized polar operations personnel are capable of meeting projected mission performance goals in light of changing environmental conditions and increased activity in the polar regions. The National Academy of Sciences made several recommendations in this regard in September 2006, but the Administration has taken no action to implement those recommendations.

Therefore, the Commandant is directed to submit a comprehensive polar operations report that fully assesses the Coast Guard's ability to meet current and projected polar mission requirements and includes an evaluation of how Coast Guard's current capabilities and resources must be adapted or enhanced to account for changing environmental conditions and increased activity in the polar regions. This report is to include an analysis of the need for any permanent, forward operating presence in the polar regions in order to meet mission requirements and an assessment of the Coast Guard's ability to meet the requirements of partner agencies operating in the polar regions, such as the National Science Foundation (NSF) and the Departments of Commerce and Defense, under current and projected environmental conditions. Finally, this report should include an appraisal of the sustainability of the current operations and maintenance cost sharing arrangement between the Coast Guard and NSF to support both current and projected polar icebreaker operations.