THE U.S. ANTARCTIC PROGRAM: ACHIEVING FISCAL AND LOGISTICAL EFFICIENCY WHILE SUPPORTING SOUND SCIENCE

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

SECOND SESSION

THURSDAY, NOVEMBER 15, 2012

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Thursday, November 15, 2012

THE U.S. ANTARCTIC PROGRAM: ACHIEVING FISCAL AND LOGISTICAL EFFICIENCY WHILE SUPPORTING SOUND SCIENCE

THURSDAY, NOVEMBER 15, 2012

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Committee met, pursuant to call, at 10:03 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Ralph Hall [Chairman of the Committee] presiding.

RALPH M. HALL, TEXAS
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Full Committee Hearing

The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science

Thursday, November 15, 2012
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Witnesses

Mr. Norman R. Augustine, Chair, U.S. Antarctic Program Blue Ribbon Panel

The Honorable Subra Suresh, Director, National Science Foundation

General Duncan J. McNabb (USAF-Retired), Member, U.S. Antarctic Program Blue Ribbon Panel

Dr. Warren M. Zapol, MD, Chair, National Research Council's Committee on *Future Science Opportunities in Antarctica and the Southern Ocean*

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HEARING CHARTER

The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science

Thursday, November 15, 2012
10:00 a.m. - 12:00 p.m.
2318 Rayburn House Office Building

1. Purpose

On Thursday, November 15, 2012, the Committee on Science, Space, and Technology will hold a hearing to review the future options and logistical recommendations of the U.S. Antarctic Program Blue Ribbon Panel Report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*, and to examine the work and goals of the U.S. Antarctic Program.

2. Witnesses

Mr. Norman R. Augustine, Chair, U.S. Antarctic Program Blue Ribbon Panel

The Honorable Subra Suresh, Director, National Science Foundation

General Duncan J. McNabb (USAF-Retired), Member, U.S. Antarctic Program Blue Ribbon Panel

Dr. Warren M. Zapol, MD, Chair, National Research Council's Committee on *Future Science Opportunities in Antarctica and the Southern Ocean*

3. Overview

- The United States presence on the continent of Antarctica began in 1830.
- In 1959, 12 nations, including the United States, signed the Antarctic Treaty establishing the peaceful purpose of the continent to continue the freedom of scientific investigation.
- Under the terms of Presidential Memorandum 6646[1], the National Science Foundation (NSF) manages the United States Antarctic Program and supports scientific research by overseeing a massive cooperative effort among researchers, the military, and civilian agencies.

[1] *President's Memorandum Regarding Antarctica*. February 1982. (http://www.nsf.gov/od/opp/ant/memo_6646.jsp)

- The United States Antarctic Program "supports the goals of the Antarctic Treaty, fosters cooperative research with other nations, protects the Antarctic environment, and develops measures to ensure only equitable and wise use of resources."[2]

- In 2010, NSF, in coordination with the Office of Science and Technology Policy (OSTP), initiated two activities to review the U.S. Antarctic program: one to focus on the science questions over the next two decades and one to focus on improving logistical support over the next two decades.

- In September 2011, the National Research Council's Committee on Future Science Opportunities in Antarctica and the Southern Ocean released a report highlighting important areas of Antarctic research and logistical "opportunities to sustain and improve the science program in the Antarctic and Southern Ocean."[3]

- In July 2012, the U.S. Antarctic Program Blue Ribbon Panel released a report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*, highlighting well-managed U.S. Antarctic activities that suffer from an aging infrastructure, lack of capital budget, and the effects of operating in an unforgiving environment.

4. Background

Antarctica

According to the CIA World Factbook, "speculation over the existence of a 'southern land' was not confirmed until the early 1820s when British and American commercial operators and British and Russian national expeditions began exploring the Antarctic Peninsula region and other areas south of the Antarctic Circle."[4] While it was not officially established as a continent until 1840 and saw very little human activity other than exploratory expeditions well into the early 20th century, the continent received an increase of interest and scientific research following World War II.[5]

Scientific evidence indicates that Antarctica was once part of an enormous and temperate supercontinent that broke free and drifted southward from other land masses. Today, it is a continent of extremes.

> The continental landmass is 5.4 million square miles, an area larger than the U.S. and Mexico combined. More than 98 percent of the landmass is covered by an ice sheet that...averages just over 7,000 feet thick, but is more than twice that thick in places. Antarctica holds 90 percent of the world's ice, which in turn represents 70 percent of the world's fresh water. Yet, precipitation in the interior averages only a few inches annually, making Antarctica one of the world's great deserts. The ice sheet at the South Pole is in constant motion, moving

[2] http://www.nsf.gov/od/opp/antarct/usap.jsp
[3] *Future Science Opportunities in Antarctica and the Southern Ocean*. National Research Council, 2011. p. 6.
[4] *The World Factbook*: Antarctica. https://www.cia.gov/library/publications/the-world-factbook/geos/ay.html
[5] Ibid.

about 30 feet every year and necessitating an annual remarking of the geographic South Pole.[6]

Currently, a number of countries have seasonal and year-round stations, camps, and refuges to support scientific research. Seven countries (Argentina, Australia, Chile, France, New Zealand, Norway, and the United Kingdom) have made territorial claims to Antarctica, but these claims are not recognized by a majority of countries. The United States and Russia reserve the right to also make a claim, but have not. In an effort to form a legal framework for the activities of countries on the continent, an Antarctic Treaty was negotiated in 1959, which neither denies nor recognizes existing territorial claims. It was put into force in 1961.

U.S. Presence in Antarctica

In 1830, James Eights became the first U.S. scientist on the continent of Antarctica. In 1841, while mapping part of the Antarctic coast, a U.S. expedition team helped prove that Antarctica was a continent. In 1947, the largest single expedition to Antarctica took place when 13 ships and 4,700 personnel were dispatched to the region for the U.S. Navy's "Operation Highjump."[7] Americans have been studying the Antarctic without interruption since 1956.

Under the terms of Presidential Memorandum 6646, the National Science Foundation (NSF), through the Office of Polar Programs, manages the United States Antarctic Program and supports scientific research by overseeing a massive cooperative effort among researchers, the military, and civilian agencies. The USAP "supports the goals of the Antarctic Treaty, fosters cooperative research with other nations, protects the Antarctic environment, and develops measures to ensure only equitable and wise use of resources."[8] Antarctic research has three goals: to understand the region and its ecosystems; to understand its effects on (and responses to) global processes such as climate; and to use the region as a platform to study the upper atmosphere and space.[9]

Antarctic Treaty

The Antarctic Treaty was signed in 1959 and entered into force in 1961. The Treaty included 12 signatories. Today, these signatories are known as the original 12 consultative nations. The Treaty established a legal framework for Antarctica, or the area south of 60°S and includes the recognition that it is in the "interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord."[10] Further, the Treaty requires Antarctica only be used for peaceful purposes and prohibits "any measures of a military nature,"[11] including weapons testing and nuclear storage and explosions. The Treaty continues the freedom of scientific investigation in Antarctica and calls for the exchange of plans, personnel and scientific observations from scientific programs and results taking place in Antarctica. It "does not recognize, dispute, or establish territorial

[6] http://www.nsf.gov/news/news_summ.jsp?cntn_id=102869
[7] Ibid.
[8] http://www.nsf.gov/od/opp/antarct/usap.jsp
[9] Ibid.
[10] *The Antarctic Treaty*. (http://www.nsf.gov/od/opp/antarct/anttrty.jsp)
[11] Ibid.

claims, and it prohibits assertion of new claims." It also guarantees access by any treaty nation to inspect others' stations and equipment."[12]

In addition to the original 12 consultative nations, 16 nations have achieved consultative status by acceding to the treaty and conducting substantial scientific research in Antarctica. "Consultative nations are empowered to meet yearly and to influence the operation of the treaty."[13] There are also 20 acceding nations that abide by the treaty but do not have substantial programs in Antarctica and are not part of the consultative process.

Original Signatories	Additional Consultative Nations	Acceding Nations
Argentina	Brazil	Austria
Australia	Bulgaria	Belarus
Belgium	China	Canada
Chile	Ecuador	Colombia
French Republic	Finland	Cuba
Japan	Germany	Czech Republic
New Zealand	India	Democratic Peoples Republic of Korea
Norway	Italy	Denmark
Union of South Africa	Netherlands	Estonia
Union of Soviet Socialist Republic (*Russia carries forward the signatory privileges and responsibilities established by the former Soviet Union*)	Peru	Greece
	Poland	Guatemala
	Republic of Korea	Hungary
	Spain	Monaco
	Sweden	Papua New Guinea
	Ukraine	Portugal
United Kingdom	Uruguay	Romania
United States		Slovak Republic
		Switzerland
		Turkey
		Venezuela

The Treaty calls for meetings of the consultative nations in order to exchange information, consult on matters of common interest, and formulate additional measures to further the principles and objectives of the Treaty that may be brought back to each nation's government for consideration. Meetings of the consultative nations have been held approximately every other year since 1961 and more frequently since 1993. Decisions are made by consensus, not vote. "Each meeting has generated recommendations regarding operation of the treaty that, when ratified by the participating governments, become binding on the parties to the treaty."[14]

The recommendations resulting from these meetings often result in a provision of rules for operating on the continent, including: the Agreed Measures for the Conservation of Antarctic Fauna and Flora;[15] the Convention for the Conservation of Antarctic Seals (1972); the Convention on the Conservation of Antarctic Marine Living Resources (1980); and the Protocol

[12] http://www.nsf.gov/od/opp/antarct/intcoop.jsp
[13] Ibid.
[14] *The Antarctic Treaty*. 1959. (http://www.nsf.gov/od/opp/antarct/anttrty.jsp)
[15] Ratified by the United States in the *Antarctic Conservation Act of 1978* (P.L. 95-541).

on Environmental Protection to the Antarctic Treaty (1991) that included the prohibition of mining.[16] Antarctic Treaty nations that operate field programs in Antarctica have established a Council of Managers of National Antarctic Programs (COMNAP) "to facilitate working level decision making and information exchange."[17]

The Role of the National Science Foundation

The United States Antarctic Program (USAP) was established in 1959, following the 1957-58 International Geophysical Year when 12 nations launched 60 Antarctic research stations. The USAP carries forward the U.S. support for the Antarctic Treaty, advances cooperative research with other nations, develops measures to ensure equitable use of resources, and protects the Antarctic environment. The USAP is managed by the National Science Foundation (NSF) as part of NSF's Office of Polar Programs (OPP).

The Administration's fiscal year 2013 (FY13) budget request included $75.8 million for Antarctic Sciences, an increase of 8.7 percent over the FY12 estimate, and $258.33 for Antarctic Infrastructure and Logistics, an increase of .6 percent over the FY12 estimate. Funding for these OPP programs supports research, labs and equipment (including the operation of the McMurdo, Palmer and Amundsen-Scott South Pole research stations), icebreakers for research and channel-breaking, small fixed-wing aircraft and helicopters, fuel tankers, and support provided by the Department of Defense (for more information see Appendix A). NSF also contracts with Lockheed Martin for logistical support for the Antarctic program. "Some 3,500 Americans are involved each year in the program's research and logistical activities. Every year, more than 800 scientists and their support teams conduct research in Antarctica's unique environment."[18]

In 1982, a *President's Memorandum Regarding Antarctica* laid out the continued role for the National Science Foundation (NSF) regarding the U.S. interests in Antarctica, including:

- budget for and manage the entire United States national program in Antarctica, including logistic support activities so that the program may be managed as a single package;
- fund university research and federal agency programs related to Antarctica;
- draw upon logistic support capabilities of government agencies on a cost reimbursable basis; and
- use commercial support and management facilities where these are determined to be cost effective and will not, in the view of the Group, be detrimental to the national interest.[19]

NSF is also a member of the Antarctic Working Group, providing policy guidance for all U.S. activities under the Antarctic Treaty. Other members include the Department of State and the

[16] http://www.nsf.gov/od/opp/antarct/intcoop.jsp
[17] Ibid.
[18] http://www.nsf.gov/news/news_summ.jsp?cntn_id=102869
[19] *President's Memorandum Regarding Antarctica*. February 1982. (http://www.nsf.gov/od/opp/ant/memo_6646.jsp)

Department of Defense. NSF is responsible for the overall funding and management of U.S. activities in Antarctica and:

- Annually prepares plans and a budget for consideration within the Executive Branch and for review and appropriation by the Congress.
- Develops scientific goals for Antarctica, obtaining advice as needed from the scientific community and communicating these goals to the scientific community.
- Receives proposals for research projects from U.S. universities, other research institutions, and federal agencies; evaluates these proposals for relevance to program goals, scientific merit, and logistics feasibility; provides funds to these institutions for performance of the projects in Antarctica and completion of analysis upon return; and arranges cooperative scientific and logistics programs with other Antarctic Treaty nations.
- Plans the logistics requirements and transmits these requirements and necessary funds to the U.S. Naval Support Force Antarctica, the Air National Guard, and the United States Coast Guard (functions are described below).
- Manages, designs, plans, engineers, constructs, and maintains U.S. Antarctic facilities.
- Manages a contract with a commercial firm for operation of McMurdo, South Pole, and Palmer Stations; the research vessels Laurence M. Gould and Nathaniel B. Palmer; construction; and other services.
- Develops and implements a comprehensive safety, environment, and health program for U.S. activities in Antarctica.
- Serves as a clearinghouse and source of information regarding Antarctic records, files, documents, and maps maintained within agencies and nongovernmental organizations.[20]

In 2010, the NSF OPP, in coordination with the Office of Science and Technology Policy (OSTP), initiated two activities to review the U.S. Antarctic program. The first asked the National Research Council's Committee on Future Science Opportunities in Antarctica and the Southern Ocean to identify and summarize the changes to important science conducted on Antarctica and the surrounding Southern Ocean that will demand attention over the next two decades. The second activity was an NSF-organized Blue Ribbon Panel tasked to assist in making strategic decisions for improving the logistical support of the U.S. science program in Antarctica and the Southern Ocean over the next two decades.

Future Science Opportunities in Antarctica and the Southern Ocean

In September 2011, the National Research Council's Committee on Future Science Opportunities in Antarctica and the Southern Ocean released its report in response to the NSF/OSTP request. The report highlights important areas of research and distributes them between two broad themes, those related to global change and those related to fundamental discoveries. The research areas identified as most important by the Committee are as follows:

[20] http://www.nsf.gov/od/opp/antarct/usagency.jsp

Global Change	Discovery
How will Antarctica contribute to changes in global sea level? What is the role of Antarctica and the Southern Ocean in the Global Climate System? What is the response of Antarctic biota and ecosystems to change? What role has Antarctica played in changing the planet in the past?	What can Antarctica and the Southern Ocean reveal about past climates? How has life adapted to Antarctica and the Southern Ocean Environments? What can the Antarctic platform reveal about the interaction between the earth and the space environment? How did the universe begin, what is it made of, and what determines its evolution?[21]

Key findings from the NRC Committee's Report include:

- The Antarctic region is both an important influence on Earth's processes and a unique environment from which to monitor global changes.
- Antarctica and the Southern Ocean provide a natural laboratory for scientific discovery.
- Conducting research in the harsh environmental conditions of the Antarctic region is logistically challenging. Substantial resources are needed to establish and maintain infrastructure while at the same time minimizing the pollution of the environment and ensuring the safety of researchers. Opportunities could be leveraged to sustain and improve the science program in Antarctica and Southern Ocean in the coming two decades, including:
    - Building collaborations between nations, across disciplinary boundaries, and between public and private sector entities, and between science and logistics personnel.
    - Taking advantage of advances in energy and technology to make scientific research in the Antarctic region more efficient.
    - Supporting educational efforts to spark interest in polar science.
    - Developing a coordinated network of observing systems that can collect and record data on the ongoing changes in the Antarctic region.[22]

The Report suggests specific actions to help the United States achieve success in the next generation of Antarctica and the Southern Ocean science. These include:

- Lead the development of a large-scale, interdisciplinary observing network and support a new generation of robust earth system models.
- Continue to support a wide variety of basic research in Antarctica and the Southern Ocean to yield a new generation of discoveries.
- Design and implement improved mechanisms for international collaboration.

[21] *Future Science Opportunities in Antarctica and the Southern Ocean*. National Research Council, 2011. p.2.
[22] Key findings of the *Future Science Opportunities in Antarctica and the Southern Ocean* Report. National Academies website. (http://dels.nas.edu/Report/Future-Science-Opportunities-Antarctica/13169)

- Exploit the host of emerging technologies including cyberinfrastructure and novel and robust sensors.
- Coordinate an integrated polar educational program.
- Continue strong logistical support for Antarctic science.[23]

The Report also encourages the Blue Ribbon Panel to develop a plan to support Antarctic science in the next two decades that includes the following goals:

- Improve the efficiency of the support provided by the contractors and enhance the oversight and management of contractors by the scientific community.
- Increase the flexibility and mobility of the support system to work in a continent- and ocean-wide manner, utilizing as much of the year and continent as possible, and fostering innovative "cutting-edge" science.
- Maintain and enhance the unique logistical assets of the U.S., including the research stations, aircraft, and research vessels and icebreakers.[24]

More and Better Science in Antarctica Through Increased Logistical Effectiveness

In July 2012, the members of the U.S. Antarctic Program Blue Ribbon Panel released a report, *More and Better Science in Antarctica Through Increased Logistical Effectiveness,* detailing suggested efforts to increase cost savings and conduct more science through the USAP. The report from the Blue-Ribbon Panel notes that "conducting world-class science is a centerpiece of U.S. activities in the Antarctic and the Southern Ocean, but the substantive research itself is only the visible part of the iceberg…Substantial opportunities exist to devote a greater share of scarce resources to science by reducing the cost of logistics efforts."[25]

The Blue Ribbon Panel was made up of 12 members who had collectively taken "82 trips to Antarctica, including 16 to the South Pole and numerous trips aboard research vessels in the Southern Ocean."[26]

The Blue-Ribbon Panel report concludes that "U.S. activities in Antarctica are very well managed but suffer from an aging infrastructure, lack of a capital budget, and the effects of operating in an extremely unforgiving environment…In the longer term, increased logistical efficiency could yield savings that would substantially increase the amount of research supported by NSF."[27] The report assesses the McMurdo, Amundsen-Scott South Pole, and Palmer Research Stations, as well as field sites and oceangoing vessels. It also acknowledges key challenges for the USAP, including environment, uncertainties in logistics planning, activities of other nations, and economic considerations.

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[23] Ibid.
[24] Ibid.
[25] *More and Better Science in Antarctica Through Increased Logistical Effectiveness.* Report of the U.S. Antarctic Program Blue Ribbon Panel. July 23, 2012, Washington, DC. p.1.
[26] Ibid. p.2
[27] Ibid. p. 3.

The Blue Ribbon Panel report focuses on eight issues the Panel views as significant: 1) capital budgeting, 2) alternatives to McMurdo Station, 3) icebreakers, 4) transportation on the Continent, 5) hard-surface ice runway at the South Pole, 6) energy, 7) communications, and 8) safety and health. The report also acknowledges that another way to ensure projects are not unexpectedly disrupted, personnel injured, or equipment damaged is to "eliminate circumstances in which the failure of one element of a system renders the entire system incapable of performing its function,"[28] termed "single-point failures." Potential single-point failures include:

- The Antarctic Treaty and related instruments (potential circumvention)
- U.S. icebreaking capability (lack of assured access)
- Broadband communications for South Pole Station (interruptions to telemedicine, impact on research)
- Pier at Palmer Station (vulnerability to major accident)
- Multimode hub at Christchurch (earthquake, airport restructuring)
- Pegasus Runway at McMurdo (melting, accidents)
- Fire Suppression Systems requiring electric power (inadequate backups)
- *Gould* and *Palmer* (aging with long replacement cycle)
- Single automated dishwasher at McMurdo (food service for as many as 1100 people) [29]

Further, the Blue Ribbon report establishes 10 overarching recommendations:

1. Antarctic Bases: Continue the use of McMurdo, South Pole, and Palmer Stations as the primary U.S. science and logistics hubs on the continent. (There is no reasonable alternative, particularly concerning McMurdo.)

2. Polar Ocean Fleet: Restore the U.S. polar ocean fleet (icebreakers, polar research vessels, mid-sized and smaller vessels) to support science, logistics, and national security in both polar regions over the long term. (Follow through on pending action in the President's FY 2013 Budget Request for the USCG to initiate the design of a new icebreaker.)

3. Logistics and Transportation: Implement state-of-the-art logistics and transportation support as identified in this report to reduce costs and expand science opportunities continent-wide and in the Southern Ocean. (Replace some LC-130 flights with additional traverse trips by automating the traverse and by constructing a wheel-capable runway at South Pole Station for C-17 use; reduce the LC-130 fleet.)

4. McMurdo and Palmer Facilities: Upgrade or replace, as warranted by an updated master plan, aging facilities at McMurdo and Palmer Stations, thereby reducing operating costs and increasing the efficiency of support provided to science projects. (Modify or replace the pier and reconstruct the boat ramp at Palmer

[28] Ibid. p. 17.
[29] Ibid. p. 17.

Station, install fire suppression—with backup power—in unprotected berthing and key operational facilities, upgrade medical clinics, and improve dormitory use to prevent the transmission of illnesses.)

5. USAP Capital Budget: Establish a long-term facilities capital plan and budget for the USAP. (Provide phased plan for modernization of USAP facilities.)

6. Science Support Costs: Further strengthen the process by which the fully burdened cost and technological readiness of research instrumentation and observing systems, as well as overall projects, are considered in the review and selection of science projects. (Increase overall awareness of the true cost of resources provided in Antarctica.)

7. Communications: Modernize communication capabilities in Antarctica and the Southern Ocean to enable increased science output and reduced operational footprint. (Provide increased bandwidth on as well as to and from the continent.)

8. Energy Efficiency: Increase energy efficiency and implement renewable energy technologies to reduce operational costs. (Provide additional wind turbine generators at McMurdo, better insulate selected buildings, and invest in technology for converting trash-to-energy and burning waste oil so that it does not have to be returned to the United States.)

9. International Cooperation: Pursue additional opportunities for international cooperation in shared logistics support as well as scientific endeavors. (The existence of numerous national stations in the Peninsula region offers a particularly promising opportunity for an international supply system.)

10. Antarctic Policy: Review and revise as appropriate the existing documents governing Antarctic Policy (Presidential Memorandum 6646 of 1982 and Presidential Decision Directive 26 of 1994) and implementing mechanisms for Antarctica, taking into account current realities and findings identified by the National Research Council report and the present report. (Focus on policy and national issues as opposed to operational matters.)[30]

The Blue Ribbon Panel report concludes with a significant recommendation (not incorporating the issue of icebreakers) regarding funding for the USAP over the next five years:

> In spite of the above challenges, USAP science and science support could be vastly enhanced within about five years. The improvements could be funded by increasing for each of the next four years the USAP's annual appropriation for support by six percent relative to the FY 2012 appropriation (an additional $16 million per year), diverting six percent of the planned science expenditures over the next four years to upgrades of the science support system ($4 million), and permitting the savings accrued from the five highest payout projects (Table 2) and

[30] Ibid. p. 18.

the 20 percent reduction in contractor labor to be reinvested in upgrading support capabilities ($20 million per year).

The investments thus made would be repaid in approximately seven years if the five highest payout projects produce the expected return and a 20 percent reduction in contractor staff is in fact possible and implemented. Thereafter, the annual savings generated will allow the USAP to increase science awards while ensuring safe and effective science support and appropriately maintained facilities. Given the important improvements in safety and science opportunities contained within the above option, a seven-year financial breakeven is considered by the Panel to be a reasonable investment, particularly when compared to the cost of not making one.[31]

[31] Ibid. p. 21-22.

APPENDIX A

NSF OFFICE OF POLAR PROGRAMS ANTARCTIC SCIENCES

NSF Spending on OPP Division of Antarctic Sciences[32]

(dollars in millions)

	FY11 Actual	FY12 Estimate	FY13 Request	FY13 Request versus FY12 Estimate	
				$	%
Research	64.20	65.03	70.93	5.90	9.1
Education	1.38	1.27	1.42	0.15	11.8
Infrastructure	3.49	3.45	3.45	0	0
Total:	69.07	69.75	75.80	6.05	8.7

Antarctic Sciences (ANT) funds research on high priority scientific topics for which access to Antarctica is essential to advancing the scientific frontiers. This includes research on physical, biological, geological, glaciological, oceanographic, and atmospheric processes in Antarctica, as well as on interactions of the ice sheets with the underlying continent, the surrounding ocean, and the overlying atmosphere. These studies also elucidate the Antarctic environment's role in the global Earth system. In particular, a new programmatic emphasis on system science fosters linkages across the disciplines in order to better advance understanding of Antarctica as an integrated system. ANT also provides instrumentation and supports research in astronomy and astrophysics that takes advantage of the polar environment to study the origin of super-high-energy neutrinos and the nature of dark energy and dark matter in the universe.

In general, 65 percent of the ANT portfolio is available for new research grants. The remaining 35 percent is used primarily to fund continuing grants made in previous years.[33]

NSF OFFICE OF POLAR PROGRAMS ANTARCTIC INFRASTRUCTURE AND LOGISTICS

NSF Spending on OPP Division of Antarctic Infrastructure and Logistics[34]

(dollars in millions)

	FY11 Actual	FY12 Estimate	FY13 Request	FY13 Request versus FY12 Estimate	
				$	%
U.S. Antarctic Facilities & Logistics	191.89	189.22	190.81	1.59	0.8
U.S. Antarctic Logistical Support	67.52	67.52	67.52	0	0
Total:	259.41	256.74	258.33	1.59	0.6

[32] *FY13 NSF Budget Request to Congress*, p. OPP-9.
[33] Ibid.
[34] *FY13 NSF Budget Request to Congress*, p. OPP-11.

Antarctic Infrastructure and Logistics supports research through a network of stations, labs, equipment, and logistical resources that enables research activities in Antarctica. This includes operation of a year-round inland research station at the South Pole and two year-round coastal research stations (McMurdo and Palmer) with extensive laboratory, transportation, housing, communication, and computing capabilities (approximately $85.0 million); summer camps as required for research (approximately $5.0 million); icebreaking research ships—the *Laurence M. Gould* and the *Nathaniel B. Palmer* (approximately $32.0 million); small fixed-wing aircraft and helicopters (approximately $9.0 million); icebreakers for channel-breaking and ship escort and an annual fuel tanker and cargo ship at McMurdo Station (approximately $40.0 million for ship charters and fuel). The division uses a mix of government and civilian contract service providers for research support activities in Antarctica.

The U.S. Antarctic Logistical Support budget line funds support provided by the U.S. Department of Defense (DoD). DoD operates as a logistical support provider on a cost-reimbursable basis. Major funding elements of DoD support include: military personnel, LC-130 flight operations and maintenance support through the 109th Airlift Wing (AW) of the New York Air National Guard in Scotia, New York, and Antarctica; transportation and training of military personnel supporting the U.S. Antarctic Program; support for air traffic control, weather forecasting, and electronic equipment maintenance; the charter of Air Mobility Command airlift and Military Sealift Command ships for the resupply of McMurdo Station; bulk fuel purchased from the Defense Logistics Agency; and reimbursement for use of DoD satellites for communications.[35]

[35] Ibid.

Chairman HALL. The Committee on Science, Space, and Technology will come to order, and we say good morning and welcome to today's hearing: "The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science."

In front of you are packets containing the written testimony and the biographies and the Truth in Testimony disclosures for today's witnesses. At this time I guess I will recognize myself for five minutes for the opening statement.

The first United States presence in Antarctica dates way back to 1830. Our support of explorers and scientists on that continent has yielded and continues to yield valuable research that not only affects our daily lives, but absolutely can't be done in any other place on earth. As much as we currently know about Antarctica, there remains much to be learned. It is hard to believe that it has only been slightly more than 100 years since humans arrived at the South Pole, and now we are performing science there year-round at the U.S. South Pole Station, in addition to the work being done at McMurdo and Palmer stations, at remote camps across the continent, and on various research vessels in the Southern Ocean.

We are fortunate to have the National Science Foundation capably managing the U.S. Antarctic Program for the entire United States and we are pleased that it, in consultation with the White House Office of Science and Technology Policy, initiated two activities to review the program: first, a National Academies report to focus on the science needed for the next two decades, and second, a Blue Ribbon Panel report to focus on the logistics required to support that science.

The purpose of the hearing today is to take a look at the recommendations of the Blue Ribbon Panel's report, "More and Better Science in Antarctica through Increased Logistical Effectiveness," is the title of it, and the benefits, costs and savings associated with those recommendations.

Personally, I have not had the pleasure of visiting Antarctica and don't expect that I ever will have an opportunity that I accept—no CODELs—and I don't know anybody that has been there that wants to go back. I personally have not had the privilege of visiting Antarctica as many of my colleagues have, but I have learned from them and from others of the immense value and unique opportunities that that continent holds for scientific discovery. It is very important to us. I also recognize the important geopolitical reasons to maintain a U.S. presence there and appreciate the cooperation that must take place not only between relevant U.S. agencies, but also between our international friends and partners. Unfortunately, the magnitude of the logistics to support these activities is enormous and overwhelmingly dominates the budget for Antarctic activities. Therefore, the Blue Ribbon Panel's report recommendations are very welcome.

The Blue Ribbon Panel report provides ten broad overreaching recommendations for logistical effectiveness, and also provides a number of specific implementing actions categorized as either, one, essential for safety and health; or number two, readily implementable; and significant investment and large payoff.

I want to thank Norm Augustine, General McNabb, Bart Gordon, the former Chairman of this Committee, a wonderful guy and a

great job he did for the years he was here, and all of the other Blue Ribbon panelists for the time and effort they spent on developing this report, and I look forward to discussing the feasibility of implementing their recommendations, particularly during this time of budgetary constraint, with all of the witnesses and I thank all of you for taking time out of your busy schedules, the time it took for you to get ready, the time it took for you to get here, the time you are going to spend with us and the time you are going to have going back. You are givers and not takers, and we appreciate every one of you.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF CHAIRMAN RALPH HALL

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I want to thank Norm Augustine; General McNabb; Bart Gordon, the former Chairman of this Committee; and all of the other Blue Ribbon panelists for the time and effort they spent on developing this report, and I look forward to discussing the feasibility of implementing their recommendations, particularly during this time of budgetary constraint, with all of the witnesses.

Chairman HALL. I yield back my time. I recognize for five minutes an opening statement, Ms. Johnson. Ms. Johnson, you present your opening statement and take as much time as you need.

Ms. JOHNSON. Thank you very much, Mr. Chairman, for holding this hearing and welcome to our esteemed panel of witnesses. The United States presence in Antarctica is critically important both strategically and scientifically. With two expert reports on both the science and logistics of our Antarctic research program recently completed, and a new contractor in place, we are at an important juncture in the 53-year-old U.S. Antarctic Program.

So I am pleased that we are having this hearing now to begin to review the many challenges and opportunities that lie ahead.

However, our ability to address them will inevitably depend on what decisions we make about the larger federal budget in the coming months. I hope that we will also keep Antarctica on our agenda in the next Congress as the budget picture comes into better focus.

By all accounts, the National Science Foundation and its agency partners have done an extraordinary job in building and maintaining a productive, safe and efficient U.S. research program across the Antarctic continent. They have done so while minimizing our environmental footprint in Antarctica, hopefully giving all of us back in the United States some lessons on how we can take easy steps to reduce our energy consumption and reduce waste.

Our efficient investment in infrastructure and operations enables cutting-edge science across many fields supported by multiple federal agencies. Most of us probably didn't know that there is an active volcano in Antarctica being studied by the NSF and the USGS scientists, and that NASA conducts some research down there because the harsh Antarctic environment is a good preliminary test bed for the harsh conditions in space. Many of our scientists are also conducting research on land and at sea to help us better understand and predict global change, global climate change, and NOAA is making critical atmospheric measurements at the South Pole.

But the more efficient and safer we are in our logistical support of these activities, the more opportunity we will have to expand and strengthen the science we do. So I commend Dr. Suresh and OSTP Director Dr. Holdren on their decision to request a two-tier review of the U.S.Antarctic Program, first to look at the science priorities, then to carry out an A to Z review of the infrastructure and logistics. This is the very definition of good government.

I look forward to hearing from Mr. Augustine and General McNabb about the Blue Ribbon Panel's recommendations and any specific advice they have for us on how the Science Committee can be helpful. I would also like to hear from witnesses as to whether the scientific community has expressed any concerns with respect to the Blue Ribbon Panel's recommendations, and how the agency might best work with the community to minimize the short-term disruption to science.

Last, but of course not least, I look forward to hearing about the scientific priorities for the U.S. Antarctic Program going forward and how and why we all benefit from the science being carried out so far away from our shores.

On another note, with this possibly being our last Committee hearing of the year, I want to take this opportunity to thank my friend and colleague Ralph Hall for his leadership of this Committee.

And with that, I yield back.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF RANKING MEMBER EDDIE BERNICE JOHNSON

Thank you, Chairman Hall, for holding this hearing and welcome to our esteemed panel of witnesses. The United States presence in Antarctica is critically important both strategically and scientifically. With two expert reports on both the science and logistics of our Antarctic research program recently completed, and a new contractor in place, we are at an important juncture in the 53-year old US Antarctic Program.

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Last, but of course not least, I look forward to hearing about the scientific priorities for the US Antarctic Program going forward and how and why we all benefit from the science being carried out so far away from our own shores.

On another note, with this possibly being our last full committee hearing of the year, I want to take this opportunity to thank my friend and colleague Ralph Hall for his leadership of this committee.

With that I yield back.

Chairman HALL. If you want to expand on that, I will give you some more time. Thank you, Ms. Johnson.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

At this time I would like to introduce our panel of witnesses. Our first witness is one who has been here many times before, Norman R. Augustine, Chair of the U.S. Antarctic Program Blue Ribbon Panel, and a good friend of this Committee, and good friend of this Congress and a good friend of this country. His name is attached to a number of reports with which we are familiar and we are lucky to have the benefit of his leadership. Mr. Augustine spent his career working in both the private and public sectors including the Department of Defense. He served as either president or CEO and chairman of the board for Martin Marietta for more than 20 years before becoming president of the newly formed Lockheed Martin in 1995. He retired as chairman and CEO of Lockheed Martin in 1997. Mr. Augustine holds 29 honorary degrees and has been presented the National Medal of Technology by the President of the United States and received the Joint Chiefs of Staff Distinguished Public Service Award.

Our second witness is Dr. Subra Suresh, Director of the National Science Foundation. Prior to assuming his current role in 2010, he

served as the Dean of the School of Engineering and the Vannevar Bush Professor of Engineering at the Massachusetts Institute of Technology, MIT.

Our next witness is General Duncan McNabb, United States Air Force, retired, a member of the U.S. Antarctic Program Blue Ribbon Panel and a former commander, United States Transportation Command. U.S. Transcom is the single manager for global air, land and sea transportation for the Department of Defense. In his distinguished career of more than 37 years, General McNabb also served in a variety of leadership roles including U.S. Air Force Deputy Chief of Staff for Planning and Programming, Director for Logistics on the Joint Staff, and Vice Chief of Staff for the Air Force, and it is not written here for me to say but he also lives in Texas. Ensign Gay, who was the sole survivor of the Battle of Midway, as many of you know and remember, was a Texan, and he always in all his speeches, I never heard him make a speech that he didn't say this: he said "Never ask anybody if they are from Texas, because if they are, they will tell you, and if they are not, there is no reason to embarrass them."

Our final witness is Dr. Warren Zapol, Chair of the National Research Council's Committee on Future Science Opportunities in Antarctica and the Southern Ocean. Dr. Zapol is an anesthesiologist and is current Director of the Massachusetts General Hospital Anesthesia Center for Critical Care Research. He is also Reginald Jenney Professor of Anesthesia at Harvard Medical School.

As our witnesses should know, spoken testimony is limited to five minutes after which the Members of this Committee will have five minutes each to ask you questions, and you are not relegated to five minutes, you are not held to that. We are too grateful to you for being here. We will work with you on that. Just do your best.

I now recognize our first witness Mr. Augustine for five minutes.

STATEMENT OF MR. NORMAN R. AUGUSTINE,
CHAIR, U.S. ANTARCTIC PROGRAM BLUE RIBBON PANEL

Mr. AUGUSTINE. Well, thank you, Chairman Hall and Ranking Member Johnson and Members of the Committee. I am pleased to have the opportunity to represent my 11 colleagues on this study here at this hearing, and I particularly appreciate your inviting General McNabb, my colleague and friend on the committee. I have submitted a written statement, Mr. Chairman.

As you all know, the purpose of the U.S. presence in Antarctica is really twofold. One is to perform science, the other is to provide a U.S. presence on the continent and in the Southern Ocean. The role of our committee, however, was, as the chairman said, to focus on logistics and support, both in Antarctica and the Southern Ocean. It is a challenge to provide logistical support there, as you can imagine. At the Pole, for example, you are on top of 9,000 feet of ice, 11,000-foot pressure altitude, strong winds, darkness for much of the year, and temperatures in that general area have been measured as far as 127 degrees below zero Fahrenheit. But it happens to be a superb place to perform certain kinds of science, and the other witnesses, I think, will describe that later so I will turn to logistics.

The logistical pipeline is rather demanding. It is about 11,000 miles long, going from Port Hueneme in California to Christchurch, New Zealand, to McMurdo Base on the Ross Sea and then another 800 miles to the Pole if that is where you are going. It is the view of our committee that the NSF over the years, today as well, has done a truly remarkable job of managing such a complex, unforgiving operation. The perhaps prime example of that is the building of the new South Pole Station, which this Committee approved a few years ago. It was a remarkable feat and was brought in basically on cost and on schedule, very close.

Science is just the tip of the iceberg, quite literally, in terms of our activity in Antarctica. As the Chairman alluded to, it happens that about 85 percent of the people days that are spent on the continent and in the Southern Ocean are associated with logistics support as opposed to the science itself, and about 90 percent—excuse me—about 80 percent of the budget is attributed to logistical support. A little arithmetic there will suggest that if the logistics costs would go up by just 13 percent, you would have to cut the science in half for a constant overall budget. On the other hand, this means there is an enormous opportunity if we can reduce the cost of the logistics.

We found the logistics and facilities in rather poor repair, particularly at McMurdo and to a lesser extent at Palmer. For example, we entered a warehouse where there were certain areas you couldn't drive forklifts because they fall through the floor. We found them storing dry food in a facility that one of our members, who is the former Vice President of Proctor and Gamble for Global Supply, he said he wouldn't store soap in that building. We saw rooms designed for two people that five people were living in, of course posing a considerable health hazard. Inventories are often stored outdoors. The wind covers them with snow, and when people need supplies they have to dig through the snow banks to try to find them. The infirmary was described to us at McMurdo by the physician there as being of 1960s vintage. The dock at Palmer Station has an underwater pinnacle of rock that makes it extremely hazardous to dock ships there. Many ships can't dock there because of that.

We think the root cause of this has to do with the lack of a capital budget plan for the U.S. program in Antarctica, and of course, that is not unique to the NSF. By having such a plan, it would be possible to greatly increase the efficiency in Antarctica.

We have proposed in our 224-page book a number of things that could be done to improve the situation, and let me emphasize that we are acutely aware of the budgetary problems that face our Nation and face your Committee. We have proposed a four-step plan that could be used to fund the program we have proposed. The first step is to increase the U.S. Antarctic Program funding by six percent for four years; correspondingly, to shift six percent of the science budget for the next four years to rebuilding the logistics system; to apply the savings from the first four years of the changes we propose to improving the logistics system; and, finally, by reducing the cost of contract activities by about 20 percent, which we believe is possible.

I should say this does not address the icebreaker issue, which transcends the NSF's ability to solve what is of the utmost importance and hopefully this Committee will be able to address that.

With that, Mr. Chairman, I will conclude my remarks and I would be happy to answer questions at the appropriate time.

[The prepared statement of Mr. Augustine follows:]

Testimony of

Norman R. Augustine

Before the

Committee on Science, Space, and Technology

United States House of Representatives

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"*The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science.*"

* * *

Washington, DC

November 15, 2012

Chairman Hall, Ranking Member Johnson and Members of the Committee. It is always a pleasure to appear before you and I appreciate today's invitation to discuss the report of the committee that recently addressed the logistical aspects of U.S. activities in Antarctica and the Southern Ocean.

I would like at the outset of my remarks to acknowledge my colleagues on the committee whose contributions made our report possible: USCG Commandant (Ret.)Thad Allen; RADM (USN, Ret.) Craig Dorman, Dr. Hugh W. Ducklow, Director, Ecosystems Center at the Marine Biological Laboratory; Mr. R. Keith Harrison, retired Global Product Supply Officer, Procter & Gamble; Dr. Don Harthill, Professor of Physics, Cornell University; Dr. Gérard Jugie, Emeritus Research Director of the French research organization CNRS; Dr. Louis J. Lanzerotti, member of the National Science Board; Gen. Duncan J. McNabb, USAF (Ret.), Former Commander, USTRANSCOM; Mr. Robert Spearing, Retired Deputy Associate Administrator for Space Communications, NASA Space Operations Mission Directorate; Dr. Diana Wall, University Distinguished Professor and Director of the School of Global Environmental Sustainability, Colorado State University, and I am particularly pleased that you invited my colleague, General Duncan McNabb to be at the witness table today.

I would like to call to the committee's attention that subsequent to beginning work on this review of Antarctic support activities I learned that the Lockheed Martin Corporation, from which I retired fifteen years ago, was planning to submit a bid to become the operating contractor for the U.S. Antarctic Program. Just prior to our committee's completing its work, the company was in fact selected to fulfill this role. In the spirit of disclosure, I should indicate that I receive a pension and healthcare from Lockheed Martin and own one share of its stock but of course had no contact with the company related to our committee's work. This circumstance has been reviewed without objection by the Counsel's Office at the National Science Foundation.

As you are aware, in 2010/2011, in consultation with the White House Office of Science and Technology Policy, the National Science Foundation tasked the National Research Council (NRC) of the National Academies to conduct a review of likely future science needs in Antarctica and the Southern Ocean. I will not seek to summarize the findings of that review here since the chair of the NRC committee is present at the witness table today. Suffice it to say that significant new opportunities for Antarctic science were identified and that many of these opportunities would best be accomplished using an integrated, international network of sensors distributed across the Antarctic Continent and collecting a variety of data on a year-around basis. This will in some respects require a quite different support network from that which exists today.

The study by the NRC formed the basis for the review my colleagues and I were asked to undertake, with our attention being principally focused upon safely and efficiently providing the logistical support that would be required to implement the NRC recommendations. In July of

this year our committee issued a 224-page report, "More and Better Science in Antarctica through Increased Logistical Effectiveness." We were assisted in our efforts, particularly in conducting cost assessments, by members and the staff of the Institute for Defense Analyses. I should note that we were provided unlimited access to facilities, people and documents by the National Science Foundation. The resulting report is solely that of our committee.

While our group noted a number of opportunities for enhanced efficiency in conducting support operations, overall the U.S. Antarctic program, in our view, has been and is being, extremely well managed. The construction of the new facility at the South Pole nearly on-schedule and very close to budget is perhaps the prime recent example. This was a truly monumental achievement.

It goes without saying that activities in Antarctica and the Southern Ocean are extremely unforgiving of error—in this regard I am reminded of our nation's pursuits in space. For example, temperatures of minus 127 degrees Fahrenheit have been recorded on the Antarctic Continent; the ice at the South Pole is some 9,000 feet thick; and the pressure-altitude at the Pole is about 11,000 feet. Very strong winds are common and darkness envelops the Continent for a significant portion of the year.

The logistical pipeline from the United States staging facility at Port Hueneme, California, is approximately 11,000 miles in length and involves cargo and tanker ships, icebreakers, fixed-wing aircraft, helicopters, sledges, and more. While science and "presence"—the latter largely justified by geopolitical considerations—form the primary motivation for U.S. activities in the region, it would not be an overstatement to assert that the dominant activity of the U.S. Antarctic program is logistics. For example, one of the key drivers of overall cost of activities in the Antarctic is the number of person-days spent on the ice and in recent years individuals dedicated to the *support* of research have generally constituted over 85 percent of the total person-days. In fact, eighty cents of every dollar invested in the U.S. Antarctic program is devoted to logistics (including infrastructure).

As is evident from such considerations, the arithmetic of operating in the Polar region is cruel. For example, if logistics costs under a fixed overall budget were to rise by thirteen percent, the science program would have to be cut in half. At the same time, the leverage for increasing science is enormous if support costs can be reduced. The latter was our objective...when it could be done in a safe and sensible manner.

As I have noted, our committee did observe a number of opportunities to reduce logistical demands as well as a few instances where current logistical activities were, in the judgment of the committee, unacceptable from the standpoint of the safety of both people and equipment. In addition, the committee identified several single-point failure modes that warrant early attention.

Some of these were already in the process of being addressed by the Office of Polar Programs; however, further work is required.

If one were to seek to identify a single root cause for the inefficiencies that we noted it would be that the Antarctic program does not have a capital budget—and, as you know, within our government that is not unique to the Office of Polar Programs. In the corporate world I am unaware of any successful firm that does not embrace capital budgeting for long-life assets, the costs of which can be amortized. Nonetheless, realizing that the government is unlikely to change its budgetary practices to accommodate the Antarctic Program, it is nevertheless possible for the Office of Polar Programs to maintain such a budget for *planning* purposes, even though its identity may be blurred during the annual federal budgeting process.

A second consideration that significantly complicates the national Science Foundation's effort to reduce the cost of logistical support in the Antarctic is the extreme nonlinearity of costs with throughput. For example, the imputed cost of a gallon of fuel at the South Pole is about seven times its cost to the government at the refinery. Furthermore, fuel, like people-days, is a major cost-driver. When considering the *fully-burdened* cost of fuel a long list of potential avenues to save money can thus be developed. However, the abovementioned issue of nonlinearities evidences itself because the saving of a single gallon of fuel will not materially decrease the cost of airlift unless it makes possible the elimination of one aircraft flight or one tanker ship's transit or enables the use of a smaller aircraft or a smaller ship. Further, such costs as those associated with icebreaker operations will be altogether unaffected. On the other hand, when enough gallons of fuel or tons of food or other supplies can be cumulatively reduced to the point where changes of the type cited above can be realized substantial savings can be accrued.

With these observations as background I would like to turn to the principal recommendations contained in our committee's report. These are as follows:

1. Antarctic Bases. Continue the use of McMurdo, South Pole, and Palmer Stations as the primary U.S. science and logistics hubs on the continent. There is no reasonable alternative to McMurdo that would eliminate the requirement for icebreakers.

2. Polar Ocean Fleet . Restore the U.S. polar ocean fleet (icebreakers, polar research vessels, midsized and smaller vessels) to support science, logistics, and national security in both polar regions over the long term. Follow through on pending action in the President's FY 2013 Budget Request for the USCG to initiate the design of a new icebreaker. (It is noted that current practice for supplying McMurdo and the South Pole is to charter Russian icebreakers when they are available.

3. Logistics and Transportation. Implement state-of-the-art logistics and transportation support as identified in the committee's report to reduce costs and expand science opportunities continent-wide and in the Southern Ocean. Replace some LC-130 flights with additional traverses by automating traverse activity and by constructing a wheel-capable ice runway at South Pole Station for C-17 use. Reduce the overall size of the LC-130 fleet.

4. McMurdo and Palmer Facilities. Upgrade or replace, as warranted by an updated master plan, aging facilities at McMurdo and Palmer Stations, thereby reducing operating costs and increasing the efficiency of support provided to science projects. In particular, modify or replace the pier and reconstruct the boat ramp at Palmer Station; install fire suppression—with back-up power—in unprotected berthing and key operational facilities; upgrade medical clinics; and improve dormitory use to prevent the transmission of illnesses.

5. USAP Capital Budget. Establish a long-term facilities capital plan and budget.

6. Science Support Costs. Further strengthen the process by which the fully-burdened cost and technological readiness of research instrumentation and observing systems, as well as overall projects, are considered in the review and selection of science projects. In this regard, increase the awareness among researchers of the true cost of support provided in Antarctica.

7. Communications. Modernize communication capabilities in Antarctica and the Southern Ocean to enable increased science output and reduced operational footprint. This will require increased bandwidth on as well as to and from the continent.

8. Energy Efficiency. Increase energy efficiency and implement renewable energy technologies to reduce operational costs. Provide additional wind turbine generators at McMurdo, better insulate selected buildings, and invest in technology for converting trash-to-energy and burning waste oil so that it does not have to be returned to the United States for disposition.

9. International Cooperation. Pursue additional opportunities for international cooperation in shared logistics support as well as scientific endeavors. The existence of numerous national stations in the Peninsula region offers a particularly promising opportunity to create an international supply system.

10. Antarctic Policy. Review and update the existing documents governing Antarctic Policy to better reflect current government organizational structure, changing science needs and increased opportunities for international cooperation.

The question of course arises how such undertakings can be funded in a time of severe budgetary pressures—even when the undertakings offer significant returns on investment. Indeed, major cost savings can be achieved and science and science support can be substantially enhanced within a period of about five years and a positive net present value realized. The necessary actions can be funded by increasing for each of the next four years the USAP's annual appropriation for support by six percent relative to the FY 2012 appropriation (an additional $16 million per year); diverting six percent of the planned science expenditures over the next four years to upgrades of the science support system ($4 million); and permitting the savings accrued from the five highest payout projects and the proposed 20 percent reduction in contractor labor cost to be reinvested in upgrading support capabilities ($20 million per year) during those four years.

The investments thus made would be repaid in approximately seven years from the five highest payout projects plus the 20 percent reduction in contractor staff. Thereafter, the annual savings generated will allow the USAP to increase science awards while ensuring safe and effective science support and appropriately maintained facilities. Given the important improvements in safety and science opportunities contained within the above option, a seven-year financial breakeven is considered by the Panel to be a reasonable investment, particularly when compared to the cost of not making it.

It should, however, be noted that this construct does not address the icebreaker issue that transcends the great majority of the U.S. Antarctic program's objectives, at least as they are understood by the Panel. Either the U.S. Coast Guard should be provided the resources to carry out its assigned responsibilities to the Antarctic Program or the National Science Foundation should be permitted to make less costly and more reliable long-term commitments to foreign operators to assure the continuation of key U.S. activities in Antarctica.

Again, Mr. Chairman and members of the Committee, thank you for the privilege of appearing today on behalf of my colleagues. I would of course be pleased to address any questions you might wish to raise.

NORMAN R. AUGUSTINE was raised in Colorado and attended Princeton University where he graduated with a BSE in Aeronautical Engineering, magna cum laude, and an MSE. He was elected to Phi Beta Kappa, Tau Beta Pi and Sigma Xi.

In 1958 he joined the Douglas Aircraft Company in California where he worked as a Research Engineer, Program Manager and Chief Engineer. Beginning in 1965, he served in the Office of the Secretary of Defense as Assistant Director of Defense Research and Engineering. He joined LTV Missiles and Space Company in 1970, serving as Vice President, Advanced Programs and Marketing. In 1973 he returned to the government as Assistant Secretary of the Army and in 1975 became Under Secretary of the Army, and later Acting Secretary of the Army. Joining Martin Marietta Corporation in 1977 as Vice President of Technical Operations, he was elected as CEO in 1987 and chairman in 1988, having previously been President and COO. He served as president of Lockheed Martin Corporation upon the formation of that company in 1995, and became CEO later that same year. He retired as chairman and CEO of Lockheed Martin in 1997, at which time he became a Lecturer with the Rank of Professor on the faculty of Princeton University where he served until 1999.

Mr. Augustine was Chairman and Principal Officer of the American Red Cross for nine years, Chairman of the Council of the National Academy of Engineering, President and Chairman of the Association of the United States Army, Chairman of the Aerospace Industries Association, and Chairman of the Defense Science Board. He is a former President of the American Institute of Aeronautics and Astronautics and the Boy Scouts of America. He is a former member of the Board of Directors of ConocoPhillips, Black & Decker, Proctor & Gamble and Lockheed Martin, and was a member of the Board of Trustees of Colonial Williamsburg. He is a Regent of the University System of Maryland, Trustee Emeritus of Johns Hopkins and a former member of the Board of Trustees of Princeton and MIT. He is a member of the Advisory Board of the Department of Homeland Security and the Department of Energy, was a member of the Hart/Rudman Commission on National Security, and served for 16 years on the President's Council of Advisors on Science and Technology under both Republican and Democratic presidents. He is a member of the American Philosophical Society, the National Academy of Sciences and the Council on Foreign Relations, and is a Fellow of the National Academy of Arts and Sciences and the Explorers Club.

Mr. Augustine has been presented the National Medal of Technology by the President of the United States and received the Joint Chiefs of Staff Distinguished Public Service Award. He has five times received the Department of Defense's highest civilian decoration, the Distinguished Service Medal. He is co-author of *The Defense Revolution* and *Shakespeare In Charge* and author of *Augustine's Laws* and *Augustine's Travels*. He holds 29 honorary degrees and was selected by Who's Who in America and the Library of Congress as one of "Fifty Great Americans" on the occasion of Who's Who's fiftieth anniversary. He has traveled in 111 countries and stood on both the North and South Poles of the earth.

Chairman HALL. And I thank you.

I now recognize our second witness, Dr. Suresh, for five minutes.

STATEMENT OF THE HONORABLE SUBRA SURESH, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Mr. SURESH. Chairman Hall, Ranking Member Johnson and distinguished Members of the Committee, I am pleased to appear before you today to discuss the results of the Blue Ribbon Panel review of the U.S. Antarctic Program, or commonly referred to as USAP.

First, let me thank my colleague and good friend, Mr. Norm Augustine, for leading this very immense undertaking. I also acknowledge the distinguished panel for their very insightful analysis of the challenges we face in supporting the research in Antarctica. I also thank Dr. John Holdren of the Office of Science and Technology Policy for collaborating with us to form and support the panel. Lastly, I acknowledge the important stage-setting provided by the National Research Council's report on "Future Science Opportunities in Antarctica and the Southern Ocean."

Mr. Chairman, the National Science Foundation is proud of its presidentially directed role in leading USAP on behalf of the U.S. government. We must continuously address and anticipate the complex logistics needed to implement frontier science and engineering research in this remote and very harsh environment.

Antarctica serves as an extraordinary laboratory and important bellwether for virtually all areas of science. In my written testimony, I highlighted three significant discoveries resulting from research in this region: the identification of the ozone hole, which resulted in the worldwide ban of chlorofluorocarbons; the discovery of antifreeze proteins that have implications for tissue preservation for medical transplants, hypothermia treatment and lengthening the shelf life of frozen foods; and the recent discovery just a few weeks ago of the Phoenix galaxy cluster that generates 700 stars a year, the highest rate ever documented.

The U.S. Antarctic Program also supports the missions of our sister agencies including NASA's long-duration scientific ballooning and meteorite collection programs and NOAA's key observations for long-term atmospheric monitoring. NSF also effectively partners with other agencies, both in the United States and in Europe, for the data acquisition system in the Antarctic that is vital to the weather prediction systems upon which we all rely.

USAP also implements U.S. policy and the interests of the State Department through an active and influential presence in Antarctica. The U.S. governing role is paramount in the Antarctic treaty system.

We have reviewed USAP roughly once a decade since its creation. These reviews help determine whether the program is effectively structured, appropriately balanced and routinely aligned with national goals. Specifically, this Blue Ribbon Panel review focused on ensuring that the logistics and infrastructure were in place to support the cutting-edge research that can only be done and best be done in this remote environment. Given the austere budget environment we are in, the panel's review was designed to

identify opportunities for efficiencies and to inform and prioritize future budget requests for logistics and infrastructure.

The panel laid out a realistic blueprint for securing and improving world-class research in Antarctica. They also provided a warning that resonated with me as an engineer. USAP is currently operating under the threat of multiple single points of failure. Immediately after the release of the report this past July, I chartered a Tiger Team of senior NSF managers to guide development of a point-by-point response that includes a rolling five-year long-range investment plan, an integrated master schedule to implement recommendations contained in the report. The Tiger Team members agree with the majority of the recommendations, although as Mr. Augustine pointed out, not all of them can be implemented solely by NSF. For example, ensuring icebreaker capabilities for the United States requires action on the part of the U.S. Coast Guard and other parts of the federal government. The balance of the recommendations can be and are being acted on. We will immediately address the critical recommendations related to safety. We are also determining the feasibility and full cost implications of others.

I have also asked the Tiger Team to develop approaches for additional improvements through cross-foundational fertilization and external engagement. For example, they are exploring issuing grand challenges in areas that are related to energy utilization and engineering.

Along these same lines, we fully expect Lockheed Martin, our current Antarctic support contractor, to implement some of the cost-saving ideas they included in their proposal. Our Department of Defense partners also continue to recommend ideas for operating more efficiently. We expect to provide the National Science Board with a point-by-point response to the Blue Ribbon Panel recommendations at its meeting in December. I would like to acknowledge the chair of the National Science Board, Dr. Dan Arvizu, who graciously joined us here this morning. We would be happy to provide a copy of that to the committee.

Mr. Chairman, we appreciate this opportunity to discuss our initial response to the Blue Ribbon Panel report and look forward to continuing to support cutting-edge research in Antarctica. Thank you.

[The prepared statement of Mr. Suresh follows:]

Testimony of
Dr. Subra Suresh, Director
National Science Foundation

Before the

U.S. House of Representatives
Committee on Science, Space, and Technology

The U.S. Antarctic Program:
Achieving Fiscal and Logistical Efficiency While Supporting Sound Science.

November 15, 2012

Chairman Hall, Ranking Member Johnson and distinguished members of the Committee, I am pleased to appear before you today to speak in my capacity as Director of the National Science Foundation (NSF) about the results of the review of the U.S. Antarctic Program (USAP) by a Blue Ribbon Panel.

I would like to take this opportunity to thank Mr. Norm Augustine for agreeing to lead this immense undertaking, and the Panel for their exhaustive work and insightful analysis of the challenges we face in supporting research in Antarctica. I also want to thank Dr. John Holdren and the Office of Science and Technology Policy for collaborating with us to form the Panel and support its efforts. I would be remiss if I did not acknowledge the stage-setting conducted by the National Research Council (NRC) Committee in its report on *Future Science Opportunities in Antarctica and the Southern Ocean.*

Let me begin by noting that NSF is proud of its Presidentially-directed role in managing and budgeting for the USAP on behalf of the U.S. Government. We must continuously address and anticipate the logistics—often extremely complex and always in a remote and harsh environment—that are needed to implement frontier science and engineering research. Providing supplies, maintaining infrastructure, and transporting people to our widely dispersed Antarctic facilities requires a tremendous logistical commitment by the U.S. Government and its partners.

Need for the USAP

So if it is so difficult, one may rightly wonder why we continue to have a U.S. Antarctic Program. The answer is that despite its breadth: the polar environment serves as an

extraordinary laboratory and important bellwether for virtually all areas of science. NSF supports research in astrophysics and geospace, organisms and ecosystems, earth science, glaciology, ocean and atmospheric sciences, and integrated system science. This research has three goals: to understand the region and its ecosystems; to understand its effects on (and responses to) global processes that impact our climate and sea level; and to exploit the region as a unique platform from which to study the upper atmosphere, space, and the inner earth. To maximize efficiency, the USAP also is responsible for providing logistic support to other Federal agencies (e.g., the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Smithsonian Institution) carrying our research in Antarctica.

If you will allow me to describe just three discoveries demonstrating this breadth: the Ozone Hole was confirmed by long-term records produced by the USAP and other countries. The USAP responded rapidly by mounting a research effort that pinpointed the cause and led to the worldwide ban on chlorofluorocarbons, and led to a 1995 Nobel Prize in chemistry. This year, the seasonal ozone hole above the Antarctic was the second smallest in 20 years. Long-term NSF support of research in Antarctica enabled U.S. researchers to discover "fish antifreeze" and genetic modifications behind its production, which led to understanding of how the organic molecules inhibit freezing and may allow anti-freeze genes to be incorporated into crops, thus allowing them to be grown in sub-zero environments And just a couple of months ago, the South Pole Telescope found an extraordinary galaxy cluster that has proven to be not only one of the most massive in the universe but also contains a galaxy producing stars at high rates never before observed. Such new and surprising information about star-forming processes is filling in key knowledge gaps regarding the formation of our universe.

To support this diverse research, the USAP operates three year-round stations: McMurdo Station, located on the southern tip of Ross Island; the South Pole Station, located at the geographic south pole, approximately 800 miles from McMurdo; and Palmer Station, located on Anvers Island on the Antarctic Peninsula. Research is also supported by icebreaking and ice-capable research vessels and at temporary camps. The USAP supports our sister agencies in implementing their missions, including NASA's long duration scientific ballooning and meteorite collection programs, and NOAA's key observations for long-term atmospheric monitoring. NSF effectively partnered with sister agencies both in the U.S. and in Europe to stand up and operate the data acquisition system in the Antarctic that is vital to U.S. and global weather prediction systems upon which we all rely. In addition to its scientific importance, the USAP implements U.S. policy and the Department of State's interests regarding an active and influential presence in Antarctica; our commanding scientific presence ensures the U.S. a governing role in the Antarctic Treaty System.

USAP Two-Tiered Review

Since 1958, the Nation has reviewed the USAP roughly once a decade to determine whether it is effectively structured, appropriately balanced, and in line with national goals. NSF began discussing a review with the Office of Science and Technology Policy

just after the landmark Antarctic Treaty marked its 50th anniversary on December 1, 2009, and coincident with the completion of the new South Pole Station that brought new capabilities to Antarctic research and the conclusion of official International Polar Year activities that pointed to new research directions and modalities. The first phase of the review, carried out by the NRC Committee, focused on identifying priorities for research over the coming decades and a second phase, the Blue Ribbon Panel, focused on ensuring that the logistics and infrastructure were in place to support that science. Given the austere budget environment, the Blue Ribbon Panel's review was designed to identify opportunities for efficiencies and to inform and prioritize future budget requests for logistics and infrastructure.

The NRC Committee considered the current importance of Antarctica and the Southern Ocean to science and engineering research, and surveyed the horizon to identify some of the science drivers that will be of increasing importance in the future. The report asserted that enhancing science in the Antarctic region will require substantial organizational changes, broader geographical spread, increased international involvement, and a growth in the quantity and duration of measurements. The Blue Ribbon Panel, in turn, surveyed the existing logistics and infrastructure system and made recommendations that will enable the USAP to meet its current and future obligations, and to meet them in a more efficient and cost-effective manner, with due regard for safety, health, and the environment.

The Blue Ribbon Panel provided our Nation – and the entire international scientific community – an enormous benefit, laying out a detailed and realistic blueprint for securing and improving world-class research in Antarctica. But they also provided a warning that resonated with me as an engineer: the USAP is currently operating under the threat of multiple single points of failure. This fact alone is a compelling illustration of the vital role of logistics to scientific research and how fine the line is between success and failure.

NSF Response to Blue Ribbon Panel Report

Immediately after release of the report, I chartered a Tiger Team of senior NSF managers to respond to and guide development of a rolling five-year Long-Range Investment Plan and Integrated Master Schedule to implement recommendations contained in the report. Their work is now nearing completion. First, let me say that NSF agrees with the majority of the recommendations, although not all of the recommendations can be implemented by NSF alone. For example, recommendations concerning icebreaker capabilities for the United States necessarily require action on the part of the other components of the Federal Government. The balance of the recommendations can be acted on, and are being acted on in different ways. Paramount of course are the recommendations related to safety. We expect to address these immediately by providing funding for the most critical, and engaging experts to assist us with identifying future courses of action for others. Some of the recommendations require further study to determine feasibility and full cost implications. The FY 2013 Budget Request for USAP logistics and infrastructure is just under $260 million.

The Tiger Team has reviewed the process underway in Polar Programs, directing particular attention to approaches that would benefit from or be beneficial to enhanced cross-Foundational and external engagement. We have also gone a step further and asked the Tiger Team to assist with developing approaches for issuing grand challenges in, for example, the energy and engineering arenas. Each of the Tiger Team members has a constituency in their discipline that can be engaged to bring fresh ideas from both their learned and their "learning" colleagues. We anticipate that we will not only learn from them but also that they will broaden their view of how to use their skills as they proceed through their careers. Along these same lines, we fully expect Lockheed Martin, our current Antarctic Support Contractor, to implement some of the cost-saving ideas they included in their proposal, such as improved supply chain and logistics management software, operational consolidation and personnel footprint reduction, and better resource management through integrated master scheduling. Since the contract transition earlier this year, they have been heavily focused on assuming responsibility for providing support to researchers in Antarctica—a very steep learning curve. Our Department of Defense partners also continue to bring forward ideas for operating more efficiently as they work to improve the fuel efficiency of and develop the remote science capabilities for the LC-130 Hercules fleet.

We expect to provide the National Science Board with a point-by-point response to the Blue Ribbon Panel recommendations at its next meeting in early December, and would be happy to provide a copy to the Committee.

Mr. Chairman, we appreciate this opportunity to discuss our initial response to the Blue Ribbon Panel report, and look forward to continuing to support cutting edge research in Antarctica and the Southern Ocean. I would be pleased to answer any questions.

Chairman HALL. Thank you for a good presentation.

Now I recognize our third witness, General McNabb, for five minutes.

STATEMENT OF GENERAL DUNCAN J. MCNABB, USAF (RET), MEMBER, U.S. ANTARCTIC PROGRAM BLUE RIBBON PANEL

General MCNABB. Chairman Hall, Ranking Member Johnson and Members of the Committee, it is my honor to be with you today to testify on the Blue Ribbon Panel's report. It was a true privilege to join our chairman, Norm Augustine, and the other Blue Ribbon panel members to look at how we might improve logistics in support of the National Science Foundation and our science community. I am also delighted to be joined today by Norm Augustine, Dr. Subra Suresh and Dr. Zapol.

As a former Commander of the U.S. Air Force Air Mobility Command and later as commander of the United States Transportation Command, I was directly involved in supporting the National Science Foundation and the Antarctic Program. As you can well imagine, the movement of people, equipment and supplies to Antarctica is one of our most demanding missions. It requires special crews and special capabilities and we take tremendous pride in it.

Having had visited the McMurdo area and the South Pole as a military commander and then later as a Blue Ribbon Panel member—so Chairman, I did go twice and really had a great time both times—I need to say first how impressed I am with the NSF, the science community and the people who support this mission day in and day out. It is not too strong a word that they perform logistics miracles. They handle unique challenges every day to make this work safely and they do an incredible job, given the challenges they face. That said, there are always opportunities to improve and hopefully the Blue Ribbon Panel's effort can offer some strategic insights into how to take an already excellent operation to an even higher level.

I also want to thank this Committee for your continuous support of the mission. It has made and will continue to make a huge difference in improving science, enhancing safety, optimizing logistics operations and reducing cost. My and my other panel members' thoughts and suggestions are captured in the report but I would like to highlight a couple of points.

First of all is the importance of McMurdo. Currently, there is no other location in the Antarctic which offers the advantages of the McMurdo area; a deepwater port with relatively easy access in the summer months using an icebreaker; a wheel capable airfield, capable of handling large aircraft within 20 miles of this deepwater port, and within effective LC–130 range of the South Pole; well-developed infrastructure including storage for 11.5 million gallons of fuel; ideal location to support NASA's satellite links and long-duration balloon program, and NOAA's and DOD's Polar Space Programs; and access to the 175,000-square-mile ice shelf which allows more efficient traverse operations to much of the Antarctic. With recommended increases in the C–17 operations and more multimodal operations, McMurdo's criticality as the principal resupply center for the NSF will even grow. For all these reasons, the Blue Ribbon Panel strongly recommends McMurdo to continue to

be the major support base for the NSF Antarctic Program and it needs to be rightsized and modernized as outlined in the report.

Second is the importance of using an enterprise transportation approach to the Antarctic region. Given the challenges of providing logistic support to this austere area, optimizing transportation's assets is essential. With new technology, capabilities and concepts of operation, there are excellent opportunities to significantly improve air, land and sea options. However, the most dramatic improvement will be realized through the use of a true enterprise approach, taking best advantage of all transportation modes by using multimodal operations across the entire resupply and retrograde operation. Given today's advances in transportation support, multimodal solutions are not difficult to put in place and the benefits far outweigh the cost. The resulting operation will offer increased options to science and also dramatically reduce cost.

The final area is the importance of a capital budget, as mentioned by our Chairman Augustine, and multiyear funding for long-term logistics infrastructure support. In the report we go through how important this would be to improving logistics support and reducing cost, but given the timelines and constraints we have in the Antarctic, this becomes an even more critical overarching issue. I would ask for the Committee's support in looking at ways we might do this.

Again, Chairman Hall and Members of the Committee, I am honored to be here today. I was privileged to be part of the Blue Ribbon Panel, and I think Norm Augustine did a superb job in leading the effort. I request my written testimony be submitted for the record, and I look forward to your questions.

[The prepared statement of General McNabb follows:]

Testimony of

Gen (ret) Duncan J. McNabb

Before the

Committee on Science, Space, and Technology
United States House of Representatives

"The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science."

Washington, DC

15 November 2012

Chairman Hall, Ranking Member Johnson and Members of the Committee, it is my honor to be with you today to testify on the Blue Ribbon Panel's Report, "More and Better Science in Antarctica through Increased Logistical Effectiveness." I was privileged to join our Chairman, Norm Augustine, and the other Blue Ribbon Panel members to look at how we might improve logistics in support of the National Science Foundation and our Science Community. I'm also delighted to be joined today by Norm Augustine, and Dr Subra Suresh, two folks I deeply admire.

As the former Commander of the USAF Air Mobility Command and later as the Commander of the United States Transportation Command, I was directly involved in supporting the National Science Foundation and the Antarctica Mission. As you can well imagine, the movement of people, equipment, and supplies to Antarctica is one of our most demanding missions. It requires special crews and special capabilities, and is truly a no mistake environment. We take tremendous pride in the mission.

Having had visited the McMurdo area and the South Pole as a military commander and then later as a Blue Ribbon Panel Member, I need to say first how impressed I am with the NSF, the Science community, and the people who support this mission day in and day out. They handle unique challenges every day to make this work safely, and they do an incredible job. That said, there are always opportunities to improve, and hopefully the Blue Ribbon Panel's effort can offer some strategic opportunities to take an already excellent operation to an even higher level.

I also want to thank this committee for your support of the mission...it has made and will continue to make a huge difference in improving science, enhancing safety, optimizing logistics operations and reducing cost.

My thoughts and suggestions are captured in the report, but I would like to highlight a couple of points.

First of all is the importance of McMurdo. Currently there is no other location on the Antarctic which offers the advantages of the McMurdo area...deep water port with relatively easy access in the summer months using an icebreaker (56 years of successful deliveries); a wheeled capable airfield capable of handling large aircraft within 20 miles; well developed infrastructure including storage for 11.5M gallons of fuel; ideal location to support NASA's satellite links and long duration balloon program and

NOAA's and DOD's polar space programs; access to the 175,000 square mile ice shelf which allows more efficient traverse operations to much of Antarctica. With recommended increase in the C-17 operations and more multimodal operations, McMurdo's criticality as the principal resupply center for the NSF will even grow. For all these reasons, The Blue Ribbon Panel strongly recommends McMurdo to continue to be the major support base for the NSF Antarctic program...and it needs to be right sized and modernized.

Second, is the importance of using an enterprise transportation approach in the Antarctic region. Given the challenges of providing logistics support to this austere area, optimizing transportation assets is essential. With new technology, capabilities, and concepts of operations there are excellent opportunities to significantly improve air, land, and sea transportation options. However the most dramatic improvements will be realized through the use of a true enterprise approach...taking best advantage of all transportation modes by using multimodal operations across the entire resupply and retrograde operation. An enterprise approach allows you to use each of the modes and combinations of modes to best advantage. From optimized sealift, to more land traverses, to increased C-17 operations, to enhanced LC-130 ski and airdrop support to forward field locations, there are lots of opportunities. This will require much improved connectivity, better and more flexible cost accounting, and, most importantly, command and control which can direct multimodal operations rapidly and effectively. Given today's advances in transportation support, none of these prerequisites are overly difficult to put in place, and the benefits far outweigh the cost. The resulting operation will offer increased options to Science and also dramatically reduce cost.

The final area is the importance of a capital budget and multiyear funding for long term logistics infrastructure support. In the report, we go through how important this would be to improving logistics support and reducing costs, but given the timelines and constraints we have in the Antarctic, this becomes an even more critical overarching issue. I would ask for the committee's support in looking at ways we might do this.

Again, Chairman Hall and members of the Committee, I am honored to be here today. I was privileged to be a part of the Blue Ribbon Panel and I think Norm Augustine did a superb job in leading the effort. I look forward to your questions.

Chairman HALL. It will be done without objection, and I thank you, and sometime I will yield you more time to tell us a little more about that National Science Foundation meeting. It sounded interesting, which surprises me.

Now I am going to recognize what the lady that prepared this for me said is our final witness. At my age, I don't like to introduce anything as final. This is our final witness for today, Dr. Zapol, and we will recognize you for five minutes and look forward to your testimony.

STATEMENT OF DR. WARREN M. ZAPOL, M.D., CHAIR, COMMITTEE ON FUTURE SCIENCE OPPORTUNITIES IN ANTARCTICA AND THE SOUTHERN OCEAN, NATIONAL RESEARCH COUNCIL

Dr. ZAPOL. Thank you. Chairman Hall, Ranking Member Johnson and Members of the Committee, thank you for inviting me to talk today. My name is Warren Zapol. I am an anesthesiologist. I am the Emeritus Anesthetist-in-Chief at Massachusetts General Hospital and the Jenney Professor of Anesthesia at Harvard. I am Director of the MGH Anesthesia Center for Critical Care Research. We will get to that later.

I speak to you in my role as Chair of the 2011 report, which I did with 17 diverse and remarkable colleagues, "Future Scientific Opportunities in Antarctica and the Southern Ocean" issued by the NRC of the National Academy, and I am a member of the Institute of Medicine. Our National Academy report holds special credibility because it was prepared according to stringent NAS guidelines for balance, objectivity and peer review, and because it was written by people including volunteer experts who have done scientific research in the Antarctic as well as many with no prior experience in Antarctica. We had preeminent scientists from a wide variety of disciplines and one Nobel Prize winner.

Allow me to begin with what is certain to be one of your first questions: why is an anesthesiologist talking to you about research in Antarctica? In the 1970s, I became fascinated by stories of Weddell seals diving to 600 meters depth in the Southern Ocean. They could hold their breath for 90 minutes. Now, wouldn't it be wonderful if we could help our patients to hold their breath for 90 minutes, especially if they had pneumonia or heart attacks and things like that. So it was obvious as an anesthesiologist I would be interested in this. To answer this question, I led a small team of multidisciplinary scientists and doctors. We built microcomputers before there were microcomputers and we studied seals in their national icy environment. Over the course of nine summer seasons in Antarctica, a nine-time visitor, we learned how specialized storage of oxygen and nitrogen within the seals played a critical role and allowing these animals to dive for extended periods without suffering the bends or hypoxia—low blood oxygen levels—not things you would want. We brought that knowledge back and eventually I developed a treatment for human hypoxic newborn babies by breathing nitric oxide, and our technique is now used to save the lives of about 15,000 U.S. babies each year.

So why did I tell you this story? Because it is an important example of the power of discovery science. Allowing scientists to ex-

plore in Antarctica leads to unanticipated discoveries, and Antarctica is a place that is ripe for such discoveries. There are large parts of the continent that have yet to be explored. As a geologist friend of mine likes to say, this is a place where you can pick up a rock and be confident that you are the first person ever to pick up that rock.

But discovery is only part of this story. Science in Antarctica is also critical for it teaches us about the earth and how it is changing. Antarctica and the Southern ocean comprise about a third of our planet. They play a key role in earth's climate and geography and provide a unique environment from which to monitor and understand global change including sea-level change. Our NAS report highlighted the need for both discovery-driven research and research on global change questions across the wide variety of scientific disciplines. More details of this are available in the complete report.

After identifying these important scientific questions, our committee made a number of recommendations about the tools and logistics we needed to support research on these questions in a more effective and more efficient manner. Our group realized the need for wider observations underpinned many of our important scientific questions and thus our first recommendation is that the United States should lead in the development of large-scale interdisciplinary observing network and support a new generation of earth systems models to integrate these observations. Antarctica is almost totally unintegrated in all our models, and it is such a big piece of the earth. This is viewed as a key element of progress on the widest area of scientific issues.

Other recommendations highlighted the need to continue to support basic research, to improve international collaboration working with others, to exploit newer technologies, and to coordinate our educational activities.

Finally, our group emphasized the need for the United States to maintain a strong logistical support for science in the environment of Antarctica, and thus we ask the Blue Ribbon Panel to address: one, improve the efficiency of the support provided by the contractors and to enhance communications between, and the oversight of and the management of contractors by the scientific community in the field. Two, increase the flexibility and mobility and support system to work on the continent and the ocean-wide manner the entire continent, use as much of it as possible for as much of the year as possible, and to maintain, develop and enhance the logistical assets of the United States including the stations, the aircraft, the research vessels and icebreakers, of which you have already heard a bit of.

Before our committee wrote its report—because our committee wrote its report as input to the Blue Ribbon Panel, we did not have the later opportunity to comment as a group on that report. As such, I can only offer you my personal views of their report. I believe they did a stellar job, and particularly they listened to our committee's recommendations for more observations and disbursed observations and for increased flexibility and the logistical support of science in the Antarctic. The only area I feel they could have paid more attention to was the need for improved communication

and interaction among the NSF leadership, the logistical support contractor and the scientists in Antarctica. Again, that is my personal opinion based on our town-hall-style meetings in Antarctica.

In closing, I emphasize that both of our committees worked very hard to identify these recommendations, and I believe that by using the recommendations, the United States can maintain its leadership in Antarctic science.

I thank you. I am happy to answer any questions.

[The prepared statement of Dr. Zapol follows:]

FUTURE SCIENCE OPPORTUNITIES IN ANTARCTICA AND THE SOUTHERN OCEAN

Statement of

Warren Zapol, M.D.
Reginald Jenney Professor of Anesthesia at Harvard Medical School
Emeritus Anesthetist-in-Chief at Massachusetts General Hospital
Director of the MGH Anesthesia Center for Critical Care Research
and
Chair, Committee on Future Science Opportunities in Antarctica and the Southern Ocean
National Research Council / National Academy of Sciences

before the

Committee on Science, Space, and Technology
U.S. House of Representatives

November 15, 2012

Chairman Hall, Ranking Member Johnson, and members of the Committee: Thank you for inviting me to speak to you today. My name is Warren Zapol and I am an anesthesiologist and the emeritus Anesthetist-in-Chief at Massachusetts General Hospital and the Reginald Jenney Professor of Anesthesia at Harvard Medical School; I am also the Director of the MGH Anesthesia Center for Critical Care Research.

I am speaking to you in my role as Chair of the report on "Future Science Opportunities in Antarctica and the Southern Ocean" issued by the National Research Council of the National Academy of Sciences (NAS). The Research Council is the operating arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine of the National Academies, chartered by Congress in 1863 to advise the government on matters of science and technology. Our 2011 report laid out future research directions for scientific research for the next two decades on the continent of Antarctica and in the surrounding Southern Ocean (an area comprising about one third of Earth). We also highlighted several important opportunities that we felt could improve the efficiency and effectiveness of the Antarctic research endeavor. As you have learned, this report served as input for the National Science Foundation Blue Ribbon Panel report on "More and Better Science in Antarctica through Increased Logistical Effectiveness."

Our NAS report holds special credibility because it was prepared according to stringent NAS guidelines for balance, objectivity, and peer review, and because it was written by a group of volunteer experts that included both those who have done scientific research in the Antarctic region as well as those with no prior experience in Antarctica. Our group included preeminent scientists from a variety of disciplines, and included a Nobel Prize winner.

Allow me to begin with what is certain to be one of your first questions, and that is why is an anesthesiologist talking to you about research in Antarctica?

In the 1970s, I became fascinated by stories of Weddell seals diving to 600 meters depth in the Southern Ocean that could hold their breath for 90 minutes. Wouldn't this be a wonderful adaptation for our patients with pneumonia or heart attacks? How was this possible? To answer this question, I led a small team of multidisciplinary scientists and doctors to Antarctica to study seals by constructing and using specially designed diving microcomputers in their natural icy environment. Over the course of nine summer seasons in Antarctica, we learned how specialized storage of oxygen and nitrogen in seals played a critical role in allowing these remarkable animals to dive for extended periods without suffering from the bends, or hypoxia (low blood oxygen levels). We brought that knowledge back and eventually developed a treatment for hypoxic human newborn babies by breathing nitric oxide. This technique is now used to save the lives of around fifteen thousand U.S. babies each year. We also spun off a new startup company in Seattle making such specialized tracking and monitoring computers called "Wildlife Computers".

Discovery Science

But why tell you this story? The simple reason is that I think it is an important example of the power of discovery science. Allowing scientists to explore in Antarctica can lead to unanticipated discoveries. And the key point is that Antarctica is a place that is ripe for just these types of discoveries. There are large parts of the continent that have yet to be explored—as a

geologist colleague of mine likes to say, this is a place where you can pick up a rock and be confident that you are the first person to ever pick up that rock.

In our NAS report, the Committee highlighted four areas of science that will be important in discovery-driven scientific research in Antarctica and the Southern Ocean over the next two decades. Key science questions that we believed should drive Antarctic research over the next 10-20 years are:

(1) *What can records preserved in Antarctica and the Southern Ocean reveal about past and future climates?* Rocks, sediment cores, and ice cores from the Antarctic region hold a treasure trove of information about the history of Earth and its climate.

(2) *How has life adapted to the Antarctic and Southern Ocean environments?* Applying new tools in genomics, metagenomics, and proteomics to study the highly-adapted organisms in the Antarctic region could lead to new understanding on a host of illnesses and conditions that plague humans, such as heart attacks, strokes, and decompression sickness.

(3) *What can the Antarctic platform reveal about the interactions between Earth and the space environment?* Space weather—magnetic storms on the sun that can spew high-energy particles toward Earth—can disrupt the proper functioning of communications satellites in orbit, GPS systems, and even electrical power distribution systems on Earth's surface. This needs to be monitored; space weather is best viewed from the poles and the South Pole is far better for this than the shifting sea ice at the North Pole.

(4) *How did the Universe begin, what is it made of, and what determines its evolution?* Antarctica's atmospheric conditions allow scientists to view far out into the cosmos and

attempt to answer fundamental questions about the evolution and composition of the Universe. In addition, scientists have built an observatory on Antarctica's vast ice sheet at the South Pole to detect neutrinos—high-energy, nearly mass-less particles that may be a key piece of understanding as to how our Universe works.

Global Change

But discovery is only half of the story. The other half relates to the role of Antarctica in our Earth system. Over the past century, temperatures on land and in the ocean have started to increase. Sea level is rising and global weather patterns are shifting, altering the chemical and biological systems of the planet. The climate and geography of Antarctica are important influences on these processes and provide a unique environment in which to monitor change.

In addition to being a place to observe changes in the Earth system, Antarctica is a key part of many processes in the Earth's system. The Southern Ocean is where a large part of the deep water of the global ocean circulation is formed and where a large amount of carbon dioxide is exchanged with the atmosphere. Antarctica's ice sheets hold about 90 percent of the world's ice and fresh water, and if all of this ice were to melt, global sea levels would rise by more than 60 meters. Understanding the changes happening in Antarctica and the Southern Ocean is crucial to avoiding surprises impacting the rest of our world.

The Committee highlighted four questions in Antarctic research that will be important for global change science over the next two decades. Those are:

(1) *How will Antarctica contribute to changes in global sea level?* Antarctica's ice sheets hold about 90 percent of the world's ice and fresh water, and if all this ice were to melt,

global sea levels would rise by more than 60 meters; therefore, scientists need to monitor and understand what is happening to Antarctic's ice sheets.

(2) *What is the role of Antarctica and the Southern Ocean in the global climate system?* The Antarctic region plays a critical role in Earth's climate, including ocean currents, atmospheric circulation, and the carbon cycle, and more information on Antarctica's influence over globally interacting systems is needed to better understand our global climate system and how it might change in the future.

(3) *What is the response of Antarctic biota and ecosystems to change?* Antarctic ecosystems are relatively simple, making it easier to detect the impacts on these ecosystems from factors like pollution, ocean acidification, invasive species, increases in UV radiation, and most critically, human-induced climate change. Changes in the ecosystems of the Antarctic region may be a harbinger of the changes to come elsewhere, and therefore monitoring Antarctic change will allow scientists to better predict future global changes.

(4) *What role has Antarctica played in changing the planet in the past?* Geologically, the Antarctic continent was once part of a massive supercontinent. Antarctica has played a central role in previous changes in Earth's climate and in both atmospheric and oceanic circulation, so understanding the history and future of the Antarctic continent is key to understanding our planet's geological history and future.

Recommendations

In addition to these four directions in global change research and four directions in discovery science, our committee examined opportunities for making research science in Antarctica and the Southern Ocean more effective and efficient. Conducting research in the harsh environmental

conditions of Antarctica is logistically challenging. Substantial resources are needed to establish and maintain the infrastructure needed to provide heat, light, transportation, and drinking water, while at the same time minimizing pollution of the environment and ensuring the safety of researchers. The Committee identified opportunities to sustain and improve the science program in Antarctica and the Southern Ocean in the coming two decades, and made six specific recommendations:

1. **Lead the development of a large-scale, interdisciplinary observing network and support a new generation of earth system models:** To better predict future conditions, scientists need a network of observing systems that can collect and record data on the ongoing changes in the Antarctic region's atmosphere, ice sheets, oceans, and ecosystems. This network should be able to measure and record ongoing changes to develop an understanding of the causes of change and to provide inputs for models that will enable U.S. scientists to better project the global impacts of a changing Antarctic environment. The envisioned observing network shares many characteristics with previous initiatives, such as the Arctic Observing Network (AON) or the proposed Pan-Antarctic Observing System (PAntOS). There is also an inherent need for improved sharing of data and information. Improvements in the collection, management, archiving, and exchange of information will allow data to be used for multiple purposes by a variety of stakeholders. In addition, improvements in scientific models of the Antarctic region are urgently needed to strengthen the simulation and prediction of future global climate patterns. These initiatives will require interdisciplinary approaches at the system scale that would be best addressed with a coordinated, long-term, international effort. Given the scope of the research program and to support infrastructure in the Antarctic region,

the United States has the opportunity to play a leading role in developing a large scale, interdisciplinary observing network and earth system models that can accurately simulate the conditions of the Antarctic region.

2. **Continue to support a wide variety of basic research in Antarctica and the Southern Ocean to yield a new generation of discoveries:** Antarctica and the Southern Ocean provide a natural laboratory for scientific discovery. The tiny air bubbles trapped within the ice hold a record of the planet's atmosphere through time, the living things in the ocean and on land can teach scientists about survival strategies in extreme environments, and Antarctica provides an excellent platform for looking out to the solar system and the Universe beyond. This type of scientific research should continue to be supported.

3. **Design and implement improved mechanisms for international collaboration**: Over the past half century, collaborations between nations, across disciplinary boundaries, between public and private sectors and between science and logistics personnel have helped research in Antarctica become a large and successful international scientific enterprise. The International Polar Year, held from 2007-2008, demonstrated how successful international collaboration can facilitate research that no single nation could complete alone. This report examines opportunities to enhance international collaboration, with the overall conclusion that by working together, scientists from many nations can reach their goals more quickly and more affordably.

4. **Exploit the host of emerging technologies including cyberinfrastructure and developing novel and robust sensors:** Advances in energy and technology can make scientific research in the Antarctic region more cost effective, allowing a greater

proportion of funds to be used to support research rather than to establish and maintain infrastructure. For example, most of the energy required to power research stations and field camps and to transport people and materials comes from burning fossil fuels. In addition to the cost of the fuel, the combustion of fossil fuels pollutes the air, and fuel leaks during storage and transport have the potential to contaminate the surrounding environment. Innovations such as more cost-effective overland transportation systems for fuel, or the use of wind power generators, promise to reduce the cost and pollution associated with fuel transport.

5. **Coordinate an integrated polar educational program**: Antarctica and the Southern Ocean offer great opportunities for inspiring popular interest in science in much the same way as space exploration did in the latter half of the 20th century. The National Science Foundation has supported a broad range of educational efforts to spark interest in polar science, including television specials, radio programs, and a multimedia presentation that toured U.S. science centers, museums, and schools. These efforts not only increase public awareness and understanding of the research taking place in Antarctica, but can help to inspire future generations of polar scientists. Building upon existing educational activities to develop a more integrated polar educational program, which would encompass all learners including K-12, undergraduates, graduate students, early career investigators, and life-long learners, would help engage the next generation of scientists and engineers required to support an economically competitive nation and foster a scientifically literate U.S. public.

6. **Continue strong logistical support for Antarctic science**: The Committee encourages the National Science Foundation-led Blue Ribbon Panel to develop a plan to support Antarctic science over the next two decades with the following goals:

    - Improve the efficiency of the support provided by contractors and enhance the oversight and management of contractors by the scientific community
    - Increase the flexibility and mobility of the support system to work in a continent- and ocean-wide manner, utilizing as much of the year and continent as possible, and fostering innovative "cutting-edge" science
    - Maintain, develop, and enhance the unique logistical assets of the U.S., including the research stations, aircraft, research vessels, and icebreakers.

Closing

The committee worked hard to identify these six recommendations that, together, will maintain our Nation's leadership in Antarctic science. After identifying the scientific questions in the first section, our group realized that a need for observations underpinned many of these questions, such that the proposed interdisciplinary observing system, although ambitious, was the key element in progress on the widest array of scientific issues and will prove invaluable over time. The committee was not charged with examining the costs of their recommendations, but our thinking was clearly influenced by the reality of limited resources.

As mentioned above, our committee wrote its report as input to the Blue Ribbon Panel, so our committee did not have the opportunity to comment as a group on the report from the Blue Ribbon Panel. As such, I can only offer my personal views on the results of their report. First, I

believe they did a stellar job, and in particular that they carefully listened to our committee's recommendations for more observations and for increased flexibility in the logistical support of science in the Antarctic region. The one area that I feel they could have paid more attention to was the need for more clearly defined and better communication channels and interaction between NSF leadership, the logistical support contractor, and working scientists in Antarctica. I can also tell you that I have heard that many in the science community are worried about the potential impacts of the Blue Ribbon Panel's recommendations on the conduct of science. With limited resources, we need to assure a balance between improving our capability to support our future presence in Antarctica and the actual conduct of research today.

To conclude, despite the challenges of working in the harsh environment of Antarctica and the Southern Ocean, this region offers great insights into our changing planet and is an invaluable platform for scientists to make new discoveries. Preserving the unique environment of the Antarctic region for new observations and experimental science requires a continued commitment to stewardship. Making use of international and multidisciplinary collaboration, emerging technologies and developing robust sensors, and educational opportunities, the next 20 years of Antarctic and Southern Ocean research have the potential to advance our understanding of this planet, and beyond. A robust and efficient U.S. Antarctic Program is needed to realize this potential.

In closing, the Antarctic region is a remarkable and truly amazing place, a place ripe for scientific discoveries that should be allowed to flourish there. What is more, Antarctica is an important part of our changing world, and we need to be watching it as it changes.

Thank you very much for your attention. I would be happy to answer your questions.

Chairman HALL. And I thank you, and I thank this group. I thank you very much. I have been up here 32 years and I have seen a lot of panels, and I have never seen a better panel than this one or more knowledgeable, more capable, more educated, and more generous with your time, and I even understood a lot of the things you said, Dr. Zapol. And thanks for the way you delivered it.

We are going to have a chance now to ask you all some questions. I guess I have the duty and the opportunity to be the first, so I will recognize myself for five minutes. You can start the clock now.

Dr. Suresh, while you testified that "NSF agrees with the majority of the Blue Ribbon Panel's recommendations," could you kind of tell us or please share with us those recommendations which NSF disagreed with and maybe why?

Mr. SURESH. I will be happy to, Mr. Chairman. It is not that we disagreed——

Chairman HALL. You only have five minutes, so you realize that.

Mr. SURESH. It will be less than that actually. I will be happy to answer that.

We set up a Tiger Team immediately after the release of the report and we charged the Tiger Team to look into ways in which we can address all the concerns of the Blue Ribbon Panel report in addition to see if we can go far beyond what was recommended in the Blue Ribbon Panel, taking also into account the NRC report. So the reason we said "majority" is that the task of the Tiger Team is not finished yet. It doesn't necessarily mean that there are areas that will have any differences of opinion with the Blue Ribbon Panel report. We will formally present the results of the Tiger Team in about three weeks or so to the National Science Board, and as I indicated, we will be happy to submit a copy of that report to this Committee.

The other reason I was careful to mention about the recommendations is that not all of the implementation is entirely within NSF's prerogative. There are aspects of it that we need to work with other agencies and other entities, and pending those conversations, it is not possible for me to say conclusively. So those are the reasons for it.

Chairman HALL. I thank you.

Norm, Dr. Augustine, as you know, and you do know this very well because you have evidenced it in all the programs and many panels you have been assigned to chair and to be a part of, you always look at the money and you are very clear about it in a great report that we really needed NASA. You declare in one short sentence there the problems that not enough money was part of the problem. And I appreciate that the panel took these constraints under consideration when you made your major recommendations here. But to pay for the improvements and upgrades at the Antarctic, the panel essentially recommends a formula of funding increases, funding shifts and reinvestment of saved cost. I believe your testimony indicates a "seven-year financial break-even," and this isn't a gotcha question at all. I wouldn't dare put a gotcha question on you. When all is said and done with additional future savings, kind of tell us or reassure us, how do you know the sce-

nario is achievable, particularly given that the panel didn't determine what the required front-end investment really ought to be. I know you had a way of fitting that in and recognizing it and agreeing or disagreeing with it and treating it and then going on with your report, but I have got almost another minute to hear you tell me about that.

Mr. AUGUSTINE. Mr. Chairman, we had the Institute of Defense Analyses help us with the cost estimating and we did calculate returns on investment and present values of the various proposals, most of the proposals we made. We couldn't do a detailed analysis. NSF is now doing it. We did identify the source of about $150 million, of which 64 would come from increased budget support from the Congress and from the White House. This should make it possible to carry out the various tasks that we have proposed.

Chairman HALL. I thank you, and I think my time is not quite gone. I will close my questions with again thanks to all of you, and to you, General McNabb, I thank you for the support you and your family gave Secretary of the Army Pete Geren, who was a long-time Member of this Congress. I know of your friendship and support there and your long-time respect for Jerry Costello, who is leaving. We are going to really miss him. He is a terrific member. But you all go way, way back, longer than I have any more time to let you express because that is five, four, three, two, I am out of time.

All right. At this time I recognize the gentlelady for her questions.

Ms. JOHNSON. Thank you very much, Mr. Chairman.

I guess I will put this question out and ask each member to comment. I have a major concern about short-term and long-term research knowing what our financial restraints are but also realizing that to sacrifice all of our research also is to cut off our nose to spite our face because it means our future, and as much as we have attempted to encourage young people to go into these fields, inengineering and scientific research, it is beginning to pose questions for them as to whether there is going to be a role in the future, not that we have impressed enough of them yet to do it but I am concerned about that and I would like to hear your comments on it. I realize how significant this research is but I also know that we are operating under great financial restraints, and if it was left up to me, I would not cut this area because I really sincerely feel that research is our future, and so I would like to have your comments on how you think we can best focus for the short term and the long term.

Mr. AUGUSTINE. Absent anyone else, I would be happy to try to answer that. Obviously, this is one of these things that you can't do all short term and you can't do all long term, it takes some balance. The advancements from science have been said to drive about 85 percent, up to 85 percent of the growth in our economy, and by my own calculations, that suggests that about each percentage point you add to the number of scientists and engineers in this country creates about a million jobs. So there is great leverage to be had here. We are not doing well at attracting young people into science and engineering. In fact, out of 93 nations, we rank 79th

of the fraction of bachelor degrees that go to science and engineering.

But I think what it takes is balance, and in business I have learned that at times that you have to cut your overall budget, there are some cases that you increase the budget in some areas, and science and engineering are one of those areas, marketing is probably another, but I think that is true of government as well.

Mr. SURESH. First of all, I want to thank you, Ms. Johnson, for your support for science. In terms of short term, we will do everything possible with the budget that we have to make sure that safety and security for not just NSF colleagues but for everybody—contractors, scientists who travel to Antarctica—is ensured. So we will do everything possible in the present environment.

Going to the long term, I fully resonate with your concern, and I also echo what Mr. Augustine just said. NSF receives approximately $7 billion a year from U.S. taxpayers to support science. Last year we supported 300,000 individuals in over 2,000 institutions in the country. I would argue based on a lot of evidence that the return to the U.S. Treasury based on the annual $7 billion investment is many, many, many times the $7 billion, and that is a compelling enough reason in addition to the jobs and everything else to continue to support science.

I am very concerned about our ability to compete with the rising competition from all over the world for not only science and engineering research but also for human talent; our ability to attract and retain talent in science, both from domestic talent and talent from all over the world which this country has relied on very heavily, and if we lose that, I think it will be major competition, so I very much appreciate your concerns.

General MCNABB. Yes, ma'am. I would say that one of the things that we really looked hard at is the productivity of your scientists and that community, and one of the things you want to do is, you can increase their productivity a lot if you give them the right facilities and logistics support. Right now I would say that if you go down and you visit the Antarctica, you will see that it is not efficient for them and it just—and it begs for the fact that if you can really help that, if you can really make sure the have the proper logistics infrastructure underneath them, it will be amazing how much more their time is worth, not only to the NSF and to the science community but really to the country.

One of the big things in this country is transportation infrastructure. It is what fuels our productivity, and if you do it right, you compete very well. Well, I think we are competing for those young people, and when they go down and do a tour down the Antarctic, you can just imagine if they go down there and give it some of the things that we saw. If you give them world-class stuff, they will give you world-class results. The problem is, it is hard to get ahead of that, especially on logistics. I was the J–4 for the joint staff looking at logistics. The one place everybody seems to think they can always take money is logistics, and normally, logistics infrastructure and all you have to do is look at what happens when a Sandy or something comes through and you go boy, I sure wish we had buried all those electrical lines. Those are things that we can get ahead of now and really do pay back some dividends, and so that

is one of the things that we really focused on in the Blue Ribbon Panel with the understanding that we are trying to increase science and reduce cost.

Dr. ZAPOL. Ranking Member Johnson, two points from an Antarctican view. First, Antarctica is extraordinarily attractive to young people. It really turns on high school classes. We surveyed in our report and we asked about—we asked do you have enough young people to do your research or enough Americans wanting to go to Antarctica and do research? We got a resounding reply that everybody wants to go, everybody is interested, there is no shortage. So this isn't like NASA. This is an extraordinarily attractive place where young people can really get the idea of science, how to do it and want to do it. So I think Antarctica is really not suffering that way.

And I think the second thing is, the science community worries about the price of logistics. We worry about the price of the Pole and the Pole Station and whether it was worthwhile, all of it, and we worry about the logistics taking over the minimal science budget. It is only 20 percent. If you shrink it, a lot of good grants won't get funded. I know more about NIH where the funding rates get down to ten percent and eight percent and you lose competitive—you just start losing people at that point. You can't shrink the science too much, and there is an anxiety. I speak for the community from what people have told me. They worry that logistics will get 100 percent of it and there won't be any science. So those are the worries.

Ms. JOHNSON. Thank you very much for your time. My time is expired.

Chairman HALL. Thank you. And when you talk about under budget and you look at NASA back through the years, and if we had just done a little different to what Norm had suggested and others for just even close to one percent of the overall budget, we would still have access to space that we must have, must get back.

At this time I recognize the gentleman from Texas, Mr. Smith, for five minutes.

Mr. SMITH. Thank you, Mr. Chairman.

Dr. Zapol, let me address a couple of questions to you. First of all, you have great knowledge both about Antarctica and the Arctic Circle, and I am wondering if that makes you a bipolar expert.

Dr. ZAPOL. It does.

Mr. SMITH. Without question. I also want to thank you for the discovery you made ten years ago and the research you did that results in the saving of 15,000 babies' lives every year. That is just incredible and a real credit to you for doing so.

My question is this, and I appreciate what you said about the Antarctic being exciting to young people. I understand what you said about the sense of exploration when you are the first person to pick up a rock, and we might say that that holds true not only for the surface of the ice in Antarctica but also picking up a rock on the moon or an asteroid or on Mars. But my question is this. Is it possible that some of the research done in Antarctica could be done elsewhere for less cost? And more specifically, for example, some of the research you did on seals that you mentioned in your opening statement, could that have been done elsewhere?

Dr. ZAPOL. Well, let me approach it from the seal point of view. I couldn't have at that time. I am not sure you could do it today. The ice, the fast ice of Antarctica, by freezing and freezing fast to the shore creates a platform, and it allowed us to go 25 miles offshore and drill a hole through the ice. Then when you released a wild seal there, we knew it couldn't breathe anywhere else. So it had a computer pack and things on its back and it had to come back to our hole. I honestly don't think if you did this on a shore where they could take off, you would probably never find them again or you would spend a lot of time tracking them down, and we did that in 1984 and so technology was in an earlier time. You might be able to today but I doubt it. I think that sort of research with captive hole diving can only be done there.

Mr. SMITH. You might be able to replicate that today but you would know more about that than I.

Let me then ask all the other panelists this question, and it is a little bit of a follow-up to what you have been asked already. The cost of research and the logistical support in Antarctica now is about a third of a billion dollars. Is it not possible that not only could some of that research be done elsewhere but is it not possible that some of the research might get done anyway by, say, the private sector, and is it possible that some of the research could be done elsewhere other than the Antarctic at that cost? And Mr. Augustine, we will start with you.

Mr. AUGUSTINE. All right. Thank you. I think when you are dealing with basic research of the type we are talking about, it is highly unlikely that the private sector would support it. The reason is that the results are too uncertain, too long term, too costly.

Mr. SMITH. But the private sector would certainly support saving 15,000 babies a year.

Mr. AUGUSTINE. The problem is, if you go to a corporation and say we want you to study Weddell seals, they probably would say no, and another former member of your Committee told me of a project your Committee supported to study butterfly wings that turned out to produce one of the ingredients that is used in treating cancer, and those things just in industry frankly were too shortsighted by pressures of the marketplace that companies just won't support it. A classic example is the great Bell Labs that are basically shutting down.

Mr. SMITH. There may be more potential than we think right now. I think about commercialization of space, which was just a few years ago thought not to be practical, and look what is happening there as well. But thank you for your answer.

Dr. Suresh, good to see you again.

Mr. SURESH. Good to see you, sir. Let me first address your earlier question about why Antarctica, can this be done somewhere else, because that is related to your second question. In my opening statement, I highlighted three discoveries. Those three discoveries could not have been done anywhere else. One of them has had a huge impact in addressing—because Antarctica is sort of a place where you identify things that you cannot see anywhere else, even if you just take Arctic versus Antarctic, the Arctic is much more heavily populated and it is not nearly as pristine as Antarctica. So the scientific discoveries that we make in Antarctica that have im-

plications for so many different fields, we could not do anywhere else. So that is the first point I would like to make.

Related to that, I think given that and given the fact that every branch of science and engineering that NSF supports, which is pretty much all fields of science and engineering, benefits from the research in Antarctica, and given the fact that 31 nations have now recognized the importance of this and are increasingly investing in it, and the United States has historically had a leadership role, I would argue very strongly that now is not the time to cut back on the investment.

Mr. SMITH. Mr. Chairman, I appreciate those answers. My time is up.

General McNabb, I assume you would agree with the responses that we just received? Okay.

Thank you, Mr. Chairman.

Chairman HALL. And I thank you.

The chair now recognizes the gentleman from California, Mr. McNerney, for five minutes.

Mr. MCNERNEY. Thank you, Mr. Chairman. I do want to echo your comments on the panel's hard work, and I want to thank you all for coming and getting engaged in this issue. As Dr. Zapol indicated, when I was in high school I wanted nothing more than to go to Antarctica. So one point of validation for that.

There was some—some of your testimony is quite concerning, almost alarming. Mr. Augustine, you sort of were indicating the dilapidation of many of the facilities there, and then Dr. Suresh, I think, mentioned operating under multiple single points of failure. What is the worst-case scenario we are talking about? Are people's lives at risk that work in Antarctica?

Mr. SURESH. So first of all, as pretty much every panel member suggested here, the National Science Foundation in partnership with other agencies for more than half a century has had a phenomenal record of safety in running the U.S. Antarctic Program, and I want to emphasize that. So I think the spirit of the recommendations, and my distinguished colleagues can speak for the report, which I cannot speak for, the spirit of the recommendations is that there is a potential if we don't address and improve the logistics. For example, having access to Antarctica to supply fuel is so critical, so if you don't have the right icebreaking capabilities, that will potentially lead to severe loss of investments for the future. Not having a capital budget is one of the biggest recommendations. So it is in that spirit, some of the recommendations like the dishwasher in McMurdo, which feeds a number of people, we take it very seriously, and it is not that—if you look at it historically, we will look at each of these recommendations and as quickly as possible try to address to see if we can improve the situation.

Mr. MCNERNEY. Well, one of the things that keeps coming up is the small fraction of money that goes to science as opposed to logistics. Is part of that because of the dilapidated state of logistics? If the logistics were improved, could more money go to science, to real science?

Mr. AUGUSTINE. I think the answer to that is without question that could be the case. If you took the one recommendation we

made that produces the highest savings after the initial investment, in the steady state, it alone could add 60 typical grants to the science effort. So there is a huge opportunity here.

Mr. MCNERNEY. Okay. Let us talk a little bit about the foreign presence or the risk to American leadership in the Antarctic. We clearly have—the United States clearly has the largest presence in Antarctic. What would be the risk if other countries were to come in and co-dominate that presence? General McNabb?

General MCNABB. I think our leadership on the Antarctic along with all the other nations that have signed a treaty has really been superb, and the ability to preserve this place on our earth in a time when science is going to be so important is going to be critical. I am not sure that if we were not there and taking the leadership role, I am not sure how fast, given what you see happen around the world and really the competitive—you know, the competitive—competition for resources, that you would end up seeing the Antarctica be what it needs to be for the world, and that would be my take.

Mr. MCNERNEY. Anyone else want to comment on that?

Mr. AUGUSTINE. I would welcome the opportunity. I think if you consider both the missions in Antarctica, with regard to the political implications, there are overlapping claims that you are well aware of that have been made by seven different countries, and there is, I think, good evidence that the United States presence there, particularly the presence at the Pole, has led to a very peaceful Antarctica, and as there is more and more exploration in that area, that will become more of a challenge, I believe.

With regard to science, the United States has given up its lead in things like particle physics that it has had for years. It would be a shame to see us give up our lead in another area. I also find a certain irony that this Committee probably has recognized it. Today we can't reach our—I say "our," the International Space Station of which we pay for a major part, without flying on Russian launch vehicles. Similarly, we can't get to Antarctica without using today Russian icebreakers, and that is a trend that probably is not something that a great nation would want to have.

Mr. MCNERNEY. Thank you.

Mr. Chairman, I concede my time.

Chairman HALL. And I thank you.

I recognize Mr. Brooks, the gentleman from Alabama.

Mr. BROOKS. Thank you, Mr. Chairman. I could not help but note the correlation between us using Russian icebreakers and manned spaceflight vehicles. Hopefully, we will be able to restore America's preeminence in both fields in our near future.

I have got a two-part question addressed to the whole panel. By the very nature of the Antarctic treaty, international cooperation is essential to success in Antarctica. With specific regard to logistics, that being such a high-cost area, how are we currently sharing logistical burdens, with whom and at what savings to the United States taxpayer, and then the more important second part of the question, how can we expand logistics cooperation with other nations and at what projected or potential savings?

Mr. AUGUSTINE. With the Committee's permission, I will start out and try to be brief. Today there is a lot of sharing, particularly

with New Zealand, somewhat with Australia and with others. New Zealand recently built three wind-power facilities at McMurdo, which provide a substantial part of the power to the U.S. station there as well.

In terms of the future, very briefly, one of the main opportunities would be on the Antarctic peninsula where Palmer Station is located. There are many stations of other countries in that same area and one could imagine instead of each nation providing its own logistics, that there could be basically a logistics Walmart, if you will, on a ship that makes a route around the Antarctic peninsula and has a stockroom that various countries could buy their parts from. So I think there is enormous opportunity.

Mr. SURESH. Congressman Brooks, I will be very brief. We have had very longstanding collaborations with a number of countries from the U.K. to New Zealand to Chile and to many others. Recently, some countries have expanded their activities in Antarctica. For example, South Korea is in the process of building a new station not too far from McMurdo, just a few hundreds kilometers from McMurdo. They have also built a new icebreaker, and we have been engaged—the head of our polar program has been engaged in discussions with the president of the South Korean Polar Program on ways in which we can collaborate including in the area of infrastructure and logistics.

General MCNABB. Congressman Brooks, I would say that one of the things that we really bring is our transportation capability to the team, if you will. Because of the nature of how our DOD works, we bring some capabilities that nobody else has. I can use the LC–130 ski bird as a great example. You know, other nations will have smaller airplanes that are equipped with skis but that LC–130 is kind of unique. One of the things we want to do is to make sure that we are freeing up assets for better support of science, and one of the places where we talk about that is a better mix of how we use our C–17s and our C–130s as an example. If we use our C–17s more to do more normal-type movement, we can free up LC–130s to do a better support for the field operations that are out there.

Mr. BROOKS. But right now I am focused just on international cooperative measures, our own logistical issues internally.

General MCNABB. And in this case, where we joined with some other nations was the AGAP project out in west Antarctica which where we provided really the LC–130 and C–17 air drop. Other countries, China provided traverse operations and other countries that did their part with little airplanes and so forth.

Mr. BROOKS. I am going to have to go to my next question. I apologize, Doctor, but you can jump on this first if you so choose. Is it the role of Congress or the White House and the NSF to facilitate these kinds of international cooperative measures to help lower our logistical costs, and if it is Congress, what can Congress do to facilitate that cooperation? Anybody can answer.

Mr. AUGUSTINE. I will step into that. I think it is the responsibility of NSF. It is the responsibility that was delegated to NSF some 30 years ago but obviously it takes the support of the Congress, the White House.

Mr. BROOKS. What, specifically, should Congress do to facilitate cooperation internationally on logistical costs?

Mr. AUGUSTINE. I think it is mainly a matter of encouragement. I should say that the State Department takes the lead, obviously, in these international contacts.

Mr. BROOKS. But we give encouragement to cut down costs so is there anything else we need to do?

Mr. AUGUSTINE. The only thing I could think of is that some of the—well, it is not the Congress's role. Some of the early presidential decisions needed to be updated but that is—I think the Congress is doing what it can do. I think it is really NSF, the State Department, they probably will be asking for funding. That will be obviously a Congressional issue.

Mr. SURESH. I would like to add to that. I think, you know, NSF has been appointed as the point agency to work with our sister agencies and coordinating, and we work very closely with the State Department and the White House and other agencies as well. I think Congress can help us with—I mean, we keep Congress involved frequently and continuously about what we do. Both moral support and support for infrastructure and funding for the science in Antarctica will go a long way.

Dr. ZAPOL. A bipolar comment. The Arctic has much more problem, and I am a commissioner, an Arctic research commissioner, and they are much more difficult. This is actually a rather easier place to work. The Antarctic treaty works. I have had five or six. In my team of eight, I had a New Zealander, an Australian, a German, a Canadian and a Dane. It is very easy to mix in our teams, and I think the scientists are way ahead there. It has been slow cooperation in a strange form. It is not a—it should go better, warmer. I think New Zealand in particular so close to McMurdo, so involved. I think we need to do more of that.

Mr. BROOKS. Thank you, Mr. Chairman, for allowing the witnesses additional time to answer my question. I yield—well, I would yield but I have none.

Chairman HALL. If you have some, I will accept the yield. If you don't, I will accept it also.

Ms. Bonamici from Oregon, I recognize you for five minutes or more.

Ms. BONAMICI. Thank you very much, Chairman Hall and Ranking Member Johnson, for calling this hearing, and to the panel, you have done an excellent job of effectively communicating the value of research in Antarctica from the discovery of the ozone hole to saving thousands of babies a year. I also want to point out, Dr. Zapol, in your testimony where you talk about monitoring space weather and how space weather could disrupt the proper functioning of communication satellites, GPS systems, electrical power distribution systems and how the space weather is better viewed from the South Pole than the shifting seas of the North Pole. I just wanted to point out, I found that extremely compelling as well.

So scientific research and technological innovation are very thriving in the district I am proud to represent. My constituents are keenly aware of the impact of NSF, fundamental research dollars, and I have, for example, Oregon State University, Portland State University, my alma mater, the University of Oregon, all have com-

pleted research projects through the U.S. Antarctic Program. In fact, the acting director of the Office of Polar Programs at the NSF was previously with Oregon State University.

Considering the role of university-based polar research in Oregon and nationally, I want you to look ahead to the impending across-the-board cuts that would be brought on by the sequester, and I have a question about the funding for science versus the funding for logistics because Mr. Augustine, you mentioned that the cruel arithmetic of conducting research in the climate presented by the polar region, meaning that if logistics costs rise by 13 percent, the science would be halved. So with that in mind, will you please comment on the impact that the proposed cuts to NSF might have on the future of the Antarctic program considering especially the multiplier effect that Mr. Augustine talked about. Would the sequester effectively end the science portion of the program, and perhaps Dr. Suresh, you could begin?

Mr. SURESH. I would be happy to address that. So if the worst-case scenario that is being proposed materializes, the Office of Management and Budget predicts that NSF's budget along with that of our sister agencies, science agencies, will suffer about 8.2 percent. So that—if it is across the board, that will be reflected across NSF. That would mean 1,000 fewer grants will be awarded. We typically give about 13,000 per year. About 1,000 fewer grants per year, thousands of scientists will be affected, and it goes back to an earlier question by the Ranking Member. It will also discourage a lot of very young people from going into science. This is the future of American leadership in science and engineering and therefore this is the future of our economic leadership and national security and other issues, and that is the biggest concern. That is our projection of the worst-case scenario of sequestration.

Ms. BONAMICI. Thank you. And I know you have already—did you want to talk about that too, Mr. Augustine?

Mr. AUGUSTINE. I would welcome the chance, just briefly, if I might. If this eight percent cut that is likely to take place if sequestration occurs, it would have an impact primarily on the science and not the logistics. It would be disproportionate, and the reason for that is that you still have to have an icebreaker. If you have one scientist, you still have to heat the buildings. If you have one scientist, then you have provide a fuel tanker, and so on. So I can imagine the impact on science, and I have never calculated the number, but it would be many times the eight percent.

Ms. BONAMICI. Thank you. And with the brief time remaining, you did an excellent job of conveying to this committee the importance of the research that you do there. What efforts are you making to convey that to the public?

Mr. SURESH. We have a lot of activities in Antarctica from conveying a lot of educational activities which reach not just researchers and undergraduate students but also schoolchildren. We even have an artist-in-residence program to convey the unique aspects of the excitement of Antarctica to the general public, and there are many, many ways in which this is communicated through videos to supporting science programs to communicating to school districts, et cetera, et cetera.

Ms. BONAMICI. Thank you. Anyone else want to weigh in on efforts?

Thank you very much, and I yield back. Thank you, Mr. Chairman.

Chairman HALL. The gentlelady yields back. I think that we have no other witnesses, and I want to thank all of you for your very valuable testimony and the Members for their questions. The Members of the Committee might have additional questions they want to submit to you, and if they do, I hope you will respond to those in writing to them. The record will remain open for two weeks for additional comments from the Members. And with once again just heartfelt thanks to all four of you and to those who attended and those who work with you and background information they sent to us, we thank all of you for it, and we are adjourned.

[Whereupon, at 11:19 a.m., the Committee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Mr. Norman R. Augustine

Questions for the Record
The Honorable Ralph M. Hall, Chairman

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science

Thursday, November 15, 2012
10:00 a.m.

QUESTIONS FOR MR. AUGUSTINE:

1. It is my understanding that the repairs and renovations to the USCG heavy duty icebreaker, *Polar Star*, will soon be complete, and she will once again be available to provide support in the Antarctic. How does this affect the urgency for the U.S. to acquire a new heavy duty icebreaker?

2. The Blue Ribbon Panel Report mentions potential circumvention of the Antarctic Treaty and related instruments as possible future single-point failures. Is this a current danger, and if so, please elaborate on the concern?

1. It is my understanding that the repairs and renovations to the USCG heavy duty icebreaker, *Polar Star*, will soon be complete, and she will once again be available to provide support in the Antarctic. How does this affect the urgency for the U.S. to acquire a new heavy duty icebreaker?

You are correct that the Polar Star will soon return to sea after a period of major maintenance. It is expected that the upgrades that have been provided should make her suitable for as much as a decade of service in the harsh environment in which she operates. At that point the vessel will be approaching a half-century of age and will inevitably need to be retired. Given the long lead time to fund, design and construct a new icebreaker, action is required promptly if the U.S. is not to be dependent upon foreign sources for icebreaking in the Antarctic.

2. The Blue Ribbon Panel Report mentions potential circumvention of the Antarctic Treaty and related instruments as possible future single-point failures. Is this a current danger, and if so, please elaborate on the concern?

As your question implies, the list of single-point failure modes contained in the report are ones that could have profound implications on the ability to accomplish the U.S. missions in Antarctica. The Committee did not attempt to assign the likelihood of each of the failure modes actually occurring. It appeared to the Committee that there is no immediate danger of a rupture in the Antarctic Treaty even given the growing interest in Antarctica and presumably its potential resources. Nonetheless, the Committee does seek to highlight the importance of preserving the treaty.

Norm Augustine
01/03/13

Responses by The Honorable Subra Suresh

Questions for the Record
The Honorable Ralph M. Hall,
Chairman

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science

Thursday, November 15, 2012
10:00 a.m.

QUESTIONS FOR DR. SURESH:

1. Has NSF heard any concerns from the scientific community regarding the impacts of the Blue Ribbon Panel's recommendations on the conduct of science in Antarctica? If so, how are those concerns being addressed?

   - NSF has generally received positive feedback for the overarching goal of improving science efficiency and broadening opportunities for the type and kind of science that could be supported in Antarctica. However, NSF managers have heard concerns about the Blue Ribbon Panel's (BRP) recommendation to redirect $4 million, or 6%, per year for four years from the NSF Antarctic science budget toward logistics improvements. NSF is implementing this recommendation by funding the science community to develop and improve remote sensing instrumentation and other technologies that will in turn increase the efficiency of the enterprise and make it possible to support more science. NSF management has and will continue to communicate this approach to the community through USAP channels, public forums, and conferences. We expect some concerns will remain until the approach has been more fully implemented.

2. It is my understanding that the repairs and renovations to the USCG heavy duty icebreaker, *Polar Star*, will soon be complete, and she will once again be available to provide support in the Antarctic. How does this affect the urgency for the U.S. to acquire a new heavy duty icebreaker?

   - The Coast Guard has informed NSF that the POLAR STAR is expected to be in service for the 2013-2014 USAP resupply mission at McMurdo. Coast Guard has indicated that the refurbishment is intended to extend the vessel life by 7-10 years. The lead-time for new vessel acquisition by the Coast Guard is such that it must proceed now to be in place by the time of retirement of the POLAR STAR if the Coast Guard is going to continue to serve the USAP resupply mission.

3. You testified that the Blue Ribbon Panel safety recommendations are paramount. I agree that the safety of those on the ice is essential. I understand you have already chartered the team of senior NSF staff to respond to the report. Can you share any initial conclusions or actions taken by the team or NSF in general to ensure the safety of those in Antarctica?

   - Safety of our personnel and operations in Antarctica is always a priority concern for NSF.

- Several of the safety and health implementing actions in the report have already been acted on. For example, a boat ramp and floating dock are being constructed this season at Palmer Station to address concerns about small boat operations (complete by June). Additionally, the flooring in the Building 120 warehouse was repaired shortly after the BRP visit to McMurdo Station.

- The new prime contractor, Lockheed Martin Corporation, has a comprehensive safety & hazard communication program for employees, including risk assessment, which is being implemented as part of the contract transition.

- The safety and health implementing actions that require engineering or large investment, including upgrading of fire suppression systems and replacing the Palmer Pier are being addressed in the long range plans for each of the Antarctic stations.

4. We look forward to receiving a copy of the point-by-point response to the Blue Ribbon Panel's recommendations, when can we expect this document to be shared with the Committee? Would you consider this a master plan for implementation, and if so, will you be prioritizing the recommendations? What can we expect to see in the FY14 Budget Request?

    - We are currently in the process of updating our response to the recommendations to account for recent activities and will provide a copy to the Committee by the end of the current Antarctic operating season (end of February 2013), coincident with briefings to the National Science Board and the Blue Ribbon Panel. A prioritized implementation plan is being developed that will continue to be updated as budget information and the results of various studies underway become known.

5. The Blue Ribbon Panel Report mentions potential circumvention of the Antarctic Treaty and related instruments as possible future single-point failures. Is this a current danger, and if so, please elaborate on the concern?

    - Despite growing international interest in Antarctica, there does not appear to be an immediate threat to the Antarctic Treaty System.

    - We concur with the Blue Ribbon Panel that maintaining an active and influential science presence in Antarctica is essential for ensuring that the US retain its governing role in the Treaty system. While the Treaty is in force, territorial claims remain in abeyance and an effective environmental protection framework is in play both helping to preserve Antarctica for peaceful, scientific purposes.

6. NSF recently announced a reorganization of several offices, including moving the Office of Polar Programs from the Office of the Director to the Geosciences Directorate. Why was this realignment necessary and how will it affect the Office of Polar Programs ability to manage the U.S. Antarctic Program? How will it affect the Foundation's ability to implement recommendations from the reports and carry out other Antarctic activities?

- The realignment is intended to strengthen science and engineering technical guidance, coordination, and leadership at NSF.

- The mission of OPP will be better addressed in a directorate where NSF's overall science and engineering programmatic responsibilities reside, and OPP staff will continue to exercise the same authorities that they currently maintain.

- The realignment will ensure that administrative resources, including resources for program oversight, are more readily available ensuring a continued commitment to polar research, infrastructure and logistics.

Responses by General Duncan J. McNabb, USAF (Ret)

Questions for the Record
The Honorable Ralph M. Hall, Chairman
HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science
Thursday, November 15, 2012

QUESTION FOR GENERAL MCNABB

1. Based on your experience in the transportation related endeavors for the U.S. Antarctic Program and your testimony regarding the importance of an "enterprise transportation approach," can you highlight for us what you view as the real strengths and weaknesses of the existing Antarctic transportation systems? If you were leading the response to the Panel recommendations, focusing solely on transportation related issues or concerns where would you begin to make changes?

I believe the greatest strength of the transportation chain supporting the NSF is the "can do" culture and innovative spirit of the great folks supporting the operation. It is amazing to me how well folks across our government have worked together to successfully support science research in this very austere environment with the tools they have. Another great strength is the capability the multimodal logistics hub at McMurdo brings to the equation. It is the only location on the continent that couples a deep water port with a airfield capable of handling large aircraft. No one has the strategic reach of the United States, and multimodal ops at McMurdo allows us to use that to great advantage. Another real strength I would like to mention is the process of how the whole interagency supports NSF in their mission. It is a great example of all parts of our government coming together under a designated lead agency and producing excellent results.

I think the greatest weaknesses of the transportation system are the single point failures identified in the report, the most notable being the reliance on contract ice breaker support to get the majority of fuel and cargo into McMurdo...for follow on support to multi-agencies, field missions, and the South Pole. Additionally, the lack of capital budgeting and multiyear funding have resulted in an inefficient logistic infrastructure and compromised NSF's ability to make best use of limited resources to support the mission.

The most important transporation endeavors which I believe would make the most dramatic impact on furthering science and reducing cost are: optimizing and expanding the traverse operations through investment in new equipment and better use of technology (crevasse detection, GPS stationkeeping, robotics, etc); using air assets more effectively like expanding use of the C-17 where possible to free up LC-130 hours for more direct field support to Science (compacting the South Pole Runway to allow routine C-17 operations is key) and increasing use of airdrop for forward camp resupply; and compacting roads, taxiways, and runways to speed up operations and reduce wear and tear on transportation assets, especially around McMurdo. Greatest bang for the buck for any improvements will be realized by using an enterprise approach to Command and Control, so all land, sea, and air assets can be used together for best advantage.

2. It is my understanding that the repairs and renovations to the USCG heavy duty icebreaker, Polar Star, will soon be complete, and she will once again be available to provide support in the Antarctic. How does this affect the urgency for the U.S. to acquire a new heavy duty icebreaker?

The renovations to the Polar Star are a good start, but our Nation needs more than one heavy icebreaker given growing demand in the Arctic and Antarctic and the need for periodic maintenance...especially on older ships like the Polar Star. I believe the Blue Ribbon Panel report outlined very well the importance of having heavy ice breaking support that the NSF and can count on for their annual surface resupply of fuel and cargo to McMurdo. Iceberg B15 demonstrated directly how fragile the surface resupply would be without heavy ice breaking cability...and depending on other Nations is problematic as demonstrated by Sweden giving late notice that they could not provide the Oden for the 2011/2012 breakin.

The breakin was provided historically by the US Navy and then by the US Coast Guard until the 2004/2005 resupply. Because of reliability and availability of US National ice breaking capabilities, USAP had to contract with other nations...which belies how critical the ice breaking mission is to the overall US Antarctica program. This is why it is identified by the BRP as one of our critical single point failures.

Currently the Polar Sea is out of commission and the Polar Star, even with its service life extension program, will unlikely have a useful life beyond the 2020/2021 season. Additionally, the requirements for icebreaker support in the Arctic are also growing and will compete for its limited availability.

For all these reason I fully concur with the BRP's strong recommendation that we follow through on the President's FY 2013 Budget request to design and build a new icebreaker that meets our National polar requirements for both the Arctic and the Antarctic. This is an absolute key to restoring our US Polar Ocean Fleet.

3. The Blue Ribbon Panel Report mentions potential circumvention of the Antarctic Treaty and related instruments as possible future single-point failures. Is this a current danger, and if so, please elaborate on the concern?

I believe the fierce competition for resources across our globe will continue. Given the abundance of precious resources in the Antarctic and Southern Seas, some Nations might consider undermining the treaty in pursuit of these rich resources. Continued strong US Leadership will be key to preserving multinational support of the Antarctic Treaty. As mentioned in the BRP report, the primary purpose of the Antarctic treaty is to ensure "in the interests of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of International discord." We must do all we can to preserve this pristine and invaluable global treasure for the world and for the science which benefits all.

Responses by Dr. Warren M. Zapol, M.D.

Future Science Opportunities in Antarctica and the Southern Ocean

Responses to Questions following the Congressional Testimony of

Warren M. Zapol, M.D.
Reginald Jenney Professor of Anesthesia at Harvard Medical School, Emeritus Anesthetist-in-Chief at Massachusetts General Hospital, Director of the MGH Anesthesia Center for Critical Care Research, and Chair, Committee on Future Science Opportunities in Antarctica and the Southern Ocean, National Research Council / National Academy of Sciences

before the Committee on Science, Space, and Technology, U.S. House of Representatives

on November 15, 2012

Questions for Dr. Zapol

Question 1: You testified that many in the science community are worried about the impacts of the Blue Ribbon Panel's recommendations on the conduct of science. Is this concern based solely on the proposed short-term recommendation to reduce funding for science in order to help defray a small portion of the costs of infrastructure and logistical improvement? Do you support the funding recommendation, and if not, why not and how would you recommend paying for the improvements, particularly the single point failure remedies?

Response: The concern I have heard from some in the science community is primarily based on the proposed short-term recommendation to reduce funding for science in order to help a portion of the costs of infrastructure and logistical improvements. I believe there are three things that contribute to this concern:

- While there is general agreement that improvements in the infrastructure supporting Antarctic science are critically needed, it needs to be emphasized that now is a critical time for science in the polar regions. There are large changes happening in Antarctica and the Southern Ocean right now and we need consistent, high quality observations and science now and without interruption in order to understand the changes and how they will affect the rest of the globe.
- As the Blue Ribbon Report describes, much of the budget (over 80%) of the Antarctic program is already allocated to logistics. It seems to me that the science portion of the budget (less than 20%) is too small to cut. Any reduction in the science budget will almost certainly result in real reductions in the amount and/or quality of the science being performed, and it would likely result in the loss of scientists getting into Antarctic

research; once people leave a specialty field and without a pipeline of incoming scientists, it is difficult to rebuild the expertise later.

Leading up to the reconstruction of the South Pole Station, Antarctic scientists were also told that by accepting a short-term reduction in the amount of support (funding and flight hours), there would eventually be a gain in support for Antarctic science in the long run. Now that the South Pole Station reconstruction is complete, there is the perception that scientists are again being asked to make a sacrifice.

To be clear, I cannot speak for the National Academy of Sciences/National Research Council or my Committee on whether or not we agree with the funding recommendation; as you know, the NRC study was completed before the Blue Ribbon Panel report was initiated. From my own personal opinion, I would suggest that the possibility of the needed funds be taken from logistics funding (perhaps cutting items that are not really vital) be examined so as to allow that the science budget be held at the present level.

Question 2: The Blue Ribbon Panel Report mentions potential circumvention of the Antarctic Treaty and related instruments as possible future single-point failures. Is this a current danger, and if so, please elaborate on the concern?

Response: Our NRC Committee was not charged nor composed of the right expertise to analyze the effectiveness of the Antarctic Treaty and I do not feel that I have any particular expertise or insight into this issue.

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