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NATIONAL SCIENCE FOUNDATION BUDGET AND MANAGEMENT CHALLENGES

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

MARCH 9, 2005

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CONTENTS

March 9, 2005

	Page
Witness List	2
Hearing Charter	3

Opening Statements

Statement by Representative Bob Inglis, Chairman, Subcommittee on Research, Committee on Science, U.S. House of Representatives	14
Written Statement	15
Statement by Representative Darlene Hooley, Ranking Minority Member, Subcommittee on Research, Committee on Science, U.S. House of Representatives	16
Written Statement	17
Prepared Statement by Representative Eddie Bernice Johnson, Member, Subcommittee on Research, Committee on Science, U.S. House of Representatives	18
Prepared Statement by Representative Russ Carnahan, Member, Subcommittee on Research, Committee on Science, U.S. House of Representatives	19

Witnesses:

Dr. Arden L. Bement, Jr., Director, National Science Foundation	
Oral Statement	20
Written Statement	22
Biography	28
Dr. Mark S. Wrighton, Chairman of the Committee on Audit and Oversight, National Science Board; Chancellor, Washington University, St. Louis	
Oral Statement	28
Written Statement	30
Biography	35
Dr. Christine C. Boesz, Inspector General, National Science Foundation	
Oral Statement	36
Written Statement	37
Biography	43
Discussion	43

Appendix 1: Answers to Post-Hearing Questions

Dr. Arden L. Bement, Jr., Director, National Science Foundation	58
Dr. Mark S. Wrighton, Chairman of the Committee on Audit and Oversight, National Science Board; Chancellor, Washington University, St. Louis	69
Dr. Christine C. Boesz, Inspector General, National Science Foundation	71

Appendix 2: Additional Material for the Record

Letter to Dr. Arden Bement from Chairman Sherwood Boehlert, dated April 13, 2005	74
Letter of Response to Chairman Sherwood Boehlert from Dr. Arden Bement, dated May 23, 2005	76

Page
National Science Board Members 2005 81

NATIONAL SCIENCE FOUNDATION BUDGET AND MANAGEMENT CHALLENGES

WEDNESDAY, MARCH 9, 2005

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:10 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Bob Inglis [Chairman of the Subcommittee] presiding.

SUBCOMMITTEE ON RESEARCH
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

National Science Foundation Budget and Management Challenges

Wednesday, March 9, 2005
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building (WEBCAST)

Witness List

Dr. Arden Bement
Director
National Science Foundation

Dr. Mark Wrighton
Chairman, Audit and Oversight Committee
National Science Board

Dr. Christine Boesz
Inspector General
National Science Foundation

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HEARING CHARTER

SUBCOMMITTEE ON RESEARCH
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

National Science Foundation Budget and Management Challenges

WEDNESDAY, MARCH 9, 2005
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose

On Wednesday, March 9, 2005, the Research Subcommittee of the Committee on Science of the House of Representatives will hold a hearing to examine the fiscal year 2006 (FY06) budget request for the National Science Foundation (NSF), as well as longer-term budget and management challenges facing the Foundation.

2. Witnesses

Dr. Arden L. Bement is the Director of NSF. Prior to his appointment as NSF Director, Dr. Bement was Director of the National Institute of Standards and Technology and before that he was Professor and Head of the School of Nuclear Engineering at Purdue University.

Dr. Mark S. Wrighton is Chairman of the Audit and Oversight Committee of the National Science Board and the Chancellor of Washington University in St. Louis, where he also serves as Professor of chemistry.

Dr. Christine C. Boesz is Inspector General of the NSF. Prior to joining NSF, she served as Head of Regulatory Accountability at Aetna U.S. Healthcare, and before that she held several government compliance and oversight positions within the Department of Health and Human Services.

3. Overarching Questions

- In developing the request, how were priorities determined across and within various agency budget accounts, programs, objectives, and priorities? If NSF were to receive additional funding in FY06 beyond the President's request, where should it be directed?
- What are the most important short-term and long-term budget and management challenges facing NSF, and how should they be addressed?
- What can NSF do to ensure that limited research and management resources are allocated most effectively?

4. Brief Overview

- NSF is the primary source of federal funding for non-medical basic research conducted at U.S. colleges and universities. In addition, NSF is the principal federal agency charged with supporting K–12 and undergraduate science, math, and engineering education, and NSF fellowships and research assistantship programs support many graduate and post-doctoral students.
- NSF funds basic research across nearly all disciplines of science and engineering. In many disciplines, such as mathematics, computer science, and the social sciences, NSF is the primary source of federal support for university researchers. Further, NSF supports research in emerging fields, such as computing and information technology since the 1960's, and nanotechnology today.
- The FY06 budget request for NSF is $5.61 billion, an increase of 2.4 percent, or $132 million over the FY05 level. However, because NSF received a 3.1 percent ($180 million) cut in FY05, the overall request level for FY06 is approximately one percent below the FY04 level. In addition, the increase includes a proposed transfer of $48 million from the U.S. Coast guard for ice

breaking expenses in support of Antarctic research, so the increase for NSF in reality is about 1.5 percent. These flat budgets have forced NSF to make difficult decisions on priorities among its many programs and placed increasing pressure on the agency to ensure that programmatic and management resources are allocated as efficiently as possible.

- The FY06 budget request recommends major cuts to the Education and Human Resources (EHR) account. The request of $737 million for EHR is $104 million, or 12 percent, below the FY05 level and $207 million, or 22 percent, below the FY04 level. The cuts are concentrated largely on elementary and secondary education programs, and, to a lesser extent, undergraduate programs. NSF has indicated that the reductions are part of a conscious policy to significantly pare its role in program implementation, allowing work in this area to migrate to the Department of Education.

5. Background

About the National Science Foundation

NSF was created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense.. . ." Roughly 200,000 people—including senior researchers, postdoctoral associates, graduate and undergraduate students, and K–12 teachers and students—are involved in NSF activities each year. NSF funds approximately 10,000 awards annually through a highly respected competitive, merit-review process. In addition to providing grants to support research projects, NSF also funds the construction and operations for major research facilities[1] (such as telescopes and ocean research vessels), supports all levels of science and engineering education, and funds programs to increase the size and proficiency of the U.S. scientific and technological workforce. Since its inception in 1950, NSF has supported 123 of America's Nobel Prize winners, including about 50 percent of winners in Chemistry and Physics and about 60 percent of winners in Economics.

NSF is organized into directorates that support specific disciplines of science and engineering research and education: Biological Sciences; Computer and Information Science and Engineering; Geosciences; Engineering; Mathematics and Physical Sciences; Social, Behavioral and Economic Sciences; and Education and Human Resources. In addition, a number of separate offices support various specific program and management functions. (See Chart 1 for a diagram of NSF's organizational structure.)

By law, NSF leadership has two major components: a director, who oversees NSF staff and management and is responsible for program administration, merit review, planning, budget and day-to-day operations; and the 24-member National Science Board that oversees and establishes policies for the Foundation. The Board members, who are Presidentially-appointed and Senate-confirmed, are supported in part by the work of the Office of the Inspector General (OIG) of the NSF. The OIG recommends policies to promote economy, efficiency, and effectiveness in administering NSF programs and operations. The OIG reports directly to the National Science Board and to Congress.

NSF has continued to receive high marks from the Office of Management and Budget (OMB) for the quality of its management and the excellence of its programs. For example, in the FY06 budget request, NSF was one of only seven agencies that were awarded three green lights on the Executive Branch Management Scorecard. In addition, eight NSF programs were examined using OMB's Program Assessment Rating Tool (PART),[2] and all eight programs received ratings of "Effective" (the highest rating). NSF was the only agency in the Federal Government to receive the highest rating on every program that underwent a PART review.

The Merit Review Process

The merit review process is a critical element of NSF activities. No research is performed at NSF by NSF employees; the Foundation's role is to solicit, select, and support the best projects proposed by the research and education communities. NSF currently receives more than 40,000 proposals per year. NSF then uses a merit review process to determine which proposals receive funding. In this process, proposals are evaluated by a panel of independent reviewers consisting of scientists, en-

[1] NSF-funded major research facilities are constructed and operated by outside consortia.

[2] PART is described by the budget as a tool "developed to assess and improve program performance so that the Federal Government can achieve better results. A PART review helps identify a program's strengths and weaknesses to inform funding and management decisions aimed at making the program more effective."

gineers and educators, who do not work at NSF or for the institution that employs the proposing researchers.[3] The reviewers assess the intellectual merit and quality of the proposed activity, taking into consideration other factors such as the impact of the work on enhancing scientific knowledge, providing educational opportunities and societal benefits, and broadening participation by under-represented groups. The reviewers' recommendations are then passed on to NSF program officers for a final decision on whether an award should be issued.

NSF Authorization

In 2002, Congress passed, and the President signed, the *National Science Foundation Authorization Act of 2002* (P.L. 107–368). The Act authorized research and educations programs and appropriations for NSF from FY03 to FY07, and strengthened management and oversight of the Foundation. The cornerstone funding recommendation in the Act placed the overall NSF budget on a five-year doubling track, a goal that Congress and the President have fallen far short of (Table 1 includes the authorization levels set forth in P.L. 107–368).

6. Issues Facing NSF

In the current tight budget environment, NSF faces difficult challenges in determining priorities among its many programs that are deserving of increased funding. For example, NSF must determine the right balance between:

— education and research activities;
— increasing grant size and duration and supporting more scientists;
— facilities construction and operations and research;
— K–12, undergraduate, and graduate education; and
— multi-investigator, interdisciplinary projects and single-investigator research in core disciplines.

In addition to these difficult decisions regarding program priorities, budget constraints also force NSF to tackle difficult questions about allocating resources for management tasks. Below are outlined several notable programmatic and management challenges facing NSF.

Decreasing Funding for Education Programs

The programs in the NSF EHR directorate are designed to support and improve U.S. science, technology, engineering and mathematics (STEM) education at all levels and in all settings (both formal and informal).

Of the seven budget categories within the Education and Human Resources Directorate, four would receive major budget cuts in the FY06 request: Math and Science Partnerships (down 24 percent), Elementary, Secondary, and Informal Education (down 23 percent), Undergraduate Education (down 12 percent), and Research, Evaluation, and Communication (down 43 percent) (see Table 2). Most programs within these accounts are planning reductions in the number of new awards in 2006, and two—Math and Science Partnerships and Research, Evaluation, and Communication—will not make any new awards.

NSF has indicated that the reductions in elementary, secondary and undergraduate education are part of a conscious policy to significantly pare its role in program implementation, allowing these to migrate to the U.S. Department of Education. However, NSF's education programs are unique in their capacity to develop new and improved materials and assessments, create better teacher training techniques and move promising ideas from research to practice. An example of the different roles NSF and the Department of Education play can be seen in their Math and Science Partnerships (MSP) programs. The Department of Education's program awards funds to states on a formula basis and focuses primarily on secondary-level mathematics, while NSF's program provides competitive, merit-reviewed grants to universities and school districts to explore innovative ideas and improve math and science proficiency for students of all grades. Some education policy experts have expressed concern that disinvesting in NSF K–12 education will deprive states, districts and schools of the tools and ideas they need to achieve the goals of proficiency under the *No Child Left Behind Act.*

Decreasing Success Rates for Grant Proposals

The total funding for NSF has increased significantly (approximately 40 percent) over the past six years, but the total number of proposals NSF receives has risen

[3] NSF selects the reviewers from among the national pool of experts in each field and their evaluations are confidential. On average, about 50,000 experts give their time to serve on review panels each year.

dramatically as well, from under 30,000 to over 44,000. This increase in proposals, coupled with a recent concerted effort to increase the size and duration of NSF grants, has led to a drop in "success rate"—the percentage of proposals that receive funding has declined from 33 percent in FY00 to an estimated 20 percent in FY05. The National Science Board has estimated that each year NSF is unable to fund 1,500 to 2,000 research proposals (about $1.5 billion worth) that receive reviewer ratings as good as those being funded.[4]

For FY06, NSF has set a goal of halting the decline in the success rate while maintaining grant size and duration.[5] Given this constraint, and the relatively flat budget requested for FY06, NSF plans to try to reduce the number of proposals it receives, in part by reducing the number of solicitations the agency issues, narrowing the areas covered in those solicitations, and requiring "pre-proposals" for some programs.[6]

NSF's efforts to reduce the number of proposals and increase the success rate are motivated by three goals: to be able to fund more of the high quality proposals they receive, to use researchers' time more effectively (putting together proposals is very time-consuming), and to reduce the administrative burden on NSF staff. However, there is some concern that narrowing the pool of proposals has the potential to lower the overall quality of the pool and hence the quality of the research NSF funds. In addition, it is not clear whether this effort will conflict with NSF's overall goal of broadening participation in NSF programs.

Funding for Major Research Equipment and Facilities Construction, Oversight, Operations, and Research

One of NSF's core missions is to provide scientists and engineers with the tools they need to perform research in a wide variety of fields. These tools range from the desktop computers and tabletop laboratory equipment used by a single researcher to scanning electron microscopes, mass spectrometers, and small supercomputers shared by multiple departments on a university campus, to large national (or international) facilities, such as radio telescopes and aircraft for environmental and atmospheric sampling.

In the 1990's, NSF created a special budget account for the largest facilities with the greatest cost, complexity, and scientific impact. Known as Major Research Equipment and Facilities Construction (MREFC) projects, these proposals must go through a special review and approval process—including merit review of the proposal quality, internal review by NSF scientific and financial staff, and final approval by the National Science Board—before they can be proposed to Congress for funding. While Congress has historically had concerns about the transparency and rigor of this process, it appears NSF has made significant progress recently in formalizing selection and oversight for MREFC projects (see below).

In the current budget situation, the key challenge will be determining how to appropriately balance the need to provide cutting-edge, large-scale research equipment with the need to fund research. Due to the multi-year nature of MREFC construction projects, and their long lifetime of use (usually 10–30 years), each project start is a serious commitment by NSF to provide construction, operations, maintenance, and research funding for many years to come. While the FY06 budget request does not propose any new MREFC starts, five MREFC projects are ongoing, five have been completed in the past two years, and four more have been approved by the National Science Board and are in the queue for future funding (Table 3). Setting aside support for these projects is placing increasing budget pressure on core research activities, and NSF faces a difficult and growing challenge in balancing these two needs.

Management and Oversight of the Construction and Operations of Large Research Facilities

As noted above, Congress has historically had concerns about the transparency and rigor of NSF's processes for selecting and overseeing large research facilities. For example, the relative priorities among projects—and the rationale supporting those priorities—have not always been clear. Also, clear guidelines for development, management, and oversight of large facilities, and responsibility within NSF for ensuring compliance with those guidelines—both key components of effective implementation—did not exist.

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[4] *Fulfilling the Promise: A Report to Congress on the Budgetary and Programmatic Expansion of the National Science Foundation* (National Science Board, January 2004), page 6.

[5] The average NSF research award provides about $137,000 per year for three years.

[6] A short "pre-proposal" is designed to allow NSF to quickly evaluate the general quality and ideas within a potential proposal so that only people with a reasonably probability of success have to go through the trouble of putting together a full proposal.

NSF is making progress in addressing these shortcomings, and four significant efforts to improve the situation are at various levels of implementation. First, NSF is now required (per P.L. 107–368) to maintain a prioritized list of pending projects that includes the criteria and rationale used in developing the rankings. Second, in 2003 NSF established the position of Deputy Director for Large Facility Projects within the NSF Office of Budget, Finance and Award Management. Third is the development of a "Major Facilities Guide" to outline a process for NSF's management and oversight of proposal, construction, and operations of large facilities projects and of a document describing the process for "Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation." Both of these documents have been drafted and are scheduled to be finalized by the NSF and the National Science Board this summer. Fourth, NSF has hired a contractor to develop an automated central cost-tracking system specifically to enable full cost accounting for large facilities projects; the basic elements of this system are expected be in place in September 2005, with the full system becoming operational in 2006.

These are all important steps that bear careful watching going forward. Of particular concern is how NSF will provide the Deputy Director for Large Facility Projects with the resources and authorities needed to carry out his oversight responsibilities. Each large facility project has program management staff within the research directorate that spawned the project, but the Deputy Director for Large Facility Projects is responsible for overseeing all of the projects. The completion of the central cost-accounting system should certainly provide the Deputy's office with a valuable tool, but support staff will also be needed to help gather and maintain information on, and assess the scientific progress and financial performance of, large facility projects.[7] Finally, the role that the Deputy will play in certifying to the National Science Board projects' readiness to begin construction and monitoring projects' progress is still to be finalized and implemented.

Workforce Planning

The Office of Inspector General (OIG) has identified workforce planning as one of the most serious management challenges facing NSF. The effectiveness of NSF's current workforce of 1,700 permanent staff, visiting personnel, and contract employees has been increasingly hampered by rapidly growing workloads and limited space. For example, since 1999, the agency has seen a 40 percent increase in the number of proposals received each year, including a 14 percent increase last year alone. As a result, NSF estimates that program officers now spend 55 percent of their time reviewing proposals, leaving less time for other duties such as award oversight and program planning.

While the OIG reports that recent steps taken by NSF to lease additional office space and add full-time employees has alleviated some of these pressures, a longer-term solution is still needed. NSF asserts that its comprehensive, multi-year project reviewing internal business processes (known as the *"Business Analysis"*), which is scheduled for completion by the end of FY05, will provide a long-term plan for identifying and addressing workforce needs.

Ice-breaking Services for NSF Facilities at the South Pole

The NSF manages three year-round facilities in Antarctica, where research in physics, astronomy, ocean science, climate science, marine and land ecosystems, and other fields is performed. To access these facilities for resupply missions, NSF uses two large ice breaking ships owned and operated by the U.S. Coast Guard (USCG). NSF reimburses the USCG for the incremental costs associated with this use. While there are other needs for these ships (such as military preparedness, law enforcement, and USCG training), over the past three years, support of NSF science activities has accounted for roughly 90 percent of the ships' time. Therefore, in the FY06 budget request, the Administration proposes shifting the base funding for the two polar class ice breakers, as well as another ship,[8] from the USCG to NSF.

Much of the information needed to evaluate the appropriateness of transferring the responsibility and funding for the ice breakers from USCG to NSF remains elusive. In the short-term, the actual costs of operations and maintenance for these ships has not been determined, and it is unclear if the transferred $48 million will be sufficient. In the longer-term, Congress and the Administration must consider how best to replace the current polar class ice-breaking ships, which are nearing the end of their useful lives. It is not immediately clear which agencies should bear

[7] Currently, the support staff for the Deputy Director for Large Facility Projects is only 1.5 full-time equivalents.

[8] The third ship is the Healy, a research vessel with ice-breaking capabilities that operates mainly in the Arctic.

the costs and be responsible for refurbishment or replacement of the existing ships. NSF and USCG, along with the Office of Science and Technology Policy and the Office of Management and Budget, are engaged in deliberations on these questions.

Post-Award Administration

For the third consecutive year, independent audits of NSF's financial statements have identified post-award monitoring of grantee institutions as a "reportable condition." The OIG reports that effective post-award monitoring should ensure that: "awardees are complying with award terms and conditions and federal regulations; adequate progress is being made toward achieving the objectives and milestones of the program; and expenditures listed on NSF's financial statements are accurate."[9]

In response, NSF has taken steps to address some of the post-award monitoring issues identified through the independent audits, such as establishing a risk-based program for identifying and tracking high-risk awardees. The Foundation has also noted that the expensive nature of site visits associated with post-award monitoring, coupled with limited administrative and personnel resources, have hindered its ability to address many of these issues. While noting that progress has occurred, and recognizing budget limitations, the OIG has (1) emphasized that NSF's measures have been too narrowly focused on "high-risk awardees," which constitute less than 0.1 percent of NSF's award portfolio; and (2) recommended that NSF "apply more cost-effective monitoring procedures such as desk reviews of reports from awardees and computer-assisted screening to medium and low-risk awardees on a random basis."

7. Witness Questions

The witnesses were asked to address the following questions in their testimony:

Questions for Dr. Arden Bement

- In developing the request, how were priorities determined across budget accounts (research, education, facilities, and administration), within accounts (i.e., K–12, undergraduate, and graduate education; research directorates and divisions), and among related agency objectives and priorities (i.e., success rate, grant size and duration; multi- and single-investigator research; facilities construction, operation, and research)? If NSF were to receive additional funding in FY06 beyond the President's request, where should it be directed?
- What are the most important short-term and long-term budget and management challenges facing NSF and how is the agency working to address them?
- The FY06 budget request includes a goal to halt this precipitous decline in the success rate while maintaining recent gains NSF has made in expanding the average size and duration of its grants. What strategies will NSF employ to achieve this? How will NSF ensure that efforts to reduce the number of proposals does not conflict with efforts to broaden participation in NSF programs? To what extent would a strategy of narrowing the pool of proposals lower the overall quality of the pool and hence the quality of the research NSF funds?
- As an increasing number of Major Research Equipment and Facilities Construction (MREFC) projects transition out of the construction phase and into operation, how will NSF balance the need to support core activities in its research accounts with the need to fully fund the operations and research costs associated with new facilities?
- Within NSF's Education and Human Resources (EHR) directorate, the Division of Research, Evaluation, and Communication receives a proposed cut of 43 percent from the FY05 enacted level and will propose no new awards. Is it NSF's goal to provide funding for new awards in FY07 and beyond, or does the fact that no new awards will be made in FY06 signal a planned phase-out of this division?
- What actions is NSF taking to address the management and performance issues outlined in the Office of Inspector General's (OIG) FY05 "Management Challenges" letter, particularly those related to workforce planning, post-award administration, and large facilities projects?

[9] NSF Office of the Inspector General's Semiannual Report to Congress (September 2004), page 52.

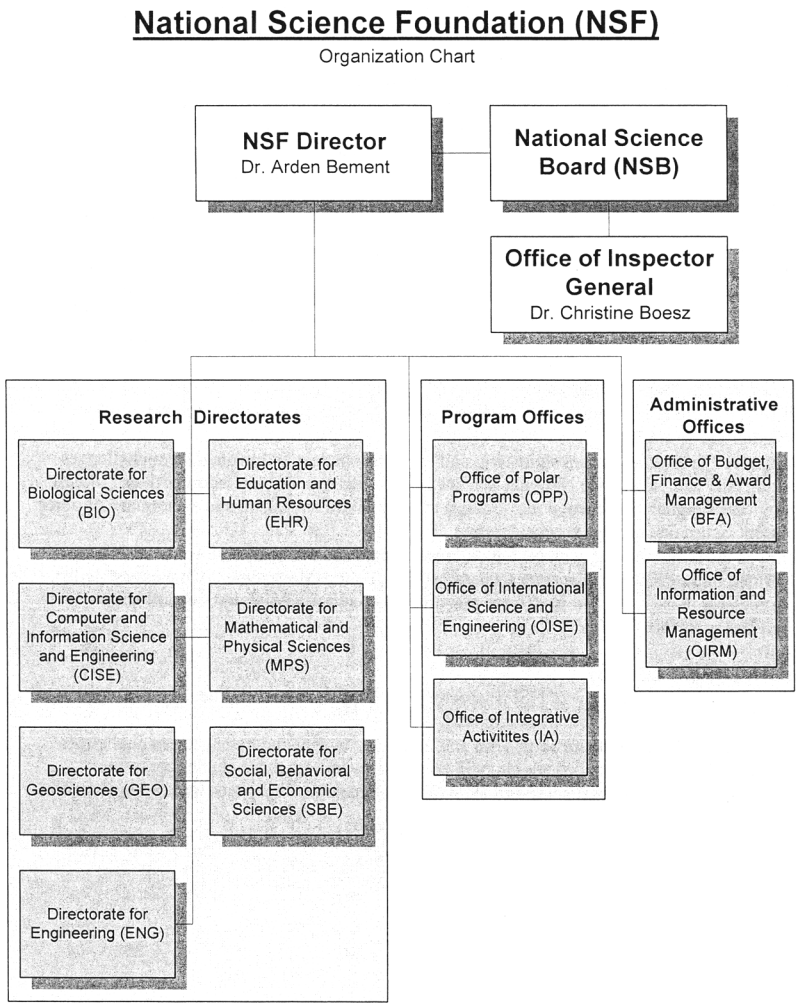
Questions for Dr. Mark Wrighton

- If NSF were to receive additional funding in FY06 beyond the President's request, where should it be directed?
- What are the most important short-term and long-term budget and management challenges facing NSF and how is the National Science Board (NSB) working to address them? Please provide a summary of recent policy actions that the Board has taken, and a summary of other current issues that are under consideration.
- How is the NSB working with NSF to address the management and performance issues outlined in the Office of Inspector General's (OIG) FY05 "Management Challenges" letter, particularly those related to workforce planning, post-award administration, and large facilities projects?

Questions for Dr. Christine Boesz

- Please provide an overview of NSF Inspector General (IG) responsibilities and activities, and a summary of recent IG actions and reports.
- What are the most important short-term and long-term budget and management challenges facing NSF, and what actions should NSF be taking to address those challenges? In particular, please discuss the issues related to workforce planning, post-award administration, and large facilities planning.

Chart 1.


National Science Foundation (NSF)
Organization Chart
NSF Director
Dr. Arden Bement
National Science Board (NSB)
Office of Inspector General
Dr. Christine Boesz
Research Directorates
Directorate for Biological Sciences (BIO)
Directorate for Education and Human Resources (EHR)
Directorate for Computer and Information Science and Engineering (CISE)
Directorate for Mathematical and Physical Sciences (MPS)
Directorate for Geosciences (GEO)
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Office of International Science and Engineering (OISE)
Office of Integrative Activitites (IA)
Administrative Offices
Office of Budget, Finance & Award Management (BFA)
Office of Information and Resource Management (OIRM)

Table 1.

National Science Foundation
FY 2005 Budget Request (dollars in millions)
(Source: Agency Budget Justification)

Account	FY04 Actual	FY05 Current Plan	FY06 Request	Change FY05 to FY06		Authorized Levels	
				Amount	Percent	FY05	FY06[1]
RRA	4293	4221	4333	113	2.7%	5544	--
BIO	587	577	582	5	0.9%	--	--
CISE	605	614	621	7	1.1%	--	--
ENG	566	561	581	19	3.5%	--	--
GEO	713	694	709	15	2.2%	--	--
MPS	1092	1070	1086	16	1.5%	--	--
SBE	184	197	199	2	1.0%	--	--
OISE	41	34	35	1	2.3%	--	--
OPP	342	344	387	43	12.4%[10]	--	--
IA	164	130	135	5	3.8%	--	--
EHR	944	841	737	-104	-12.4%	1331	--
MREFC	184	174	250	76	44.0%	259	--
S&E	219	223	269	46	20.5%	231	--
OIG	9	10	12	1	14.7%	9	--
NSB	2	4	4	0	0.8%	4	--
Total	**5652**	**5473**	**5605**	**132**	**2.4%**	**7378**	**8520**

[1] The National Science Foundation Act of 2002 did not authorize funding for specific budget accounts in FY06.

Acronyms:

RRA = Research and Related Activities
EHR = Education and Human Resources
MREFC = Major Research Equipment and Facilities Construction
S&E = Salaries & Expenses
OIG = Office of Inspector General
NSB = National Science Board
BIO = Biological Sciences
CISE = Computer & Information Science & Engineering
ENG = Engineering
GEO = Geosciences
MPS = Mathematical and Physical Sciences
SBE = Social, Behavioral, and Economic Sciences
OISE = Office of International Science and Engineering
OPP = Office of Polar Programs
IA = Integrative Activities

[10] Includes $48 million transfer from the Coast Guard for ice-breaking activities.

Table 2.

NSF Education and Human Resources Directorate
FY 2006 Budget Request (dollars in millions)
(Source: Agency budget justification)

Account	FY04 Actual	FY05 Current Plan	FY06 Request	Change FY05-06 $	Change FY05-06 %
EISE	206	182	141	-41.2	-23 %
IMD	29	29	19	-9.6	-33 %
TPC	62	60	33	-27.2	-45 %
CLT	27	26	22	-4.5	-17 %
MSP	139	79	60	-19.4	-24 %
Undergrad	163	154	135	-18.7	-12 %
SfS	16	14	10	-4.1	-29 %
CCLI	40	46	31	-9.6	-23 %
Graduate	155	155	155	0.3	0.2 %
HRD	120	119	119	-0.1	-0.1 %
CREST	14.9	15.9	18.5	2.6	16 %
MIE	2.5	2.5	0	-2.5	-100%
EPSCOR	94.2	94	94	0.3	0.3 %
REC	66.4	59	33.8	-25.7	-43 %
TOTAL	**944**	**841**	**737**	**-104**	**-12 %**

*Not a complete list of education programs.

Acronyms:
EISE – Elementary, Secondary and Informal Education
IMD – Instructional Materials Development
TPC – Teacher Professional Continuum
CLT – Centers for Learning and Teaching
SfS – Scholarship for Service
CCLI – Course, Curriculum and Laboratory Improvement
MSP – Math and Science Partnership Program
HRD – Human Resource Development
CREST – Centers for Research Excellence in Science and Technology
MIE – Model Institutions for Excellence
EPSCoR – Experimental Program to Stimulate Competitive Research
REC – Research, Evaluation and Communication

Table 3.

NSF Major Research Equipment and Facilities Construction Account FY 2006 Budget Request (dollars in Millions) Source: Agency budget justification						
	FY04 Actual	FY05 Current Plan*	FY06 Request	FY07 Estimate	FY08 Estimate	FY09 Estimate
Ongoing and Recently Completed Projects						
ALMA	50.7	49.3	49.2	47.9	46.5	37.4
EarthScope	43.2	47.0	50.6	26.8		
HIAPER	12.5					
Ice Cube	38.4	47.6	50.5	28.7	21.8	11.3
LHC (completed in FY03)						
NEON				12.0	12.0	20.0
NEES	8.1					
RSVP		14.9	41.8	48.0	30.8	15.0
SODV		14.9	57.9	42.2		
South Pole Station	21.0					
Terascale Computing Systems	10.1					
Projects Approved as Future Starts						
Ocean Observatories Initiative				13.5	42.0	65.5
Alaska Region Research Vessel				49.3	32.9	
Advanced LIGO					28.5	42.81
Total	**$184.0**	**$173.7**	**$250.0**	**$268.4**	**$214.4**	**$192.0**

Totals may not add due to rounding.

*The FY 2005 total includes $37.13 million carried forward from previous years. This includes $29.87 million for the South Pole Station Modernization project, $115,000 for Polar Support Aircraft upgrades, $34,418 for the South Pole Safety project, and $7.11 million for IceCube.

Acronyms and Project Information:

ALMA (Atacama Large Millimeter Array) – a large radio telescope to look at the evolution of the universe.

EarthScope – a geosciences project to put sensors on earthquake faults and at sites across the U.S.

HIAPER (High-performance Instrumented Airborne Platform for Experimental Research) – an aircraft to take environmental and atmospheric measurements at high altitudes.

Ice Cube – an array of sensors under the ice at the South Pole to observe neutrinos for astronomy research.

LHC (Large Hadron Collider) – detectors at LHC to study fundamental laws of particle physics.

NEON (National Ecological Observatory Network) – a U.S.-wide array of stations to study environmental systems.

NEES (Network for Earthquake Engineering Simulation) – a collection of facilities to model earthquake-related effects.

RSVP (Rare Symmetry Violating Processes) – detectors to study fundamental laws of particle physics.

SODV (Scientific Ocean Drilling Vessel) – a deep-sea drilling vessel for environmental and ocean research.

South Pole Station – renovation of the NSF facility in Antarctica.

Terascale Computing Systems – a large, distributed supercomputing network.

Ocean Observatories Initiative – a distributed array of sensors to gather data on conditions throughout the world's oceans.

Alaska Region Research Vessel – a new vessel to study climate and ecosystems issues in the Arctic.

Advanced LIGO (Laser Interferometer Gravitational Wave Observatory) – phase 2 of an astronomy experiment on the structure of the universe.

Chairman INGLIS. Thank you for coming to this morning's hearing on the *National Science Foundation Budget and Management Challenges,* the first Research Subcommittee hearing of the 109th Congress.

I want to extend a special welcome to my colleague, Ms. Hooley, the Ranking Democrat on this committee. I am glad that the Science Committee has a history of working in a bipartisan way. It is a new thing for me, having been on Judiciary and Budget in my previous time in Congress, so it is very refreshing to be here at Science.

I spoke recently to a General Electric executive in the course of a plant tour in Greenville, South Carolina. They have 2,600 employees and 1,000 of them are engineers in Greenville, South Carolina. We are very happy about that. And I asked him, "Could you hire more?" He said, "We could take 300 right away. The core problem," he said, "those are just not available." I asked him, "Why not?" He said, "It is the teachers." He said, "You need inspiration in order to teach people engineering and science."

Well, that is what we are here about today. And to celebrate the work of NSF and to provide for its future.

He also told me that they are using the technology in their gas turbines, technology that is unique in the whole world. GE depends on their ability to innovate to be competitive. For most American companies, innovation is their only edge. To continue to win in this world of commerce, we must continue to create new and improved technologies. If we want to lead the world in innovation, we must train the Ph.D.s whose basic research fuels technological innovation for the decades to come.

Basic research is surely the lifeblood of innovation. It used to be that our large companies did the basic research, companies like Bell Labs, IBM, and Xerox. They were supplemented in their work by the Department of Energy, and the Department of Defense, and NSF. Now, market pressures and the need to return bottom-line numbers by their shareholders have pushed the burden almost entirely to the Federal Government in basic research and increasingly the NSF. Without NSF supporting basic research, our edge in science will slip, and our innovation gap will grow.

That is why I am so concerned about the current NSF budget. Although there is a slight increase for this year, it doesn't make up for last year's cuts, and it is far below the promised level that we had of doubling NSF's budget over five years. In my previous stint in Congress, as I mentioned, I was on the Budget Committee, and I am quite concerned about our current budget deficit. I learned during those years, though, that it takes two things to balance the budget, and amazingly, we did it between 1993 and 1998. We went from a $300 billion deficit to a slight surplus. Now we are in the $400 billion range, and we need to get to a slight surplus again, we hope. But what I learned, though, is it takes two things. It takes spending restraint, plus economic growth. Spending restraint alone is not enough. You have got to have economic growth.

So the key, I think, for us, is to figure out how to stop simple spending and start thoughtful investing. And that is what we are here to talk about today with NSF.

We have a need to train more scientists and engineers. We have to continue the stream of exciting innovations that save lives and improve our quality of life. Just as it would be shortsighted for a company not to plan the next generation of products, it would be irresponsible of us to neglect future research in basic science. It is more important than ever, because it is the foundation of our innovation economy.

The NSF has been a key force for innovation, from the MRI to bar code scanners to the creation of the Internet and the origins of Google. The NSF has a track record of accountability and a focus on excellence, and we have to seek continuous improvement. The standard for us is higher because the work—the nature of the work is harder for many of us to understand.

I will tell you that I wonder about the cuts in math and science education and indications that some NSF activities may be migrating to the Department of Education. The NSF has a passion for excellence, while the Department of Education is arguably focused on simple proficiency. Passion isn't easily transferred. Are we investing enough in research? Are we simply spending on current needs? If we continue down this path, will we be positioned in the global—where will we be positioned in the global economy in 20 years? Will the modifications to merit review ultimately reduce the quality of submissions? Also, what are the appropriate costs for Coast Guard icebreaking services, and are these activities best funded through the NSF? These are challenging questions, and I am hopeful that we can get some answers today.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF CHAIRMAN BOB INGLIS

I want to welcome everyone and thank you for coming to this morning's hearing—the first Research Subcommittee hearing of the 109th Congress. I want to extend a special welcome to my esteemed colleague Congresswoman Hooley, who is the new Ranking Member of the Subcommittee. I am glad that the Science Committee works in such a bipartisan way, and I look forward to working with Ms. Hooley.

I recently spoke to an executive for General Electric. When I asked him if he had enough qualified engineers to fill his research jobs, he said "No." He could hire 300 tomorrow if they were available. The core problem is teachers. There just aren't enough qualified and inspiring teachers to produce the scientists and engineers his company needs.

He also told me about the technology that they are using in their gas turbines—technology that is currently unique in the world. GE depends on their ability to innovate to be competitive. For most American companies, innovation is their only edge. To continue to win in this world of commerce, we must continue to create new and improved technologies. If we want to lead the world in innovation, we must train the Ph.D.s whose basic research fuels technological innovation in decades to come.

Basic research is the lifeblood of innovation. It used to be that our large companies did the basic research—companies like Bell Labs, IBM, and Xerox. They were supplemented by the work of the DOE, DOD, and NSF. Now, market pressures and shifting government priorities have pushed the burden almost entirely to the Federal Government, and, increasingly, NSF. Without NSF supporting basic research, our edge in science will slip away and an innovation gap will grow.

That's why I'm so concerned about the current NSF budget. Although there is a slight increase this year, it doesn't make up for last year's cuts, and is still below the FY04 level. It is also now far from the Congress' promise to double the NSF budget over five years. On my previous stint in Congress, I was on the Budget Committee and I was quite concerned about our budget deficit. I learned during those years that getting it balanced requires spending restraint and economic growth. We've got to stop spending and start investing. Investing in basic and applied

science research makes sense. If we invest wisely, we can find economic growth through innovation.

We also have to train more scientists and engineers. We have to continue the stream of exciting innovations that save lives and improve our quality of life. Just as it would be short-sighted for a company to not plan the next generation of products, it would be irresponsible of us to neglect future research in basic science. It's more important than ever because it is the foundation of our innovation economy.

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I wonder about the cuts in math and science education, and indications that some NSF activities may be "migrating" to the Department of Education. The NSF has a passion for excellence, while the Department of Education is arguably focused on proficiency. Passion isn't easily transferred. Are we investing enough in research? Or are we simply spending on current needs? If we continue down this path, where will we be positioned in the global economy in twenty years? Will the modifications to merit review ultimately reduce the quality of submissions? Also, what are the appropriate costs for Coast Guard ice-breaking services, and are these activities best funded through NSF? These are challenging questions, and I'm hopeful that we can get some answers today.

Chairman INGLIS. The Chair now recognizes Ms. Hooley, the Ranking Minority Member on the Subcommittee, for an opening statement.

Ms. HOOLEY. Mr. Chair, thank you, and I am looking forward to working with you. Welcome back to Congress.

I, too, served on the Budget Committee and know what you are talking about. So I am looking forward to serving on this committee and working in a bipartisan way.

I want to welcome our witnesses. Thank you very much for taking your time to be here, and I look forward to working with you.

The thrust of this hearing is on the fiscal year 2006 budget request for the Foundation, and more broadly, on policy issues that affect the ability of the Foundation to carry out its historic role of nurturing the research and education capabilities of the Nation in all fields of science and engineering.

I must say at the onset that I am deeply concerned about the overall level of the resources provided for our NSF in the President's budget. The budget is clearly inadequate to meet the wide-ranging responsibilities of NSF. It was just a little over two years ago that we said we wanted to double the budget over five years. Congress asked the National Science Board to report back on how the increased resources authorized by legislation would be used. The Board subsequently responded and made the case that valuable as the budget doubling would be, it would still be inadequate to allow NSF to satisfy all of the unmet needs in basic research and education that would be required to sustain future U.S. leadership in science and technology. The Board set the desired target as a four-fold increase in the budget over five years.

The budget request before us would leave an accumulative shortfall of $5.8 billion in meeting just the doubling goal, let alone achieving the target suggested by the Science Board. I recognize what our budget looks like, that we are in a deficit. And without commenting on the priorities and events that led to our current fiscal situation, I believe it is time to answer the many calls for strengthening federal support for research from such diverse sources as former Presidential Science Advisor Alan Bromley, Fed-

eral Reserve Chairman Alan Greenspan, former Speaker of the House Newt Gingerich, and the Hart-Rudman Commission on National Security.

Increased funding for research is not a drain on the budget, but rather it is a necessary investment to allow our country to succeed in an increasingly competitive world. Withholding this investment, even at a time of tight budgets, places us in real danger of losing the competitive edge that we have enjoyed for so long. The President's Council of Advisors for Science and Technology has called for adjusting the federal R&D budget upward for the physical sciences and engineering to bring them in collective parity with life sciences over the four-year budget cycle.

I am disappointed that the current budget request for the main agencies that support research in these fields, including NSF, makes no forward progress toward achieving this goal. In addition to the meager levels of the fiscal year 2006 NSF budget request, I am also puzzled and concerned about the lack of priority it affords to science education activities. NSF K–12 education funding level, under this request, would drop by over 50 percent relative to fiscal year 2004. Not only is the Math and Science Partnership Program targeted for a close-out, but core programs are slashed that support teacher professional development that develop improved educational materials.

In the face of widespread concerns about the quality of science and math in our schools, I am at a loss to imagine any reasonable justification for these budget decisions. I would note that they seem to be counter to the position that the National Science Board has taken on K–12 programs, particularly on the value and importance of the Math and Science Partnership Program. I believe NSF is making a serious mistake in abandoning its long-time role in K–12 science education. I suspect this is not a policy change that will be viewed favorably by many Members of the Science Committee.

Adequate funding for basic research and education in science and engineering is not a partisan issue. The benefits from this investment flow to our economy, to national security, and to the well being of our citizens. We in Congress must take action that will provide for a vigorous academic research enterprise for the Nation. NSF is a key player in realizing this vision.

Mr. Chairman, I want to thank you for calling this hearing and thank our witnesses for appearing before the Subcommittee today, and I look forward to our discussion.

[The prepared statement of Ms. Hooley follows:]

PREPARED STATEMENT OF REPRESENTATIVE DARLENE HOOLEY

Mr. Chairman, I am pleased to join you in welcoming our witnesses today to this oversight hearing on the National Science Foundation. I want to congratulate you as you begin your chairmanship of the Subcommittee on Research, and I look forward to working with you.

The thrust of this hearing is on the fiscal year 2006 budget request for the Foundation, and more broadly, on policy issues that affect the ability of the Foundation to carry out its historic role of nurturing the research and education capabilities of the Nation in all fields of science and engineering.

I must say at the outset that I am deeply concerned about the overall level of resources proposed for NSF in the President's budget. The budget is clearly inadequate to meet the wide ranging responsibilities of NSF. It was only a little over two years ago that the Congress passed, and the President signed, legislation calling for a five-year doubling of the NSF budget.

Congress asked the National Science Board to report back on how the increased resources authorized by the legislation would be used by NSF. The Board subsequently responded, and made the case that, valuable as a budget doubling would be, it would be inadequate to allow NSF to satisfy all of the unmet needs in basic research and education that would be required to sustain future U.S. leadership in science and technology. The Board set the desired target at a fourfold increase in the budget over five years.

The budget request before us would leave a cumulative shortfall of $5.8 billion in meeting the doubling goal—let alone achieving the target suggested by the Science Board.

I recognize that we are facing a daunting budgetary outlook. Without commenting on the priorities and events that led to the current fiscal situation, I believe it is time to answer the many calls for strengthening federal support for research from such diverse sources as former presidential science advisor Allen Bromley, Federal Reserve Chairman Alan Greenspan, former speaker of the House Newt Gingrich, and the Hart-Rudman Commission on National Security.

Increased funding for research is not a drain on the budget. But rather it is a necessary investment to allow the Nation to succeed in an increasingly competitive world.

Withholding this investment, even in a time of tight budgets, places us in real danger of losing the competitive edge we have enjoyed for so long.

The President's Council of Advisors for Science and Technology has called for adjusting the federal R&D budget upward for the physical sciences and engineering to bring them collectively to parity with the life sciences over four budget cycles. I am disappointed that the current budget requests for the main agencies that support research in these fields, including NSF, make no forward progress toward achieving this goal.

In addition to the meager level of the FY 2006 NSF budget request, I am also puzzled and concerned about the lack of priority it affords to science education activities. NSF's K–12 education funding level under this request would drop by over 50 percent relative to fiscal year 2004.

Not only is the Math and Science Partnership program still targeted for close-out, but core programs are slashed that support teacher professional development and that develop improved educational materials.

In the face of widespread concerns about the quality of science and math education in our schools, I am at a loss to imagine any reasonable justification for these budget decisions. I would note that they also seem to be counter to the position the National Science Board has taken on K–12 programs, particularly on the value and importance of the Math and Science Partnership program.

I believe NSF is making a serious mistake in abandoning its long-time role in K–12 science education. I suspect this is not a policy change that will be viewed favorably by many Members of the Science Committee.

Adequate funding for basic research and education in science and engineering is not a partisan issue. The benefits from this investment flow to our economy, to national security, and to the well being of our citizens. We in Congress must take action that will provide for a vigorous academic research enterprise for the Nation and, thereby, will help fill the storehouse of basic knowledge that powers the future. NSF is a key player in realizing this vision.

Mr. Chairman, I want to thank you for calling this hearing and thank our witnesses for appearing before the Subcommittee today. I look forward to our discussion.

Chairman INGLIS. Thank you, Ms. Hooley. Thank you for those remarks.

And any additional opening statements will be welcomed by the Committee and may be submitted by the Members for the record.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF REPRESENTATIVE EDDIE BERNICE JOHNSON

Thank you, Mr. Chairman. I also would like to thank our witnesses for agreeing to appear before us today. The purpose of this hearing is to provide an opportunity to discuss the National Science Foundation's budget for FY 2006.

I am very excited about this hearing today because we will be discussing something that is very close to my heart, and that is National Science Foundation (NSF) funding.

Three years ago, Congress sent the President a bill authorizing a doubling of NSF's program over five years. Despite signing that bill to glowing reviews, the President has sent us four successive budgets that fall far short of reaching that goal. This marks a fundamental breach of trust with our institutions of higher education and with our children, who depend on NSF to fund the best and brightest to pursue the most promising scientific insights. The only thing more surprising is the continued phase out of the K–12 Math and Science Partnerships (MSP) program (down $20 million) and additional cuts to the K–12 activities in the education directorate. With funding levels down another 24 percent from last year, we are devastated our K–12 education programs.

With this budget, what messages are we sending to our children? The Nation must take advantage of the human resource potential of all our people if we are to succeed in the international economic competition of the 21st century. This will require that reform efforts in science and math education be founded on educational materials and practices that are derived from rigorous research and that seek to engage and cultivate the interest of all children.

For my entire Congressional career, I have worked to increase the participation by minorities and women in science, mathematics and engineering programs and increased funding for institutions who actively recruit under-represented students for these paths of study. It is time to take action to ensure the best possible education for our children.

Hopefully, the witnesses today can discuss ways to protect the future of our children's education. Thank you, Mr. Chairman.

[The prepared statement of Mr. Carnahan follows:]

PREPARED STATEMENT OF REPRESENTATIVE RUSS CARNAHAN

Mr. Chairman and Ms. Ranking Member, I want to thank you for holding this subcommittee hearing today.

I am pleased to have Dr. Mark Wrighton, Chancellor of Washington University, which resides in my congressional district, testifying before us. "WashU" is a remarkable institution and I am blessed to represent many outstanding minds who continually provide our nation with important scientific research.

Today's discussion on the National Science Foundation (NSF) allows us to examine our research and development priorities. I am disheartened to find much of our budget cuts are again in the area of education, specifically K–12 science education programs. Many of us on this committee and in the larger U.S. House have noted that our continuing global presence in science and technology is reliant upon a strong student body, well-versed in science and math curricula. Furthermore, our nation's economic and security interests will be affected by the priorities we place on invigorating our science and technology. I sincerely hope that we can recognize the real value of science education when we make NSF's budgetary decisions.

Dr. Wrighton, thank you for being here today. I look forward to hearing the testimony of all our witnesses. However, I want to apologize that I must leave the hearing early to attend a previously scheduled appointment.

Chairman INGLIS. At this point, I would like to introduce our witnesses. Dr. Arden Bement is the Director of the National Science Foundation and a former Director of NIST. Dr. Bement and I first met at the R&D budget hearing two weeks ago, and I am encouraged by his vision for innovation and in keeping our economy strong. Dr. Mark Wrighton is also with us, and I am going to defer to my colleague, Mr. Carnahan, for an introduction.

Mr. CARNAHAN. Thank you, Mr. Chairman. It is an honor to welcome hometown St. Louis here today in Dr. Mark Wrighton.

I am pleased to have you here before the Research Subcommittee. He is here in his capacity as Chairman of the Audit and Oversight Committee of the National Science Board, but back home, he is our Chancellor at the Washington University in St. Louis and has been one of our fine local leaders. Not only do they have a national reputation at Washington University, but he has been really instrumental in developing a lot of our science and re-

search technology and capability in the St. Louis region. So it is great to have you here today.

Chairman INGLIS. Thank you, Mr. Carnahan.

And our third witness is Dr. Christine Boesz, the Inspector General of the National Science Foundation and performs there this indispensable oversight work.

Thank you all for coming. We are looking forward to what you have to say. We would ask, if you can, to limit your remarks to five minutes, although we will be flexible with the time limits, as we have already been this morning. Afterwards, Members of the Subcommittee will have five minutes each to ask their questions.

We will start with the testimony of Dr. Bement.

STATEMENT OF DR. ARDEN L. BEMENT, JR., DIRECTOR, NATIONAL SCIENCE FOUNDATION

Dr. BEMENT. Thank you, Chairman Inglis and Ranking Member Hooley and Members of the Subcommittee.

Thank you for this opportunity to provide you with some context for our fiscal year 2006 budget request. I welcome you to your new positions on the Research Subcommittee, and I look forward to continuing the close and productive relationship that NSF has had with the Congress over the past 55 years.

Let me get right to the questions in your invitation letter regarding the management challenges we face.

The first of them deals with priorities, how they are set both within and across accounts, and among agency objectives. This is an excellent starting point for gaining a perspective on NSF, because setting priorities is at the core of what we do every day.

The most important source of information for setting priorities comes from the research communities themselves. In addition to proposals, the broader research communities also provide continuous input in the form of advice from National Academy reports, analyses by professional societies, and national and international workshops and conferences.

Our directorate Advisory Committees and Committees of Visitors provide top-to-bottom reviews of existing programs and help formalize research priorities within and across disciplines.

Ultimately, the priorities reflected in our budget request are refined through consultations with the Deputy Director, the Assistant Directors, the National Science Board, and the Office of Science and Technology Policy. Finally, they are negotiated with the Office of Management and Budget in developing the President's budget request to Congress.

This year's budget request highlights four broad priorities: strengthening core disciplinary research, providing broadly accessible cyberinfrastructure and world-class research facilities, broadening participation in the science and engineering workforce, and sustaining organizational excellence in NSF management practices.

This last priority leads directly into the next question raised in your invitation letter regarding our budget and management challenges.

Nearly three years ago, NSF initiated an independent business analysis that has identified a number of important management

challenges in the areas of workforce requirements, information technology, and business practices.

It may help to give you some examples of NSF's workload.

In 1993, NSF had 1,205 full-time equivalent employees, and we processed 29,000 proposals. In the intervening 12 years, our budget has doubled, and the number of proposals we have processed grew by more than 50 percent. But our FTEs have increased only by 5.7 percent. We have dealt with this increased workload by relying on investments in technology. But the need for additional people becomes an overriding need at some point, and we have reached that point.

Last year, more than 44,000 proposals submitted to NSF received approximately 250,000 reviews by outside experts. Yet, in some programs the success rate is 10 percent or less. So one of our management challenges we face is being clearer in our solicitations so that researchers are not writing proposals that are unlikely to get funded.

Large facilities are necessary to keep NSF at the frontier. Although our budget does not request any new starts for major research facilities, we will continue projects already underway.

While new starts receive a great deal of attention, very little is paid to research facilities that are phased out at the end of their useful life. Over the past five years, for example, we have phased out four ocean research vessels, two aircraft, and two accelerators.

These decisions were based on the scientific value of these platforms, as well as their operation and maintenance costs. Indeed, the operation and maintenance costs are a key factor in the decision-making process for approval of new research facilities.

When we set priorities, a number of programs in our Education and Human Resources directorate were protected from reductions. We are maintaining effective programs aimed at increasing the participation of women and under-represented minorities in research fields. We are also maintaining programs to increase the number of science and engineering baccalaureate degrees as well as our prestigious fellowship support to the most talented U.S. graduate students.

After providing for high-priority areas, it is necessary to find offsets, and as you know, this is the most difficult part of priority setting. However, it is important that we focus not only on the numbers, but look at the broader policies as well.

For example, we are proposing a significant reduction in the Research, Evaluations, and Communication Division. This is not a signal that we are no longer committed to evaluation. Rather, we are committed to building evaluations into the projects we fund rather than treating it as a separate activity. Already, we have used this approach in major projects to great advantage, and we expect to expand this design throughout EHR.

NSF faces many management challenges, including, but not certainly limited to, those identified by the Inspector General. We have been steadily implementing the recommendations from the business analysis and will continue to do so. NSF employees and I take very seriously the need to earn and maintain the taxpayers' trust and to preserve the agency's reputation.

Mr. Chairman, I hope that this brief overview conveys to you NSF's commitment to advancing science and engineering in the national interest. I am very aware and appreciate the Committee's long-standing bipartisan support for NSF, and I would be happy to respond to any questions you have.

[The prepared statement of Dr. Bement follows:]

PREPARED STATEMENT OF ARDEN L. BEMENT, JR.

Chairman Inglis, Ranking Member Hooley, and Members of the Subcommittee, thank you for this opportunity to discuss NSF's FY 2006 budget Request. It is a pleasure to appear before you today. For over fifty years, NSF has been charged with being a strong steward of the scientific discovery and innovation that has been crucial to increasing America's economic strength, global competitiveness, national security, and overall quality of life.

For many years, the United States economy has depended heavily on investments in research and development—and with good reason. America's sustained economic prosperity is based on technological innovation made possible, in large part, by fundamental science and engineering research. Innovation and technology are the engines of the American economy, and advances in science and engineering provide the fuel.

Investments in science and technology—both public and private—have driven economic growth and improved the quality of life in America for the last 200 years. They have generated new knowledge and new industries, created new jobs, ensured economic and national security, reduced pollution and increased energy efficiency, provided better and safer transportation, improved medical care, and increased living standards for the American people.

Investments in research and development are among the highest-payback investments a nation can make. Over the past 50 years technological innovation has been responsible for as much as half of the Nation's growth in productivity.

Sustaining this innovation requires an understanding of the factors that contribute to it. The Council on Competitiveness, a consortium of industry, university, and labor leaders, has developed quantitative measures of national competitiveness: the number of R&D personnel in the available workforce; total R&D investment; the percentage of R&D funded by private industry; the percentage of R&D performed by the university sector; spending on higher education; the strength of intellectual property protection, openness to international competition; and per capita gross domestic product. A similar set of indicators has been developed by the World Bank Group, and voluminous data have been compiled by NSF. The important point underscored by these indicators is that, for America to remain a prosperous and secure country, it must maintain its technological leadership in the world.

Perhaps the Council on Competitiveness' 2004 *National Innovation Initiative* report captured it best by simply stating, "Innovation has always been the way people solved the great challenges facing society."

Often the connection between an area of research, or even a particular scientific discovery, and an innovation may be far from obvious. Fundamental research in physics, mathematics and high-flux magnets supported by NSF led to the development of today's Magnetic Resonance Imaging (MRI) technology. Today, MRIs are used widely to detect cancer and internal tissue damage. Fundamental research on extremophiles, or microorganisms living in extreme environments, led to the polymerase chain reaction, a procedure essential to modern biotechnology, as well as one that allows us to use DNA for forensic evidence. Continuing progress in basic science and engineering research promises more discoveries as well as further improvements in living standards and economic performance.

And still, science and engineering is becoming an ever-larger portion of our nation's productivity. In the early 1950s, Jacob Bronowski wrote, "The world today is powered by science." I would take this premise one step farther, "No science; no economic growth." Our current level of scientific and technological productivity is what keeps us ahead of our global competitors as the playing field continues to become more level.

NSF has helped advance America's basic science and engineering enterprise for over fifty years. Despite its small size, NSF has an extraordinary impact on scientific and engineering knowledge and capacity. While NSF represents only four percent of the total federal budget for research and development, it accounts for fifty percent of non-life science basic research at academic institutions. In fact, NSF is the *only* federal agency that supports *all* fields of science and engineering research and the educational programs that sustain them across generations. NSF's pro-

grams reach over 2,000 institutions across the Nation, and they involve roughly 200,000 researchers, teachers, and students.

NSF specifically targets its investments in fundamental research at the frontiers of science and engineering. Here, advances push the boundaries of innovation, progress and productivity.

Compared to other commodities, knowledge generated from basic science investments is unique, long lasting and self-leveraging. Knowledge can be shared, stored and distributed easily, and it does not diminish by use. Incremental advances in knowledge are synergistic over time. NSF is proud to have built the foundation for this knowledge base through decades of peer-reviewed, merit-based research.

Management Perspectives on the FY 2006 Budget Request

Before I get into the details of our FY 2006 request, let me first address the questions you have raised in your invitation letter so that you can see how we plan to meet the challenges we face. The first item deals with priorities—how they are set both across and within accounts and among agency objectives. This is an excellent starting point for gaining a perspective on NSF, because setting priorities is at the core of what we do every day.

The most important source of information for setting priorities comes from the research communities themselves. The research proposals that we receive help identify the leading edge of research and areas ripe for greater investment. The broader research communities also provide continuous input in the form of advice and analyses from myriad National Academy reports, analyses by professional societies, and national and international workshops and conferences. Our Committees of Visitors provide top-to-bottom reviews of existing programs and help formalize research priorities within and across disciplines. Ultimately the priorities reflected in our budget request are refined through consultations with the Deputy Director, the Assistant Directors, the National Science Board, and the Office of Science and Technology Policy. Finally, they are negotiated with the Office of Management and Budget in developing the President's budget request to Congress.

This year's budget request has four priority areas:

- Strengthening core disciplinary research;
- Providing broadly accessible cyberinfrastructure and world-class research facilities;
- Broadening participation in the science and engineering workforce; and
- Sustaining organizational excellence in NSF management practices.

This last priority leads directly into the next question raised in your invitation letter regarding our short and long-term budget and management challenges. Nearly three years ago NSF initiated an independent business analysis that has identified a number of important management challenges in the areas of workforce requirements, information technology, and business practices.

It may help to give you some examples of NSF's workload. In 1993 NSF had 1,205 full-time equivalent (FTE) employees and we processed 29,000 proposals. In the intervening 12 years, our budget has doubled and the number of proposals we process grew by more than 50 percent. But our FTEs have increased by only 5.7 percent. To put it another way, 15,000 more proposals were being managed with 69 additional people. We have managed this increased workload by relying on investments in technology and other efficiency gains, but the need for additional people becomes an overriding need at some point, and we have reached that point.

Last year the more than 44,000 proposals submitted to NSF received approximately 250,000 reviews by outside experts. Yet in some programs the success rate is 10 percent or less. So one of the management challenges we face is better calibration of our solicitations so that the research community spends less time writing proposals that are not likely to get funded. We expect this to result in fewer noncompetitive proposals and a more productive use of resources.

Another challenge we face is maintaining a healthy and vibrant science and engineering workforce. To do so means encouraging students from all backgrounds to enter into science and engineering careers. We are protecting effective programs at NSF aimed at increasing the participation of women and under-represented minorities in research fields, as well as programs to increase the number of science, engineering and technology baccalaureate degrees, and our prestigious fellowship support for the most talented U.S. graduate students.

An area that has received a great deal of attention in recent years is our support of large research facilities. Our budget does not request any new starts for major research facilities, but we will continue construction and operation of projects underway. While new starts receive a great deal of attention, very little is paid to re-

search facilities that are phased out at the end of their useful life. Over the past five years, for example, we have phased out or de-commissioned four ocean research vessels, two aircraft, and two accelerators. These decisions were based on the scientific value of these platforms as well as their operation and maintenance costs. Indeed, the operation and maintenance costs are a key factor in the decision-making process for approving new research facilities.

One of the most conspicuous aspects of our budget request is the change in funding for the Education and Human Resources Directorate. As I mentioned earlier, when we set priorities, we protected a number of programs in EHR from significant reductions. After providing for high-priority areas, it is necessary to find offsets. As you know, this is the part of the priority setting that is most difficult. However, it is important that we focus not only on the numbers, but look at the broader policies as well.

For example, although we are proposing a significant reduction in the Research, Evaluations and Communication division, this is not a signal that we are no longer committed to evaluation. Rather, we are committed to building evaluations into the projects we fund, rather than treating it as a separate activity. Already we have used this approach in major projects to great advantage and we expect to expand this design throughout EHR.

NSF faces management challenges from a number of directions including, but certainly not limited to, those identified by the Inspector General. Earlier I mentioned our business analysis. We undertook this as a proactive measure to help identify workforce issues, business practices, and information technology needs that we are, and will be, confronting in the future. We have been steadily implementing recommendations as they come forth and will continue to do so. In the year that I have been at NSF I have been extremely impressed by the professionalism and dedication that I have encountered. NSF employees, and I, take very seriously the need to earn and maintain the taxpayers' trust and preserve the agency's reputation. A complete list of agency actions in response to the management challenges is included in NSF's FY 2004 Performance and Accountability Report, and would be pleased to include a copy for the record.

FY 2006 Budget Request

Mr. Chairman, the Foundation's FY 2006 budget Request reflects the Administration's confidence in our continuing with this mission. In light of the tight fiscal climate, NSF fared relatively well. For the coming fiscal year, NSF requests $5.6 billion, an increase of $132 million, or 2.4 percent, over last year's appropriated levels.

At a time when many agencies are looking at budget cuts, an increase in our budget underscores the Administration's support of NSF's science and engineering programs, and reflects the agency's excellent management and program results.

With the wealth of benefits that investments in science and engineering bring to the Nation, perhaps none is more powerful than the capability to respond quickly and effectively to challenges of all kinds. NSF's programs reach over 2,000 institutions across the Nation, and they involve researchers, teachers, and students in all fields of science and engineering and at all levels of education. They also keep us abreast of scientific advances throughout the world. This breadth of activity in and of itself creates a vital national resource, as it provides the Nation with a constantly invigorated base of knowledge, talent, and technology. For example, in areas ranging from terrorism threats to natural disasters, NSF's ongoing support of research in areas such as advanced information technologies, sensors, and earthquake engineering ensures a broad base of expertise and equipment that allows the science and engineering community to respond quickly in times of need and in partnership with scientists and engineers from other countries.

Four funding priorities centering this year's request are designed to address current national challenges and strengthen NSF's core research investments. They include: (1) Strengthening core disciplinary research; (2) Providing broadly accessible cyberinfrastructure and world-class research facilities; (3) Broadening participation in the science and engineering workforce; and (4) Sustaining organizational excellence in NSF management practices.

This year's investments will strengthen the core disciplines that empower every step of the process from discovery at the frontier to the development of products, processes, and technologies that fuel the economy. At the same time, NSF's investments will enable increasing connections and cross-fertilization among disciplines.

NSF's focus on a clear set of priorities will help the Nation meet new challenges and take advantage of promising opportunities, while at the same time spurring the growth and prosperity needed to secure the Nation's long-term fiscal balance. The FY 2006 budget will emphasize investments that address established interagency research priorities, meet critical needs identified by the science and engineering

community, and advance the fundamental knowledge that strengthens the Nation's base of innovation and progress. NSF will respond to these challenges by supporting the best people, ideas, and tools in the science and engineering enterprise, and by employing the best practices in organizational excellence.

Research and Related Activities Account

For FY 2006, total funding for NSF's Research and Related Activities account increases by $113 million—nearly three percent—to $4.33 billion. This increase largely reflects NSF efforts to strengthen fundamental research in the core scientific disciplines as well as promote emerging areas of research. The FY 2006 portfolio balances research in established disciplines with research in emerging areas of opportunity and cross-disciplinary projects. The most fertile opportunities sometimes lie in novel approaches or a collaborative mix of disciplines.

Maintaining a strong and robust core is critical during such a budget climate as certain segments of the academic community rely heavily on NSF funding. In many scientific disciplines, NSF is a major source of federal funding to academic institutions, including mathematics (77 percent), computer sciences (86 percent), the social sciences (49 percent), the environmental sciences (50 percent), engineering (45 percent) and the physical sciences (39 percent).

Research, however, is only part of the NSF equation. Training the Nation's next generation of scientists and engineers is another key component of NSF's mission, and critical for maintaining economic prosperity and global competitiveness. Here, we are finding ways to leverage our resources. For example, as we strengthen our core disciplinary research programs, we will continue to encourage the types of partnerships between researchers and students that provide hands-on experience while ensuring that future generations gain the skills, knowledge and insight that come from working at the frontier of discovery.

Providing Broadly Accessible Cyberinfrastructure and World-Class Research Facilities

Twenty-first century researchers and the students who will bring new skills into the workforce rely on cutting-edge tools. In FY 2006, NSF is placing a high priority on investments in cyberinfrastructure and in unique, widely shared research equipment and facilities.

An infrastructure of power grids, telephone systems, roads, bridges and rail lines buttressed this nation's industrial economy and allowed it to prosper. However, cyberinfrastructure—a networked system of distributed computer information and communication technology—is the lynchpin of today's knowledge-based economy. In FY 2006, NSF cyberinfrastructure investments total $509 million, an increase of $36 million (7.6 percent) over the FY 2005 level.

Modeling, simulation, visualization, data storage and communication are rapidly transforming all areas of research and education. NSF investments in cyberinfrastructure support a wide mix of projects and encourage participation from broad segments of the research community that rely on such technology as they tackle increasingly complex scientific questions. Thanks to cyberinfrastructure and information systems, today's scientific tool kit includes distributed systems of hardware, software, databases and expertise that can be accessed in person or remotely. In fact, programs such as Teragrid, a multi-year effort to create the world's largest distributed infrastructure for open scientific research, are specifically designed to transcend geographic boundaries and accelerate virtual collaborations.

NSF is also increasing funding for the Major Research Equipment and Facilities Construction by $76 million or 44 percent, in FY 2006 for a total of $250 million. There are no new starts, but we will continue to fund ongoing projects. Work will proceed on five major facilities that will serve a spectrum of the science and engineering community. These include world-class astronomy, physics, and geosciences observatories identified as the highest priorities for advancing science and engineering.

- The Atacama Large Millimeter Array (ALMA), in Chile, is a model of international collaboration. It will be the world's largest, most sensitive radio telescope.
- The EarthScope facility is a multi-purpose array of instruments and observatories that will greatly expand the observational capabilities of the Earth Sciences and permit us to advance our understanding of the structure, evolution and dynamics of the North American continent.
- Ice Cube, the world's first high-energy neutrino observatory, will be located under the ice at the South Pole.

- RSVP, the Rare Symmetry Violating Processes Project, will enable cutting edge physics experiments to study fundamental properties of nature. Studies will probe questions ranging from the origins of our physical world to the nature of dark matter.
- SODV, the Scientific Ocean Drilling Vessel, is a state-of-the-art ship that will be a cornerstone of a new international scientific ocean-drilling program. Ocean core sediment and rock collected by the vessel will help investigators probe changes in the earth's oceans and climate, and explore the planet's geological history.

Additionally, In FY 2006, NSF will assume the responsibility, from the U.S. Coast Guard, for funding the costs of ice-breakers that support scientific research in polar regions; $48 million was transferred for those purposes.

Broadening Participation

To feed our knowledge-based economy, the Nation needs to capitalize on all of its available talent to produce a workforce of skilled technologists, scientists and engineers. That means developing the largely untapped potential of those under-represented in the science and engineering workforce—minorities, women and persons with disabilities. It also means supporting science education and training in all regions of the country—not just at large universities or in a handful of states.

To achieve these goals, the FY 2006 Request maintains a total investment of almost $400 million. Funding will be targeted to programs with a proven track record of progress in these areas. Included in this is $8 million in additional support from the research directorates that will supplement the Education and Human Resources Account to help achieve our goal of broadening science and engineering participation. Working closely with the directorates offers a dual benefit of providing educational opportunities and hands-on research experience to prepare students for the 21st century workforce.

NSF will invest $396.5 million in a range of programs with proven track records. Several highly successful programs for broadening participation—the Louis Stokes Alliances for Minority Participation, the Alliances for Graduate Education and the Professoriate, the Centers for Research Excellence in Science and Technology (CREST), Robert Noyce Scholarship program, STEM Talent Expansion Program and EPSCoR—just to name a few, are secured in this request. Each of these serve as models for integrating educational and research resources to improve recruitment and retention in science and engineering to all sectors of our diverse population.

Sustaining Organizational Excellence in NSF Management Practices

NSF directly supports over 210,000 scientists, educators and students and processes over 40,000 proposals a year. Balancing the needs of a growing, increasingly complex portfolio with new requirements for e-business practices, security, accountability, and award oversight presents a challenge. NSF sets high standards for its business practices and strives to create an agile, innovative organization through state-of-the-art business conduct and continual review. In order to meet these management goals, NSF will be increasing funding for activities that advance organizational excellence by $46 million, to a total of $336 million. In addition to critically needed upgrades to our information technology infrastructure, this increase will allow for the recruitment of 25 full-time employees—23 for NSF and one each for the National Science Board and the Office of the Inspector General—which will improve our ability to manage our increasingly complex portfolio.

Expanding our e-government systems and the implementing of our ongoing business analysis recommendations are high priorities for FY 2006.

Over the past two years, as part of the Administrations Program Assessment Rating Tool, NSF has worked with OMB to rate eight of our investment categories. All of these areas have received the highest rating of Effective. As such, NSF programs fall within the top 15 percent of 600 government programs evaluated to date.

Crosscutting Activities

Beyond our budget priorities lie dozens of programs and initiatives that cut across NSF directorates and enrich the overall science and research enterprise. NSF sets priorities based on a continual dialogue and exchange of ideas with the research community, NSF management and staff and the National Science Board. Programs are initiated based on several criteria: intellectual merit, broader impacts of the research, balance across disciplines and synergy with research in other agencies. The Committee of Visitors process ensures a continuous evaluation of our merit review process and feedback on how NSF programs are performing. In FY 2006, NSF will emphasize four crosscutting areas.

Crosscutting areas of emerging opportunity: Over several years, NSF has funded exceptionally promising interdisciplinary efforts aimed at advancing our knowledge, addressing national needs, and probing the grand challenges of science. The FY 2006 request maintains or increases FY 2005 levels of funding for the following priority areas: $84 million for Biocomplexity in the Environment, $243 million for Nanoscale Science and Engineering, $89 million for the Mathematical Sciences Priority Area and $39 million for Human and Social Dynamics.

International Collaborations: Science and engineering research are increasingly global endeavors. International partnerships are critical to the United States in maintaining a competitive edge, capitalizing on global opportunities, and addressing global problems. The Office of International Science and Engineering's recent move to the director's office, and the budget request reflects this important trend. The FY 2006 budget provides $35 million for NSF's Office of International Science and Engineering.

The recent Indian Ocean Tsunami disaster represents the finest in international cooperation—and clearly demonstrates an international desire to develop scientific methods for natural disaster prediction and ways to reduce losses when such catastrophic events do inevitably occur. A network of more than 128 sensors—which NSF has a 20-year investment in—recorded shock waves from the recent earthquake as they traveled around the Earth. This network is the primary international source of data for earthquake location and tsunami warning and its data forged the critical core of the early knowledge of this event. Within days of the disaster NSF research teams deployed to the region to gather critical data before it was lost to nature and reconstruction. Their work will help scientists and engineers better understand the warning signs of natural disasters, the design of safer coastal structures, the development of early warning and response systems, and effective steps for disaster recovery.

Interagency Initiatives: NSF will continue to play a lead role in interagency collaborations to address national needs and take advantage of economic growth opportunities. In FY 2006, NSF investments in the National Nanotechnology Initiative increase by $6 million over FY 2005 levels to total $344 million. NSF participation in the Networking Information Technology Research and Development initiative will increase to $803 million—$8 million over the FY 2005 level. The NSF contribution to the Climate Change Science Program decreases slightly to $197 million.

Homeland Security Activities: The FY 2006 Request includes a $2 million increase for government-wide efforts in homeland security research and development. This $344 million investment will strengthen NSF's commitment to cyber security by supporting innovations to secure today's computer and networking systems, embed cyber security into future systems and preparing tomorrow's workforce with state-of-the-art security skills.

Conclusion

Mr. Chairman, I've only touched upon the variety and richness of the NSF portfolio. NSF research and education efforts contribute greatly to the Nation's innovation economy and help keep America at the forefront of science and engineering. At the same time, NSF supported researchers produce leading edge discoveries that serve society and spark the public's curiosity and interest. Extraordinary discoveries coming from dozens of NSF programs and initiatives are enriching the entire science and engineering enterprise, and making education fun, exciting and achievement-oriented. In fact, just this month, two of the most widely-read and e-mailed stories from the national press were the discoveries of NSF-supported researchers.

In one, scientists using new bio-bar-code technology created a detection method for a protein implicated in Alzheimer's disease. It's the first test designed for use in living patients and holds promise for diagnosing Alzheimer's at an early stage. In the second development, scientists generated an entirely new classification system for the brains of birds based on recent studies showing that birds are much closer in cognitive ability to mammals than previously thought. The new scheme will affect thousands of scientists, and help merge research efforts on both birds and mammal. These two examples, fresh off the press, illustrate NSF's motto "Where Discoveries Begin."

Mr. Chairman and Members of the Subcommittee, I hope that this brief overview conveys to you the extent of NSF's commitment to advancing science and technology in the national interest. I am very appreciative of the Subcommittee's long-standing bipartisan support for NSF. I look forward to working with you and your colleagues in continuing the close and productive relationship that NSF has had with Congress over the past 55 years.

I would be happy to respond to any questions that you have.

BIOGRAPHY FOR ARDEN L. BEMENT, JR.

Arden L. Bement, Jr., became Director of the National Science Foundation on November 24, 2004. He had been Acting Director since February 22, 2004.

He joined NSF from the National Institute of Standards and Technology, where he had been director since Dec. 7, 2001. Prior to his appointment as NIST director, Bement served as the David A. Ross Distinguished Professor of Nuclear Engineering and Head of the School of Nuclear Engineering at Purdue University. He has held appointments at Purdue University in the schools of Nuclear Engineering, Materials Engineering, and Electrical and Computer Engineering, as well as a courtesy appointment in the Krannert School of Management. He was Director of the Midwest Superconductivity Consortium and the Consortium for the Intelligent Management of the Electrical Power Grid.

Bement served as a member of the U.S. National Science Board from 1989 to 1995. The board guides NSF activities and also serves as a policy advisory body to the President and Congress. As NSF director, Bement will now serve as an ex officio member of the NSB.

He also chaired the Commission for Engineering and Technical Studies and the National Materials Advisory Board of the National Research Council; was a member of the Space Station Utilization Advisory Subcommittee and the Commercialization and Technology Advisory Committee for NASA; and consulted for the Department of Energy's Argonne National Laboratory and the Idaho National Engineering and Environmental Laboratory.

Bement joined the Purdue faculty in 1992 after a 39-year career in industry, government, and academia. These positions included: Vice President of Technical Resources and of Science and Technology for TRW Inc. (1980–1992); Deputy Under Secretary of Defense for Research and Engineering (1979–1980); Director, Office of Materials Science, DARPA (1976–1979); Professor of Nuclear Materials, MIT (1970–1976); Manager, Fuels and Materials Department and the Metallurgy Research Department, Battelle Northwest Laboratories (1965–1970); and Senior Research Associate, General Electric Co. (1954–1965).

He has been a director of Keithley Instruments Inc. and the Lord Corp. and was a member of the Science and Technology Advisory Committee for the Howmet Corp. (a division of ALCOA).

Bement holds an Engineer of Metallurgy degree from the Colorado School of Mines, a Master's degree in Metallurgical Engineering from the University of Idaho, a doctorate degree in metallurgical engineering from the University of Michigan, an honorary doctorate degree in engineering from Cleveland State University, and an honorary doctorate degree in science from Case Western Reserve University. He is a member of the U.S. National Academy of Engineering.

Chairman INGLIS. Thank you, Dr. Bement.

Dr. Wrighton.

STATEMENT OF DR. MARK S. WRIGHTON, CHAIRMAN, AUDIT AND OVERSIGHT COMMITTEE, NATIONAL SCIENCE BOARD

Dr. WRIGHTON. Chairman Inglis, Congresswoman Hooley, and Members of the Subcommittee, I appreciate the chance to be here this morning. I am Mark Wrighton, Chancellor of Washington University in St. Louis. My testimony today is in my capacity, however, as a member of the National Science Board and chair of the Audit and Oversight Committee.

As Chairman of the National Science Board, Dr. Warren Washington regrets that he is unable to be here to give this testimony. However, he did ask me to say that on behalf of the entire Board and the widespread and diverse research and education communities that we serve, that he thanks the House for its long-term commitment to a broad portfolio of investments in science, engineering, mathematics, and technology research and education.

The Congress established the National Science Board in 1950 and gave it two key responsibilities: number one, to oversee the activities of and establish policies for the National Science Foundation; and number two, to serve as an independent national science

policy body to render advice to the President and to Congress on policy issues related to science and engineering research and education.

During our recent Board retreat in February, Board members reaffirmed their strong commitment to fulfilling these responsibilities. Board members, including the NSF Director, also discussed the important role of the Board in establishing a vision in setting priorities for the Foundation. Approving the annual NSF budget is one way for the Board to contribute to the setting of priorities.

I would like to provide some general comments regarding the NSF fiscal year 2006 budget and then briefly update you on the National Science Board activities over the last year and discuss some of the priorities for the coming year. The written testimony that has been provided provides more detail on the following points.

First, on the 2006 budget, the Board has reviewed and approved the NSF 2006 budget request that was submitted to the OMB in September of 2004, and, broadly, we support the President's budget request.

Given the overall cut to non-defense domestic discretionary spending, the Board appreciates that the President's budget request recognizes the importance of returning NSF to positive growth. We are also certain that the Members of this subcommittee fully understand the unique and long-term value of NSF programs to important national priorities; these being to ensure the future economic health of our nation, maintain the United States' pre-eminence in discovery and innovation, and provide valuable contributions to homeland security efforts.

The Board fully supports the fiscal year 2006 NSF budget focus on the four funding priorities that Dr. Bement has indicated. These address the current national challenges as well as making NSF's core portfolio of research investment stronger. We recognize that a budget request of $5.6 billion, representing a 2.4 percent increase over NSF's fiscal year 2005 budget, is a significant investment in NSF programs in these difficult times. However, we, and others, have noted that this request remains below the level of the 2004 NSF operating budget.

Should additional funds beyond the Administration's request be made available to NSF in 2006, the National Science Board recommends the following: that we support a strong and growing role for the NSF in the Nation's investment in science and engineering education. There is no greater—no more valuable investment than in preparing young men and women to enter careers in science and engineering. We should also address the backlog of Board-approved and prioritized Major Research Equipment and Facilities Construction projects, the so-called MREFC projects. Further, we should provide support for addressing the financial burden the Foundation will encounter related to the transfer of the icebreaker-ships from the Coast Guard to the National Science Foundation, in terms of financial responsibility.

Let me give you a brief overview of some of the NSB activities during the past year.

We have developed and implemented a process for the annual Board re-prioritization of all approved but not yet funded MREFC

projects. We have provisionally approved the report *Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation.* We are also seeking comments from hundreds of individuals and organizations that would be expected to use these facilities. We expect Board approval and full implementation of the revised process by the fall of 2005.

The Board examined our policies and positions relevant to the NAPA report recommendations concerning the Board's implementation of the Sunshine Act, the use of IPA and rotator-type employees, the appointment and reporting process of the NSF Inspector General, and the role of the Board in oversight and in setting policies for the National Science Foundation.

There are a number of other important activities that the Board engages in. We are currently examining issues raised by the fiscal year 2004 financial statement audit and the NSF Office of Inspector General on NSF procedures for post-award administration of grants and contracts. The Board feels strongly that the reportable conditions surrounding post-award grant monitoring must be dealt with by NSF management in a timely manner. It is my understanding that NSF management has developed a draft corrective action plan and is currently discussing it with the Inspector General. I would expect that both the IG and the NSF management will provide the Board's Audit and Oversight Committee an update at our meeting later this month.

While much can and will be done to address these issues in 2005, the Board is also cognizant that to fully implement the auditor recommendations for corrective action—with which the Board concurs—that an appropriate level of future funding must be provided to support the administrative effort within the Foundation.

We appreciate very much the budget extended to the National Science Board, approximately $4 million. In the coming year, the Board will expand its ongoing examinations of its role and responsibilities as it implements the new protocol for the process by which MREFC proposals are developed, prioritized, and funded; NSF policies for long-lived data collections, policies regarding the identification, development, and funding of transformative research; and policies to ensure an adequate and diverse science and engineering workforce for the future.

Let me thank this committee for its role in enhancing the investment that will bring great strength to America in the future. There is no better investment that you can place than in science and engineering education and research.

Thank you very much.

[The prepared statement of Dr. Wrighton follows:]

PREPARED STATEMENT OF MARK S. WRIGHTON

Chairman Inglis, Congresswoman Hooley and Members of the Subcommittee, I appreciate the opportunity to testify before you. I am Mark Wrighton, Chancellor, Washington University, Saint Louis, Missouri. My testimony today is in my capacity as Member of the National Science Board and Chairman of its Committee on Audit and Oversight.

The Chairman of the National Science Board, Dr. Warren Washington, regrets that he is unable to provide this testimony to you today. However, he did ask me to say that—on behalf of the Board and the widespread and diverse research and education communities that we all serve—he thanks the House for its long-term

commitment to a broad portfolio of investments in science, engineering, mathematics, and technology research and education.

The Congress established the National Science Board in 1950 and gave it dual responsibilities:

- oversee the activities of, and establish the policies for, the National Science Foundation (the Foundation, NSF); and
- serve as an independent national science policy body to render advice to the President and the Congress on policy issues related to science and engineering research and education.

During our recent Retreat, Board Members reaffirmed their strong commitment to fulfilling these responsibilities. Board Members, including the NSF Director, also discussed the important role of the Board in establishing a vision and setting priorities for the Foundation. Approving the annual NSF budget is one way for the Board to set priorities.

I would like to provide some general comments regarding the NSF FY 2006 budget request, then update you on National Science Board activities over the last year and some of our priorities for the coming year.

FY 2006 NSF BUDGET REQUEST

The National Science Board has reviewed and approved NSF's FY 2006 budget request that was submitted to the Office of Management and Budget (OMB) in September 2004, and we generally support the President's budget request before you today. Given the overall cut to non-defense domestic discretionary spending, the Board respects and appreciates that the President's budget request recognizes the importance of returning NSF to positive growth. We are cognizant of the current federal fiscal constraints that our nation faces and that there are many worthy competing interests for a limited resource. However, we are also certain that the members of this House Authorization Subcommittee fully understand the unique and long-term value of NSF programs in science and engineering research and education to ensuring the future economic health of our nation, maintaining U.S. preeminence in discovery and innovation, and providing valuable contributions to homeland security efforts.

The Board fully supports the FY 2006 NSF budget focus on the four funding priorities that address current national challenges as well as strengthening the core portfolio's of NSF's research investment. We also recognize that a budget request of $5.605 billion, representing a 2.4 percent increase over NSF's FY 2005 budget, is a significant investment in NSF programs in a time of National fiscal austerity. Nevertheless, it is incumbent on the Board to note that this request remains below the level of the 2004 NSF operating budget.

Should additional funds, beyond the Administration's request, be made available to NSF in FY 2006, the National Science Board would recommend support for a strong and growing role for the NSF in the Nation's investment in science and engineering (S&E) education, addressing the backlog of Board approved and prioritized Major Research Equipment and Facilities Construction (MREFC) projects, and addressing the financial burden to the Foundation related to the transfer of financial responsibility for ice-breaker ships from the Coast Guard to the NSF.

Adequate preparation of future participants in the U.S. workforce, at all levels of education, will require increasing mathematics and science understanding and skills if the U.S. is to sustain global preeminence in S&T. The Board has underscored its concern about the poor performance of U.S. citizens in essential knowledge and skill areas in science, technology, engineering, and mathematics (STEM) fields, in comparison with other high technology countries. It is impossible to conclude that growth in our National capabilities can occur without continual enhancement of the skills of our workforce. We have relied too heavily on attracting international students and professionals to meet our workforce needs, and, as a result, we need to do a better job of preparing U.S. students for joining the S&E workforce. Other nations are competing with the U.S. for the best international students and most accomplished S&E professionals. We must recognize the critical challenge our Nation now faces in sustaining a U.S. science and technology (S&T) workforce that will be competitive over the long-term in an increasingly global and competitive S&T environment.

The Board fully supports the proposed FY 2006 funding for MREFC projects, and appreciates the significant increase in funding for this budget category. Members of the House Authorization Subcommittee are aware of the exciting opportunities at the frontiers of knowledge that we are unable to pursue without the cutting edge facilities that are funded under this account. While funding for ongoing MREFC projects is the highest priority for the Board, the lack of any new project starts in

FY 2006 will increase the concern of the science community that the U.S. is losing its ability to sustain cutting edge S&E research. Should additional funding for MREFC projects be available, the Board recommends, in priority order, support for Ocean Observatories and the Alaska Regional Research Vessel.

The third area for which the Board would recommend any additional NSF funding be allocated is appropriate support for the costs that NSF will incur with the transfer of financial responsibility for ice-breaking activities previously supported by U.S. Coast Guard. The Administration's FY 2006 NSF budget request allocated $43 million. The Board is very concerned that the true costs to NSF for these new responsibilities will be greatly more that $43 million and will, therefore, drain resources from NSF research and related activities. We understand that a new NSF-Coast Guard Joint Working Group is discussing various options for dealing with this issue. In addition, we understand that the National Academies Polar Research Board is studying this issue and expects to provide an interim report in September 2005. When these two groups have completed their discussions and assessments, we urge Congress to factor their conclusions into any final budget decisions and provide adequate funding to fully support this new NSF responsibility.

Again, the NSB supports the integrated portfolio of investments in S&E research and education represented in the NSF FY 2006 budget proposal. It thoughtfully blends support for the core disciplines with encouragement for interdisciplinary initiatives, brings together people from diverse and complementary backgrounds, provides infrastructure for research and STEM education, and strengthens the NSF's management of the enterprise.

Further, in this time of National emergency, this budget for NSF continues to foster S&T that enhances our homeland security. NSF activities in this area include Critical Infrastructure Protection, Research to Combat Bioterrorism, Cybercorps/Scholarships for Service, Counterterrorism, and Physical/Information Technology Security. Of course, by enabling future discovery and innovation, NSF supports our nation's long-term prosperity and economy security.

OVERVIEW OF NSB ACTIVITIES DURING THE LAST YEAR

During the last calendar year, even while going through a continuing evolution in terms of its operation, the Board has accomplished a great deal in terms of our mission to provide oversight and policy direction to the Foundation.

I would like to briefly highlight some of these accomplishments, but will not attempt to discuss them all here.

In terms of providing oversight for the Foundation, the Board has:

- reviewed and endorsed the Office of Inspector General Semi-annual Reports to Congress, and approved NSF management responses;
- approved the NSF FY 2006 budget request for transmittal to OMB;
- reviewed the Foundation's report on its merit review system;
- provided review and decisions on nine major awards or proposal funding requests;
- developed and implemented a Board process for re-prioritization of all Board approved, but not yet funded, MREFC projects; and
- provisionally approved the report *Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation* (NSB/CPP–04–20).

The Board and Foundation are implementing the principles of the revised process described in this provisionally approved document for the FY 2006 budget. At the same time, the Board Office has implemented an extensive outreach effort to invite comments from nearly 400 individuals and organizations that would be expected to have particular interest in large facilities. We expect final revisions based on this additional review and input, Board approval of all revised procedures and policies, and full implementation of the revised process in the Fall, 2005.

With respect to providing policy direction to the Foundation, the Board has:

- approved a report on Broadening Participation in Science and Engineering Faculty (NSB 04–41) that addresses the need to increase the diversity of this component of the S&E workforce to more nearly reflect the diversity of the student body it serves, and
- approved elimination of agency requirements for cost sharing, beginning this year (2005), while retaining the one percent statutory cost-sharing requirement.

In terms of advice to the President and the Congress, the Board has:

- published and distributed widely *Science and Engineering Indicators 2004,* the 16th volume of this statutory, biennial series and initiated the *Science and Engineering Indicators 2006* report;
- published a policy statement accompanying Indicators 2004, *An Emerging and Critical Problem of the Science and Engineering Labor Force* (NSB 04–07), which draws attention to the disturbing long-term trends in U.S. education and the globalization of S&T that, if ignored, may result in a loss of U.S. leadership in innovation and high technology;
- approved the draft report on *Long Lived Data Collections: Enabling Research and Education in the 21st Century* (NSB/CPP–04–21);
- reported to the Congress on Delegation of Authority in accordance with Section 14 of the NSF Act of 2002;
- responded to four specific IPA-related questions that NSB's Executive Officer received from the House Appropriations Subcommittee for VA, HUD, and Independent Agencies;
- published and disseminated *Fulfilling the Promise: A Report to Congress on the Budgetary and Programmatic Expansion of the National Science Foundation* (NSB–03–151);
- provided testimony to congressional hearings;
- interacted with Office of Science and Technology Policy (OSTP) and OMB on NSF and S&E issues;
- provided briefings and presentations to the Congress and other policy organizations concerning the Board's reports and statements; and
- responded to specific questions and inquiries from Senators and Representatives.

In an effort to facilitate more openness of Board meetings in accord with the Sunshine Act, we expanded our practices for:

- providing public notice of all our meetings in press releases, the *Federal Register,* and the NSB website;
- treating teleconferences of committees as open meetings;
- providing much more information to the public in a more timely manner regarding meeting discussions and decisions; and
- encouraging public comment during the development of Board publications.

Also, this past year the Board:

- examined our policies and positions relevant to the recommendations of the National Academy of Public Administration report concerning the Board's implementation of the Sunshine Act, the use of Intergovernmental Personnel Act (IPA) employees and other rotators at NSF, the oversight of the NSF Inspector General, and the role of the National Science Board in oversight and setting policies for NSF;
- began implementing recommendations of the Office of Inspector General to continue enhancing our procedures and policies related to compliance with the Sunshine Act; and
- significantly increased and improved our direct outreach and communication with OMB, OSTP, Congress, other federal agencies, various interest groups and the outside S&E research and education community.

To that end, the Board Office is contracting to develop monitoring and evaluation tools, to expand outreach, and measure the impacts of NSB statements, resolutions and reports; and to redesign the NSB website for greater accessibility and utility to the public.

- One thematic area of significant accomplishment was transformative or "high risk" research where the Board organized a Workshop on *Identifying, Reviewing, and Funding Transformative Research* and established within the Committee on Programs and Plans a Task Force on Transformative Research.
- Another thematic area of accomplishment this year was long-lived data collections where the NSB established within the Committee on Programs and Plans a Task Force on Long-Lived Data Collections; and prepared a draft report, *Long-Lived Date Collections: Enabling Research and Education in the 21st Century* (NSB/CPP–04–21).
- The year 2004 also saw the Board's examination of NSF issues related to broadening participation in S&E; as well as efforts toward obtaining industry

perspectives on workforce issues. The Board has also continued its recognition of outstanding science, engineering and science education accomplishments through the Vannevar Bush Award, Alan T. Waterman Award, and Public Service Awards.

FY 2006 NSB BUDGET

The Administration's FY 2006 Budget Request of $4.0 million for the NSB will be adequate to support Board operations and activities during FY 2006. The request seeks resources to carry out the Board's statutory authority and to strengthen its oversight responsibilities for the Foundation. We expect that the Foundation will continue to provide accounting, logistical and other necessary resources in support of the NSB and its missions, including expert senior S&E staff serving as a cadre of executive secretaries to Board committees and task forces.

At the urging of Congress, in FY 2003 the Board began examining options for augmenting its professional staffing levels. At its May 2003 meeting, the Board decided to begin a process to assess the feasibility of recruiting for positions that would broaden its policy support, provide additional legal advice, and enhance the Board's capabilities in advanced information technology. The Board Office has continued to implement the staff enhancement plan, adding four positions this fiscal year for support staff, including information technology staff, science assistants, national awards assistant, and filling the vacancy for an editor/writer. The Board Office will be recruiting two senior professionals to provide policy and legal support to the Board this year. The Board is very pleased with the progress of the staff enhancement process.

The NSB Office staff provides the independent resources and capabilities for coordinating and implementing S&E policy analyses and development. It also provides operational support essential for the Board to fulfill its mission. By statute, the Board is authorized five professional positions and other clerical staff as necessary. In consultation with the Congress, the Board has defined these professional positions as NSB senior S&E policy staff, and the clerical and technical positions as NSB staff that support Board operations and related activities. The full impact of increasing the number of professional positions closer to the statutory level is expected to occur in FY 2005, emphasizing a broadening of professional skills to support the Board.

In addition to the NSB Office's essential and independent resources and capabilities, external advisory and other services are especially critical to support production of NSB reports, and supplement the NSB staff's general research and administration services to the Board. These external services provide the Board and its Office with the flexibility to respond independently, accurately and quickly to requests from Congress and the President, and to address issues raised by the Board itself.

In FY 2006, the Board will expand its ongoing examinations of its role and responsibilities regarding the NSF's MREFC programs as it finalizes the development and implementation of a new protocol for the process by which major research equipment and facilities proposals are developed, prioritized, and funded; NSF policies for Long-lived Data Collections; NSF policies regarding the identification, development and funding of transformative "high risk" research; and policies to ensure an adequate and diverse S&E workforce for the future. These special activities are, of course, in addition to NSB's normal oversight of the Foundation.

For example, through the Board's Audit and Oversight Committee, which I chair, we are currently examining issues raised by the FY 2004 Financial Statement Audit and the NSF Office of Inspector General on NSF procedures for post-award administration of grants and contracts. The Board feels strongly that the reportable conditions surrounding post-award grant monitoring must be dealt with by NSF Management in a timely manner. NSF has assured the Board that corrective actions will be taken. It is my understanding that NSF Management has developed a draft corrective action plan and is currently discussing it with the IG. NSF has been requested to provide updates to the Board on progress in addressing this issue. I would expect that both the IG and NSF Management will provide the Board's A&O Committee with an update at our March meeting. While much can and will be done to address these issue in FY 2005, the Board is also cognizant that to fully implement the auditor recommendations for corrective action, with which the Board concurs, appropriate level of future funding must be provided.

At the request of Congress, and consistent with Board discussions during our recent Retreat, the Board will undertake the development and establish a new vision for the Foundation for the 21st Century. This visionary document will also include overarching goals with both long- and short-term priorities that take into account federal fiscal realities. We expect to work closely with the NSF Director and finalize this effort by the end of 2005.

At the request of Congress, the Board will also conduct an examination of the NSF Merit Review System and report our initial findings before the end of this fiscal year.

The Board will continue to review and approve NSF's actions for creating major NSF programs and funding large projects. Special attention will be paid to impacts of budget constraints on the S&T workforce, broadening participation in higher education, national S&T infrastructure, and the size and duration of NSF grants.

Effective communications and interactions with our constituencies contribute to the Board's work of identifying priority S&T policy issues, and developing policy advice and recommendations to the President and Congress. To this end, the Board will increase communication and outreach with the university, industry and the broader S&E research and education community, Congress, Federal S&T agencies, and the public. These activities will support U.S. global leadership in discovery and innovation based on a continually expanding and evolving S&T enterprise in this country, and will insure a principal role for NSF programs in providing a critical foundation for S&E research and education.

With our eight new Board Members, new openness, and new modes of operations, the Board has much to do in 2005. However the most daunting challenge we face is making the tough choices and prioritizing NSF programs and projects in the face of constrained federal budgets and a growing competition for those funds.

CLOSING REMARKS

This is a difficult time for federal budgets for S&E research and education and the institutions and individuals in the nonprofit and public sectors that rely on federal support. For over 50 years the Federal Government has sustained a continual, visionary investment in the U.S. research and education enterprise in the expectation that such investment would redound to the benefit of all Americans. That federal effort has expanded the horizon of scientific discovery and engineering achievements far and wide, leading to the realization of enormous benefits to our nation and, indeed, all of humanity.

In recognition of the federal fiscal realities our nation faces, the National Science Board pledges that we will be a force for causing the NSF to set priorities, to make hard programmatic budget decisions and, as a result, to obtain the most benefits from the funds provided. However, even in a time of budget constraints, as a nation we cannot ignore our growing dependence as a society on innovation for economic prosperity and the ever-improving quality of life Americans have come to expect. The federal compact in research and education with the nonprofit sectors is an essential pillar of our nation's global dominance in S&T.

We know what works—we have a very long history of success to draw on. We know the expanding frontiers of knowledge offer enormous opportunities for research and innovation. We also know that the education of all our citizens in the fundamentals of math, science and engineering must be addressed if the U.S. is to remain eminent in S&T when we enter the 22nd century. As other nations ramp up their investment in the infrastructure for S&E research and innovation, we cannot be complacent. The federal investment in the Nation's S&T is a necessity for the Nation's future prosperity and security. The U.S. must sustain its advantages through continued wise, adequate federal support for our S&E enterprise.

BIOGRAPHY FOR MARK S. WRIGHTON

CHEMISTRY

B.S., Florida State University, 1969

Ph.D., California Institute of Technology, 1972

Mark Stephen Wrighton was born in Jacksonville, Florida, and attended the California Institute of Technology, where he was awarded the Ph.D. degree in Chemistry in 1972. Following graduation, he joined the chemistry faculty at the Massachusetts Institute of Technology (MIT), became a Full Professor in 1977, was named the Frederick G. Keyes Professor of Chemistry in 1981, headed the Department of Chemistry from 1987 to 1990, was named the Ciba-Geigy Professor of Chemistry in 1989, and served as provost of MIT from 1990 to 1995. He was elected the 14th Chancellor of Washington University in St. Louis in 1995 and also serves as professor of chemistry. Wrighton's research interests include transition metal catalysis, photochemistry, surface chemistry, molecular electronics, and photoprocesses at electrodes. He has authored or co-authored more than 300 articles in professional and scholarly journals, and he holds 14 patents.

Wrighton serves on the Board of Directors of the Consortium on Financing Higher Education, the Donald Danforth Plant Science Center, Cabot Corporation, Helix Technology Corporation, Ionics, Inc., and A.G. Edwards, Inc. He is also a trustee of the Missouri Botanical Garden and the St. Louis Science Center. Wrighton has served on numerous editorial advisory boards, councils, committees, and study groups for scientific organizations, including the National Science Foundation.

Among Wrighton's many awards are the Herbert Newby McCoy Award in 1972 and the California Institute of Technology Distinguished Alumni Award in 1992. The American Chemical Society honored him in 1981 with the Pure Chemistry Award and in 1988 with the Award in Inorganic Chemistry. In 1983 he received the E.O. Lawrence Award from the U.S. Department of Energy and the Gregory and Freda Halpern Award in Photochemistry from the New York Academy of Sciences; the same year, he was named a MacArthur Fellow. He is also a fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, and the American Philosophical Society. He is a member of the American Chemical Society, Sigma Xi, and the Electrochemical Society. Wrighton was appointed to the National Science Board in 2000. He chairs the Board's Audit and Oversight Committee.

Chairman INGLIS. Thank you, Dr. Wrighton.

Dr. Boesz.

STATEMENT OF DR. CHRISTINE C. BOESZ, INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION

Dr. BOESZ. Good morning, Chairman Inglis, Congresswoman Hooley, and distinguished Members of this subcommittee.

I appreciate the opportunity to appear before you today. I am Christine Boesz, sometimes called Tina, and I am the Inspector General of the National Science Foundation.

The National Science Foundation, or NSF, is an innovative agency dedicated to maintaining American leadership across the frontiers of scientific and engineering research and education. As the scientific enterprise changes and research evolves, new challenges inevitably arise.

Consequently, my office has worked closely with the National Science Board and NSF management to identify and begin to address issues that are important to the success of NSF achieving its goals.

As Inspector General, I enjoy a unique perspective. My office is responsible for promoting economy, efficiency, and effectiveness in administering NSF's programs; for detecting and preventing fraud, waste, and abuse within NSF or by individuals that submit proposals to or receive funding from NSF; and for identifying and helping to resolve cases of research misconduct. We also engage in outreach activities in an effort to build partnerships within NSF, with other federal agencies, with NSF awardees, and with the scientific, engineering, and educational communities.

In addition to individual audit and investigation reports, the two primary methods for communicating with the Congress, the National Science Board, and NSF management are through our semiannual reports and annual management challenges letters.

Today, I want to highlight two of the most important short-term and long-term management challenges facing NSF: the strategic management of NSF resources and improved financial performance.

First, the strategic management of NSF administrative resources, especially human capital, is an ongoing and pressing issue. In 2002, NSF launched a multi-year business analysis effort to ad-

dress this challenge, yet NSF still struggles with the development of a workforce plan.

While NSF's workload has rapidly increased over the past few years, the agency has not identified the amount of staffing and other administrative resources needed to address this growing disparity. NSF's critical staffing shortage is evident in NSF's management and oversight of its large facility portfolio. It is also apparent by the lack of resources that have been assigned to carry out many of NSF's general post-award monitoring responsibilities.

This brings me to the second challenge: improved financial performance through better post-award administration. For four consecutive years, auditors have found that NSF's monitoring of grantee institutions has significant weaknesses. Specifically, NSF's current program is not comprehensive enough for it to be effective in identifying and resolving issues. An effective monitoring program would ensure that awardees are complying with federal requirements, are making adequate progress towards achieving research objectives, and are charging allowable costs.

Further, an audit by my office recently found that many research reports, which are used to monitor progress, are submitted significantly late or not at all. While NSF has taken steps over the past three years to improve its post-award administration, progress is slow and much remains to be done.

I realize that resources are needed for NSF to fully address its challenges. While new resources would be highly desirable, I believe that realignment of certain management priorities would ease some of the current burden. Just as the scientific enterprise has changed over the past few decades, NSF must address its changing administrative challenges by reassessing how it conducts its business. In an environment of increased accountability and stewardship of limited federal funds, effective award administration is essential.

In closing, I want to point out that in my recent semi-annual report to the Congress for the 6-month period ending September 30, my office reported on numerous audit and investigative activities, resulting in over $30 million in questioned costs and $500,000 in investigative recoveries. My written testimony highlights samples of both audit and investigative matters.

I look forward to working with the National Science Foundation management, the National Science Board, and you as together we address the challenges facing the National Science Foundation, a unique and innovative agency.

Again, thank you for your invitation to participate in this hearing, and I would be happy to answer any questions that you may have.

[The prepared statement of Dr. Boesz follows:]

PREPARED STATEMENT OF CHRISTINE C. BOESZ

Chairman Inglis, Ranking Member Hooley, and distinguished Members of the Subcommittee, I appreciate the opportunity to appear before you today. As you know, the National Science Foundation (NSF) is an innovative agency dedicated to maintaining American leadership in discovery and the development of new technologies across the frontiers of scientific and engineering research and education. As the scientific enterprise changes and research evolves, new challenges arise. Consequently, my office has worked closely with the National Science Board and NSF

management to identify and begin to address issues that are important to the success of NSF achieving its goals.

As Inspector General, I enjoy a unique perspective on NSF activities and the research and education enterprise in general. My office is responsible for promoting economy, efficiency, and effectiveness in administering NSF's programs; detecting and preventing fraud, waste, and abuse within NSF or by individuals that submit proposals to or receive funding from NSF; and identifying and helping to resolve cases of research misconduct. My office also engages in outreach activities in an effort to build partnerships within the agency, other federal agencies, NSF awardees, and the scientific, engineering, and education communities. These partnerships assist us in resolving audit and investigation matters effectively and promoting education on research misconduct and award administration issues. In addition to reports on individual audits and investigations, the two primary methods for formally communicating with the National Science Board, NSF management, and the Congress are through our Semiannual Reports and annual management challenges letters.

Management Challenges

This past October, my office conducted its annual assessment of the most serious management and performance challenges facing NSF.[1] My office compiled a list of eleven management challenges based on our audit work, general knowledge of the agency's operations, and the evaluative reports of others, such as the Government Accountability Office and NSF's various advisory committees, contractors, and staff. These challenges, which are essentially unchanged from our previous assessment,[2] fall into five general categories: 1) strategic management of agency resources, 2) improved financial performance, 3) expanded electronic government, 4) budget and performance integration, and 5) program-specific challenges.

I believe that the two most important challenges are related to the first two of these general categories, which encompass both the short-term and long-term needs of NSF. The strategic management of NSF resources is an ongoing and pressing issue. NSF needs to devote more resources and attention to making business and process improvements, while at the same time, planning for its future workforce needs. Although advances in technology have enhanced the workforce's productivity, NSF's rapidly increasing workload has forced the agency to become increasingly dependent on temporary staff (e.g., rotators and visiting scientists) and contractors to handle the additional work. NSF's efforts in the past to justify an increase in staff have been impeded by the lack of a comprehensive workforce plan that identifies workforce gaps and outlines specific actions for addressing them. Without such a plan, NSF cannot determine whether it has the appropriate number of people or the types of competencies necessary to accomplish its strategic goals. In 2002, NSF launched a multi-year business analysis effort to address this challenge. To date, NSF has made few decisions regarding implementation of a workforce plan. Without such a plan, NSF is unable to assess the number and skill-level of rotators and other personnel needed to carry out its work. Of particular concern is the need for resources to oversee NSF's large facility projects and carry out effective post-award monitoring.

Throughout my five years as Inspector General of NSF, my office has increased its audit attention on matters related to NSF's management and oversight of its large facility project portfolio, which includes projects ranging from tens of millions to hundreds of millions of dollars. In 2000 and 2002, my office issued reports critical of NSF's management of large infrastructure projects and made recommendations for addressing this important piece of NSF's research portfolio.[3] These recommendations urged NSF to establish formal guidance for the programmatic and financial management of large facilities, including full-cost tracking. An important aspect of NSF's plan to address these recommendations is the establishment of a Large Facility Project (LFP) Office with responsibility for managing and overseeing large facility projects. We reviewed the progress this Office is making in issuing project man-

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[1] Memorandum from Christine C. Boesz, Inspector General, National Science Foundation, to Warren Washington, Chairman, National Science Board, and Arden Bement, Acting Director, National Science Foundation (Oct. 15, 2004) (on file with NSF OIG).

[2] Memorandum from Christine C. Boesz, Inspector General, National Science Foundation, to Warren Washington, Chairman, National Science Board, and Rita R. Colwell, Director, National Science Foundation (Oct. 17, 2003) *http://www.nsf.gov/oig/managementchallenges2004.pdf.*

[3] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, AUDIT OF THE FINANCIAL MANAGEMENT OF THE GEMINI PROJECT, Report No. 01–2–001 (Dec. 15, 2000); OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, AUDIT OF FUNDING FOR MAJOR RESEARCH EQUIPMENT AND FACILITIES, Report No. 02–2–007 (May 1, 2002) (both on file with NSF OIG).

agement guidance and providing oversight of current projects.[4] The Office's progress has been slow and constrained by workload and staffing issues. Currently the LFP Office has 2.5 full-time-equivalent employees responsible for overseeing 13 projects, each of which is estimated to receive an average of $100–$400 million in total Major Research Equipment and Facilities Construction appropriation funding. While the LFP Office may have some access to other NSF staff to support its activities, I believe that dedicated resources, specific to the Office's oversight responsibilities, are essential. In addition to resources, however, and perhaps more importantly, the LFP Office needs organizational authority to independently oversee the management and construction of these projects, and a high-level champion to ensure that authority. I believe Dr. Arden Bement, as NSF Director, intends to be this champion. Further, the Office needs a more structured management approach that includes a formal mission statement, specific goals and measures, and a realistic staffing plan.

Finally, over the past five years, we have focused increasing audit efforts on addressing NSF's challenge to effectively administer and oversee all of its approximately 30,000 active grants and cooperative agreements once they have been awarded. Since 2002, four consecutive independent audits of NSF's financial statements have cited weaknesses in the agency's post-award monitoring of grantee institutions as a significant deficiency.[5] Specifically, the auditors found that (1) NSF's current risk model for focusing its monitoring efforts does not adequately capture all high-risk awardees; (2) NSF's award-monitoring program does not address procedures for both baseline and advanced monitoring depending on the financial risk of the award; and (3) procedures for conducting on-site award monitoring at awardee institutions are not adequate for the performance of an effective on-site review. In addition, in the FY 2004 audit, the independent auditor identified a second reportable condition: contract monitoring. The auditors found that NSF does not adequately review public vouchers submitted by contractors receiving advance payments to ensure that the reported expenditures are proper and allowable under the contract. Without adequately performing such procedures, misstatements and unauthorized expenditures may go undetected.

A recent audit by my office further highlights the need for increased post-award monitoring.[6] My auditors found, over a five-year period, that approximately 47 percent of the 151,000 annual and final project reports required by the terms and conditions of NSF's grants and cooperative agreements were either submitted late or not at all. Of the 43,000 final project reports, eight percent were never submitted, and 53 percent were submitted, on average, five months late. Of the 108,000 annual progress reports, 42 percent were never submitted. This is due in part because of a lack of emphasis placed on the importance of these reports, as evidenced by a lack of policies and infrastructure that facilitate the staff's ability to adequately address this key facet of award administration. Moreover, in 74 of 571 occurrences over the past five years, NSF provided additional funding, contrary to its own policy, to principal investigators who had not submitted final project reports for prior awards.

An effective post-award monitoring program should ensure that: awardees are complying with award terms and conditions and federal regulations; adequate progress is being made toward achieving the objectives and milestones of the funded research project; and awardee expenditures listed on NSF's financial statements represent costs that are accurate and allowable. While NSF has taken some steps over the past three years toward establishing a risk-based program for post-award monitoring of its grants, more needs to be done. NSF must broaden its approach

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[4] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, SURVEY OF LARGE FACILITY PROJECTS MANAGEMENT AND OVERSIGHT DIVISION, Report No. 05–6–002 (Dec. 29, 2004) *http://www.nsf.gov/oig/LFP_Report.pdf*

[5] KPMG Auditor's Report, Fiscal Year 2004 National Science Foundation Financial Statement Audit (Nov. 12, 2004) (page III–45 of NSF's 2004 Accountability Report found at *http://www.nsf.gov/pubs/2005/nsf0501/new_pdf/nsf0501.pdf*); KPMG Auditor's Report, Fiscal Year 2003 National Science Foundation Financial Statement Audit (Nov. 17, 2003) (page III–43 of NSF's 2003 Accountability Report found at *http://www.nsf.gov/pubs/2004/nsf0410/new_pdf/nsf0410final.pdf*); KPMG Auditor's Report, Fiscal Year 2002 National Science Foundation Financial Statement Audit (Jan. 29, 2003) (page III–39 of NSF's 2002 Accountability Report found at *http://www.nsf.gov/pubs/2003/nsf03023/pdf/nsf03023final.pdf*); KPMG Auditor's Report, Fiscal Year 2001 National Science Foundation Financial Statement Audit (Jan. 18, 2002) (page 71 of NSF's 2001 Accountability Report found at *http://www.nsf.gov/pubs/2002/nsf02097/nsf02097.pdf*).

[6] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, AUDIT OF PROJECT REPORTING FOR NSF AWARDS, Report No. 05–2–006 (Dec. 13, 2004) *http://www.nsf.gov/oig/05-2-006Final.pdf.*

to award monitoring to go beyond the relatively few high-risk awardees,[7] develop more effective award oversight guidance, and increase the coordination between program and financial officers. We have recently received and are currently reviewing an action plan from NSF that proposes to address these additional award-monitoring activities.

All of these challenges reflect areas of fundamental program risk that continue to pose barriers to NSF's accomplishment of its responsibilities. They will therefore require ongoing attention from NSF management over the long-term. While NSF recognizes these challenges, progress has been slow and much remains to be done in order for NSF to become a more successful organization and better serve the research and education communities, which so heavily rely on it. In addition, NSF has results from its own consulting study of post-award monitoring, which includes specific recommended actions.[8] Although NSF now recognizes that both post-award and contract monitoring activities are necessary, the next step is for NSF to more aggressively implement concrete actions that will mitigate my concerns. I am particularly concerned over NSF's response to the independent auditors finding of a reportable condition in the area of contract monitoring. NSF's corrective action plan suggests that my office, rather than NSF staff, be responsible for the periodic testing of contract vouchers recommended by the auditors. Voucher examination is a basic accounting function that resides with management. As such, it would be inappropriate for my office to take on this management function in light of our statutory independence.

I realize that resources are needed for NSF to fully address these challenges. However, I also believe that realignment of NSF's management priorities should ease the resource burden. The nature of the scientific research enterprise has changed over the past few decades. Consequently, the programmatic and management challenges facing NSF have changed. NSF's assessment of needed resources should address its changing administrative challenges.

Investigative and Audit Activities

In our most recent Semiannual Report to the Congress for the six-month period ending September 30, 2004, my office reported on numerous audit and investigative activities.[9] During that time period, my office issued one interim and 10 final audit reports that contained over $30 million in questioned costs, and made recommendations that would improve grants management controls and oversight processes at both NSF and its awardee institutions. We closed 38 civil/criminal cases and 51 administrative cases and our investigations recovered $522,387. Three cases were referred to the Department of Justice for criminal prosecution and 15 administrative cases were forwarded to NSF management for action during this period. The following is a sample of investigations and audits that were reported in our most recent Semiannual Report.

Investigations

My office investigates allegations of wrongdoing involving organizations or individuals that receive awards from, conduct business with, or work for, NSF. In investigating these allegations we assess their seriousness and recommend proportionate action. When possible, we work in partnership with agencies and awardee institutions to resolve these issues. Where appropriate, the results of these investigations are referred to the Department of Justice or other prosecutorial authorities for criminal prosecution or civil litigation, or to NSF management for administrative resolution.

For example, as we reported in our most recent Semiannual Report, the owner of a company that received Small Business Innovation Research (SBIR) awards from NSF and other federal agencies pleaded guilty to mail fraud and tax evasion as a result of our investigative efforts. The owner sent a progress report to NSF for his

[7] In FY 2004, NSF identified only 42 of its approximately 30,000 awards as "high risk" and did not include some awards that were known to be high risk. For FY 2005, NSF has revised its risk assessment model and has identified 252 awards as "high risk." While the revised model captures a greater number of risky awards, it still identifies less than one percent of NSF awards as "high risk."

[8] NSF contracted with a consultant to assess NSF's post-award monitoring processes. The results of this assessment, issued in March 2004, indicated that while NSF made commendable efforts to develop policies and procedures, it still faces a number of challenges to achieve effective administration. Further, using other grant making agencies as a benchmark, the consultant identified gaps in NSF's post-award administration. IBM, *Post-Award Monitoring Assessment* (March 2004). NSF has not developed an action plan to address the reported opportunities for improvement.

[9] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, SEMIANNUAL REPORT TO THE CONGRESS (September 2004) *http://www.nsf.gov/pubs/2004/oigsept2004/oig2004sept.pdf*

SBIR award that included research previously conducted by his company under an Air Force SBIR award. He also used federal SBIR funds to pay for personal expenses, such as repairs and improvements to his home, thereby evading over $93,000 in income tax on his personal tax return for 1999. The total loss of federal funds related to the subject's fraudulent scheme is estimated at $1.4 million. Based on the guilty plea and our recommendation, NSF recovered $120,000 of its funds that it withheld from the NSF grant pending the outcome of our investigation. We also recommended that NSF exclude through debarment the owner and his company from receiving funds from any federal agency.

One of the more unique areas of investigation for my office is in the realm of research misconduct, specifically falsification of data, fabrication of results, and plagiarism. Research misconduct strikes at the core of NSF's mission, and is a special concern for my office. Although there is a strong sense of integrity within the scientific and engineering research communities, my office often receives allegations that result in misconduct findings. For example, after receiving an allegation that a postdoctoral scientist fabricated and falsified data in a published research paper, my office concluded that the researcher knowingly and intentionally fabricated data in multiple analyses to make it appear that replicate experiments had been completed when in fact only a single analysis had been performed. The scientist's actions ultimately led to the retraction of the entire publication in which the fabricated and falsified data appeared. We recommended that NSF make a finding of research misconduct against the subject and prohibit him from receiving federal funds, otherwise known as debarment, for two years.

In addition, my office recommended to NSF that it take action to protect federal interests by debarring a researcher for two years for his fabricating the existence of and citations for two manuscripts referenced in his two NSF awards. An investigation by the researcher's university determined that he provided false biographical information as part of his NSF proposals. The researcher cited two manuscripts as "submitted to" two prominent journals, and also referenced a "submitted" manuscript within the text of the proposal for his NSF award. However, our investigation revealed that those manuscripts did not exist. The investigation also identified a pattern of misrepresentation by the researcher that extended over a 10-month period.

While the majority of our investigations involve individual actions, some involve entire organizations. For example, my office received a complaint that a university was charging a five percent surcharge to NSF awards for technical support salaries. We initiated an investigation and worked with the university to review technical support charges to NSF awards. Although we found no evidence of fraud, the university restored $364,539 to NSF for technical support expenses that were erroneously charged to its NSF awards.[10] As a result of our investigation, the university changed its policies and procedures to ensure that technical support is charged appropriately to federal awards. The university also identified $518,993 of technical support charges that had been wrongfully charged to awards from 12 other federal agencies. We notified the other federal agencies of this issue and obtained a commitment from the university to work with each of them to resolve these overcharges.

Audits

Our audit activities have two primary thrusts that often complement each other. We conduct financial audits of NSF's awards and awardee institutions to determine whether costs claimed by awardees are allowable, reasonable, and were incurred for the benefit of NSF's award. These audits also seek to identify weaknesses in awardee's controls in accounting for and in administering their NSF awards to ensure that NSF funds are spent properly. In addition, we conduct internal audits, which are reviews of selected NSF programs and operations that provide policy-makers and management with an independent appraisal of whether desired results and objectives are achieved efficiently, economically, and in accordance with prescribed laws, regulations, policies, and procedures.

Recent examples of both these types of audits include an audit of a foreign treaty organization that, since 1996, has received $16.4 million in NSF awards for global change research.[11] The audit found that NSF, on behalf of the United States, is funding a disproportionate share of the organization's total costs. The U.S. contribu-

[10] Generally, technical support costs can be charged to federal grants as direct costs only for particular services provided for particular grants; otherwise such costs constitute administrative support services costs that are included in the university's indirect cost rate.

[11] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, AUDIT OF INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH, Report. No. 04–2–007 (Sept. 30, 2004) *http://www.nsf.gov/oig/IAI-GCR.pdf*

tion, which was initially expected to comprise 25 percent of the organization's total funds, actually represents 87 percent of its income from 1996 to 2003. This occurred because 18 other member countries did not provide research and operational contributions in the amounts originally committed. As a result, the foreign organization has average annual expenditures of only $2.6 million or 82 percent less than expected, thereby impeding its ability to achieve its research goals. Additionally, the organization has not properly monitored its 14 research subawards valued at $10.3 million. This resulted in serious problems with two subawards that cannot adequately support their $1.1 million of claimed costs. Given the lack of financial support by other member countries, we recommended that NSF work with the foreign organization's governing bodies to promote and oversee fundraising activities; re-assess the organization's mission, goals, and staffing levels if additional funding is not obtained; and ensure that the organization establishes written subaward management policies and procedures. Finally, we recommended that NSF cease providing additional research awards to the organization until it has developed and implemented written monitoring procedures to ensure its subawardees are properly accounting for and managing NSF grant funds. NSF has agreed with the OIG recommendations and is implementing actions to address them.

My office also recently completed another audit of a foreign organization identifying similar award administration issues.[12] This audit found that NSF, along with three other federal agencies, did not establish adequate grant agreements requiring the foreign organization to comply with statutory funding requirements as a condition for receiving U.S. monies for the organization's research endowment fund. Consequently, the organization did not provide 45 percent of its required matching contribution ($5 million) or implement adequate financial controls to account for and administer almost $11 million in U.S. funds. We recommended that as the largest U.S. contributor, NSF bring these concerns to the attention of the President's Office of Science and Technology Policy (OSTP) in order to facilitate a coordinated U.S. effort to secure corrective actions on the part of the foreign organization. While NSF responded favorably to the audit report, it does not agree that it should take a leading role in coordinating corrective actions for the entire U.S. Government. Nevertheless, NSF does generally agree to implement the remaining audit recommendations to secure improved financial controls over its own contributions to the foreign organization. It is my opinion that NSF should take the lead to bring these matters to OSTP in order to coordinate the U.S. interests in obtaining the needed corrective actions from the foreign organization.

As another example, at NSF's request, my office contracted with the Defense Contract Audit Agency (DCAA) to perform a financial audit of NSF's Antarctic Support Services Contractor.[13] This contractor is NSF's largest, providing logistics and support services estimated at approximately $1.1 billion over ten years. In September 2004, DCAA staff reported on the interim results of the first phase of this audit. Of the $363 million total costs claimed by the Contractor for the three-year period ending December 31, 2002, the auditors questioned $29.2 million because the Contractor improperly billed indirect costs to the contract.[14] The auditors also questioned $6.7 million because the Contractor claimed indirect costs that exceeded the limitations specified in the contract agreement. The remaining phases of the Antarctic Services Contract audit will include a review of the Contractor's internal controls for administering, monitoring, and accounting for the NSF contract funds and a review of the direct costs and remaining indirect costs charged to the contract through December 31, 2004.

As a final example, my office conducted an internal, or performance audit of the Math and Science Partnership (MSP) Program.[15] In FYs 2002 and 2003, NSF awarded a total of $436.6 million for 35 comprehensive and targeted awards under this program. The audit objective was to determine the effectiveness of a sample of MSP projects' evaluation methods and measures to assess the impact of the inter-

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[12] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, AUDIT OF UNITED STATES-MEXICO FOUNDATION FOR SCIENCE, Report. No. 05–2–005 (Dec. 8, 2004) *http://www.nsf.gov/oig/USMFS05.pdf*

[13] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, AUDIT OF RAYTHEON POLAR SERVICES COMPANY'S INDIRECT COSTS CLAIMED FOR FISCAL YEARS 2000 TO 2002, Report. No. 04–1–010 (Sept. 30, 2004) (on file with NSF OIG).

[14] Specifically, the contractor claimed indirect costs as direct costs of the contract, including $8.6 million related to home and corporate office costs, $5.7 million related to facilities costs, $3.4 million related to human resources costs, $2.7 million related to financial management costs, and over $700,000 related to sign-on bonus costs.

[15] OFFICE OF INSPECTOR GENERAL, NATIONAL SCIENCE FOUNDATION, AUDIT OF NSF'S MATH AND SCIENCE PARTNERSHIP PROGRAM, Report. No. 04–2–003 (May 14, 2004) *http://www.nsf.gov/oig/mspprogram.pdf*

vention strategies on student achievement. This audit reviewed nine partnership projects funded in FY 2002 and found that five had effective evaluation plans designed to evaluate, define, and measure the impact of the intervention strategies, activities and outcomes on student achievement in math and science. While the remaining four projects did not address all the elements for an effective evaluation process, with appropriate guidance and monitoring NSF could ensure that each partnership had an effective evaluation process.

Through these audits, and others like them, my office is able to make recommendations to NSF management aimed at correcting specific problems found with programs and awards. For example, as a result of the audit of the MSP program, NSF convened a workshop of subject matter experts to prepare an evaluation statement for current and future MSP projects. The results of these audits and others help to inform our assessment of the most critical challenges facing NSF, and help my office focus its future audit efforts.

Chairman Inglis, this concludes my written statement. Thank you for the opportunity to share this information with you. I would be happy to answer any additional questions you or other Members of the Subcommittee may have, or to elaborate on any of the issues that I have addressed today.

BIOGRAPHY FOR CHRISTINE C. BOESZ

Christine C. Boesz assumed the duties as Inspector General of the National Science Foundation (NSF) in January 2000, reporting to the National Science Board and the Congress. As head of the Office of Inspector General (OIG), she recommends policies for promoting economy, efficiency and effectiveness of NSF programs and operations. She leads efforts to prevent and detect fraud, waste, and abuse, improving the integrity of NSF programs and operations and investigating allegations of misconduct in science. Dr. Boesz participates in leadership activities of the Inspector General community by serving on the Executive Council, the Inspection and Evaluation Committee, and by chairing the Misconduct in Research Working Group for the federal IG community, responsible for setting standards and training for investigations into research misconduct allegations.

Prior to this position, Dr. Boesz served as Head of Regulatory Accountability, at Aetna U.S. Healthcare Inc. While there she had broad responsibilities for establishing and maintaining a compliance program for the managed care Medicare program. She also served as senior policy analyst on federal legislative and regulatory activities. From 1995 to 1998, she served as Vice President of Government Programs at New York Life, developing and operating Medicare and Medicaid managed care programs in ten states. She oversaw product development, pricing, marketing, and compliance with government contracting requirements. She also developed legislative policy for the company.

Prior to 1995, Dr. Boesz held several Federal Government compliance and oversight positions over an 18-year period with the Department of Health and Human Services. In her last position she served as Director of Operations and Oversight for the Medicare managed care program, responsible for awarding and overseeing contract compliance. Earlier in her federal career she was instrumental in developing the regulatory framework for health maintenance organizations (HMO), in operating the HMO loan fund, and in building a compliance staff for managed care oversight.

Dr. Boesz is a Past President of the National Association of Managed Care Regulators, a member of the American Statistical Association, and the American Public Health Association. Over her career she has received numerous awards, including the Lifetime Service Award from Managed Care Regulators, and has been recognized as a Distinguished Alumna from Douglass College, Rutgers University.

Dr. Boesz received her B.A. in mathematics from Douglass College (1966) and a M.S. in statistics from Rutgers University (1967). Her Doctorate in Public Health (health policy) was awarded by the University of Michigan School of Public Health (1997) where she was a Pew Fellow.

DISCUSSION

Chairman INGLIS. Thank you, Dr. Boesz.

I am happy to see that we have been joined by the Chairman of the Full Committee, Mr. Boehlert, and I would be happy to recognize him.

Mr. BOEHLERT. Short and sweet.

I am here because of my interest in the subject matter being discussed. And as Dr. Bement knows, we are sort of cheerleaders, unabashed cheerleaders for NSF, and we will continue in that role.

But most importantly, Mr. Chairman, I am here to welcome you to this first hearing as Chairman of this subcommittee, and I want to wish you well, and I know you will do well, and we will be as cooperative as we can, because we have got important work.

Thank you very much.

Chairman INGLIS. Thank you, Mr. Chairman.

At this point, we are going to move to the first round of questions, and the Chairman recognizes himself.

Dr. Bement, I hear some tension here between the objectives of NSF, and we all have tensions. We have got to keep them in balance, I suppose. But the tension between the funding of post-graduate education and projects there as opposed to the K–12 effort. And it occurs to me that if we were inspiring kids in K–12 with great teachers and, like this fellow at General Electric pointed out to me, that is what it takes is somebody who really knows their subject matter and somebody who loves to teach it and somebody who is really excellent at it. Talk to me about the tension between doing that at NSF and the exciting things that we could be developing and getting quickly to market. I am inviting you to talk about that tension, I suppose.

Dr. BEMENT. Okay. Thank you.

First of all, let me assure you, Mr. Chairman, there is no tension. Our reach to K–12 pervades NSF. It is part of every program that we have. It is one of our criteria in terms of broader impacts. We encourage all of our scientists to extend themselves to K–12. We have a formal program called GK-12, which we are investing $50 million for it to enlist 1,000 graduate students and upper-level undergraduate students to work at the schools at the interface between universities and K–12 programs. And that is turning out to be exceptionally exciting and effective.

In addition, in all of our cooperative agreements with our centers programs, as a requirement, they are expected to engage in K–12 education to bring that excitement and show why science is fun and to try and encourage younger minds to enter into the STEM fields. So rather than just focusing on a couple programs in our EHR budget line, I would advise you to look at the broader perspective and what we do across the board in that area.

Chairman INGLIS. But are you comfortable with essentially transferring some of that money to the Department of Education that is the effect of what has happened?

Dr. BEMENT. I think it is a matter of leadership. We have invested now over 10 years in these types of programs. They started out as Rural Systemic Initiatives and Urban Systemic Initiatives, and we have had extraordinary results. And then we tacked on to that the MSP program. It changed. It morphed into a new program. So we have 10 years of experience of what works. And if you ever look at the Appalachian project, which started as a Rural Systemic Initiative and it is now an MSP program, the amount of achievement they have made in the last 10 years is remarkable. The same thing in El Paso, Texas, which is largely—well, almost

87 percent Hispanic, and they are now one of the top performing school districts in the State of Texas.

So those lessons learned and those best practices need to be propagated across all of the school districts in the country. And the place where the resources exist and where the mission exists is within the Department of Education. So we have been working very closely with them to develop peer-reviewed projects to carry on that mission within the Department of Education. They have committed to putting more resources into math and science education. And the President now has established a President-level advisory board on education science—or education research, which I serve on, as a matter of fact.

So through this partnership between NSF and the Department of Education, I can assure you we are going to try and transfer the passion.

Chairman INGLIS. Great.

Dr. Boesz raised some crucial objectives. What is your response, Dr. Bement, to those—the two objectives that she laid out?

Dr. BEMENT. Well, let me say, first of all, we welcome management challenges. No, I am quite serious about that. We not only feel we are an exemplary agency, but other people tell us so. On the other hand, we know that there is room for improvement, and management challenges challenge us to continuously improve. So we pay attention to those challenges.

Just quoting from her statement, she has credited progress, and on the two areas that she cited, we made significant progress. And since the full answer to your question is very involved and very complex, I would like to give you that statement for the record, if I may, on the progress that we have made.

Chairman INGLIS. Certainly.

Dr. BEMENT. Having said that, she also pointed out that progress isn't as rapid as she wants. She has indicated that it is resource paced. That is a basis for a significant increase in our S&E account in our fiscal year 2006 budget, because we need additional personnel. But in addition to that, we need the electronic business systems that will improve the productivity of our practices that will free up additional personnel to pay more attention to some of those challenges. So they all work together.

Chairman INGLIS. Thank you, Dr. Bement.

My time has expired.

Ms. Hooley.

Ms. HOOLEY. Thank you, Mr. Chair.

I am going to follow up on some educational questions, and then I am going to go to the icebreaker, because I have a lot of questions about that.

Dr. BEMENT. Yes.

Ms. HOOLEY. You know, I am concerned as I look at this budget, and the policy behind the change in the treatment of math and science programs that have been targeted for extinction. And I know that they are going to—some of that is going to the Department of Education. You have built a lot of good relationships, K–12, and you have got a lot of expertise that have helped you out in that K–12 program. I am trying to understand why you wouldn't continue that, and the thing that the Department of Education, I

think, does well is dissemination and replication of best practices. But it seems to me that you have an equal role there. So help me understand what is going on and why that is targeted for extinction.

Dr. BEMENT. I think the true picture is that this is the second year in which the draw-down on the program has occurred——

Ms. HOOLEY. Right.

Dr. BEMENT.—and when I say drawdown, it only means that we are not providing any new grants, but we are sustaining the grants that we currently have. And in those programs, we will continue to pursue further improvement.

A lot of the activities under Math and Science Partnership deal with teacher development course and curriculum development and evaluation, for the most part; thus, they are not entirely research. And there is a lot of research that still needs to be done in math and science education so that as we transition or phase that part of the program over to the Department of Education, we are generating new programs. I mentioned the GK–12 program, but there are other programs within our overall portfolio that tend to be more consistent with our research mission that we will continue to focus on. In particular, the portfolio of programs that have been highly successful in broadening participation is an area where we are investing upwards to $400 million just out of the EHR directorate this year. And we have kept those programs at about the enacted level from last year's appropriation, because we feel they need to be sustained.

But in addition to those programs within EHR, we are also integrating programs within the science directorates. And if we count those activities, that adds about another $200 million to that general focus area of broadening participation. So the total investment is about $600 million. We feel that is where we really need to put our attention for the next decade, because with the declining interest in science and engineering among graduating seniors, it is not enough just to stimulate interest in math and science in K–12. We need to do that as well as we can. And I mentioned some programs that do that. But we also have to pay attention to replacing the current scientists and engineers who are going to be retiring over the next 10 years. And right now, we are going to fall short of that goal unless we broaden participation.

Ms. HOOLEY. But it seems to me we are going to fall short of that goal if we don't generate enough interest in grade school and high school.

Dr. BEMENT. Yes, your point is well taken.

Ms. HOOLEY. And when we look at—right now, I know throughout this country, we have a shortage of math and science teachers. And I mean, if you don't get kids interested early on, you are never going to have enough math and science people to fulfill the needs of this country.

Dr. BEMENT. Yes, Congresswoman; I agree. I think my main point is that the few districts we can touch, and we have improved over the last 10 years, is only a very minute fraction of the total school districts in the country. We have to build those programs in the Department of Education, and we have to touch all of the school districts if we are going to make the kind of impact that you

are calling attention to. And that is what we are dedicated to doing.

Ms. HOOLEY. Let me switch gears really quickly and talk a little bit about—I mean, if you look at this budget, so much of the budget really is an accounting change, because of taking over the icebreakers for the Coast Guard. So you are really looking at a 0.3 percent increase as opposed to a 2.7 percent increase. Tell me at what level of the Administration was the decision made to give NSF the responsibility to assume more of the icebreaker operation and maintenance for 2006. Tell me, who made that decision? Is that high level, lower level?

Dr. BEMENT. No, that was a high-level decision made within the White House, and the reason for that decision was that in the new mission that the Coast Guard has at Homeland Security, supporting science was not going to be sustained by the Department of Homeland Security. So there was a concern that if the current icebreakers were decommissioned because the Department would not support their operation and maintenance, then our polar programs, especially in Antarctica, are at risk. So the decision was made to transfer responsibility for the operation and maintenance to the National Science Foundation to assure that there will be continuity of support over time to maintain our polar programs.

Ms. HOOLEY. How much money is in the budget for that? What—do you—is that 48—what did you put in the budget for that?

Dr. BEMENT. The transfer was $48 million.

Ms. HOOLEY. Is that going to be enough? I mean, there is some indication the Coast Guard thinks it runs somewhere between $70 million and $75 million.

Dr. BEMENT. Well, we are working closely with the Coast Guard to try and determine the structure of that estimate and to determine whether $48 million is enough. We have an interagency working group now focused on looking at all of the options of minimizing the cost of icebreaker operations. And at the present time, I don't really have an answer to your question, but we will have an answer some time this summer.

Ms. HOOLEY. Do you have to use the Coast Guard icebreakers, or can you use a foreign company to do that? Or can you lease for foreign icebreakers? Is that viable?

Dr. BEMENT. I think it is viable. Our Office of General Counsel has looked into statutory obligation, and their review indicates that there is no statutory restriction in our using other than Coast Guard icebreaker services, whether they are commercial or other nations'. We derived part of our guidance from the Presidential Memorandum Number 6646 on U.S. Antarctic Policy and Programs, and that goes way back. It was dated February 5, 1982 when the Coast Guard was in the Department of Transportation. And that provided the Department of Defense and Coast Guard a continuing role in Antarctic logistics to ensure that the United States has the necessary flexibility and operational reach in the area, which goes beyond research or science and engineering.

On the other hand, that directive also pointed out that every effort should be made to manage the United States Antarctic Program in a manner that maximizes cost effectiveness. And then it goes on to say that it authorizes the NSF to use commercial sup-

port when it is determined to be cost effective and not detrimental to the national——

Ms. HOOLEY. Does OMB agree with you?

Dr. BEMENT. Well, this is just a finding that has just come to my attention within the last day or two. We have not yet had a chance to discuss this with OMB.

Ms. HOOLEY. Okay. I have used more than my time. Thank you, Mr. Chair.

Chairman INGLIS. Thank you, Ms. Hooley.

At this point, I would be happy to recognize Mr. Johnson.

Mr. JOHNSON. Mr. Chairman, thank you for the courtesy of allowing me to ask the question, given the structure to today's process back in the office. I do appreciate it.

I would like to address this question to Dr. Bement, Director.

As you know, I represent the University of Illinois, which is the home of the Beckman Center, among others, and we are very proud of that. And so this question, at least revolves in part, around that reality.

In the fiscal year 2006 budget request you have stated that providing cyberinfrastructure is one of your top priorities. Supercomputing is, as we all know, a key element of robust cyberinfrastructure, and NSF supports those key national centers that provide supercomputing facilities and expertise, including the National Center for Supercomputing Applications in my hometown. The budget request indicates that approximately, and this is a quote, $19 million will be provided for selective cyberinfrastructure enhancements in the fiscal year 2006. How much of this upgrade funding will go to hardware for supercomputing centers? And how and when will you decide what upgrades are needed and when? I know that sounds like a bit scripted question, but——

Dr. BEMENT. No, no. It is a good question. I might point out parenthetically that Champaign is very close to Bement, Illinois.

Mr. JOHNSON. It is, indeed. That is one of the finest country operas in the United States, so in case you ever have time to visit Champaign, see the supercomputer, and you are into country music, come over with me to the Bement Bowl, and we will have a good time.

Dr. BEMENT. Thank you, Mr. Johnson.

Total investment in cyberinfrastructure for 2006 is at $509 million, which is a substantial increase over our 2005 enacted level. And a good part of that is in high-end computing, and not just in architecture, but also in software tools and also in networking as well as interface tools. So we are looking at it as a total system.

We continue to support the supercomputing centers, including the ones in San Diego, Illinois, and Pittsburgh. And we have made investments to upgrade their facilities to the latest capabilities that are commercially available. In addition to that, we are trying to further integrate them into our Teragrid, which provides a broad network for very high bandwidth computing and data streaming within the science community. They were just—I just recently authorized an advisory committee that links all of these operations together to further leverage their capabilities and find new ways to serve the scientific community as part of our shared infrastructure in cyber tools.

So I think our program is well balanced, in my opinion. I think we are paying attention to at least the near-term needs of the scientific community within our budget flexibility, and we are looking at all of the elements, including higher-end language and new algorithm development that will be required to use super-high-end computing.

Mr. JOHNSON. Well, let me just underscore the significances of NSF to our specific facility, what an outstanding job you do, what a good cooperative relationship there is nationwide. And without sounding provincial, I think anyone who understands the area would understand that ours is among the finest, if not the finest, facility in the country, and its impact nationwide is something that not only we are very proud of, but the country is—relies in large or small part on in terms of the whole matrix. And so we are very grateful and hope that you will put us higher on your radar screen in terms of future, not only allocations, but prioritization.

Dr. BEMENT. Thank you. We will.

Mr. JOHNSON. And you are also welcome to join us, not only at the Bement Bowl and at the Beckman Center, but on April 5, 2005 when we celebrate the national championship at the University of Illinois. And we will make it a three-fer, and you will be one of our guests as we introduce the national champions.

Dr. BEMENT. I would love to see that game. Thank you.

Chairman INGLIS. Mr. Lipinski.

Mr. LIPINSKI. Thank you, Mr. Chairman. And I thank the other Chairman now taking the seat there for holding this hearing. And I will make sure I don't go too much over time, although I see my time hasn't started, which is good.

Oh, there you go. I know what a tough man the Chairman is here, so I will be careful.

I have a rather unique perspective. I have a mechanical engineering degree, and we actually have the head of a company that I had applied for a job at—back 20 years ago, and I chided him jokingly on how he crushed my hopes as a young mechanical engineer by not offering me a job at that time. And I have since moved on, but one thing I did between here and there was I was a political science graduate student. I got my Ph.D. in political science. And Dr. Bement, I am happy to say that I did apply for an NSF grant, and I did receive the NSF grant, so you know, you are in a—from that perspective, you are in a much better position than the witnesses that I have talked to before.

Okay. I am—because of my background, both as an engineer—well, from being an engineer of science and math education, I know how important it is in K–12 and higher education and also the—to tell you the truth, I didn't know until I went to grad school in political science that social sciences were funded, also, with NSF grants.

One thing that—I am echoing some of Ms. Hooley's concerns, I have seen, through my experiences, a real lack of connection between higher education and K–12. I always felt that more could be done with university research and the faculty at universities to help with science and math education in the K–12 level. And I think NSF is in a unique position to help to make that connection. So I just—you know, I just want to say I would like to see NSF

doing more of that, and I encourage, you know, more of that, because I think it could be extremely helpful, especially in science and math.

But what I wanted to ask Dr. Bement about is the research grants for NSF, the funding has been increased for—the proposed increase for research project support is 0.3 percent, but it also, I see, the budget says that, you know, for fiscal year 2006, you want to increase the success rate while maintaining grant size and duration, which the only way to accomplish that would be to somehow discourage proposals from coming in. And so I was just wondering what the plan is there. Of course, I would like to see much more funding for these grants, but specifically to that question, you know, how is it possible to do both of those things, increase success——

Dr. BEMENT. Yes.

Mr. LIPINSKI.—and maintain the same level of funding while you are, you know, flat-lined in growth?

Dr. BEMENT. There are many practical ways of doing that. One is we have both solicited and unsolicited proposals. The one thing we really want to encourage is more unsolicited proposals, because many of those are closer to the frontier, and many of them support newer, untenured faculty as well as minority faculty coming into the academic workplace.

The success rate of some of our solicited proposals has been very low, too low, in some cases, as low as 10 percent. Part of that is because we weren't focused enough in our solicitation. Part of it is we did not indicate to the community initially what the likely success rate would be, so we are going to correct that. And hopefully, that will reduce the proposal volume for a small amount of funding.

Secondly, we are going to limit our solicitations to only those key programs that are essential to our major priorities within the Foundation. So that will reduce the number of solicitations. And that should, also, automatically help increase our success rate. In some cases, in awards that we are making under solicitations, instead of giving all of the awards in one year, we are extending it over two years. So we are stretching our resources for each solicitation.

And then finally, we are taking a hard look at our centers programs, and this is an area that we are engaged with the Board, the Board will be working with us on this, because it has had Board interest, to look at the balance between multi-investigator awards as centers versus individual and small group awards through our unsolicited proposals.

For centers that are reaching end of life where they are no longer working at the frontier or they are not meeting the criteria that we expect, we will be phasing those out and moving those resources back to the frontier to help support more individual and small group awards.

And that is just a few examples of a large number of initiatives we are taking. But we feel that by refocusing, by working more closely with the community so that their expectations are not overblown, we will be able to, even within our given resources, turn around our decline in success rate. It is not going to go up dramatically without new resources, but at least we will halt the erosion.

Mr. LIPINSKI. Thank you.

Chairman INGLIS. The gentleman could have mentioned that he has got his Ph.D. from a great school, my alma mater, from college. So——

Mr. LIPINSKI. You know, that is terrible that I didn't mention Duke.

Chairman INGLIS. There we go. There we go.

Now that Dr. Lipinski has fixed that, we are going to go down to Mr. Sodrel to find out whether Indiana is in the NCAA. Are you doing all right?

Mr. SODREL. Yes, Mr. Chairman. We are—the reason he says that, I use—in the 9th District in the bulletin, so I have to stick up for IU.

Thank you, Mr. Chairman.

You know, you pointed out in your opening statement that R&D used to be—perform basic research by Bell Labs, by IBM, Xerox, and a lot of the large corporations, and less of that is being done today.

And forgive me, but I am a new Committee Member, so this may sound like an elementary question, but I would like to know if, when we develop technology with public tax dollars, how do we then transfer that to the private sector? In other words, who maintains the intellectual property rights to technologies that are developed with taxpayer-funded research? And Dr. Bement, would you be best to answer that?

Dr. BEMENT. I think there are two or three components of the question.

First of all, an investment in the National Science Foundation research tends to support graduate students who do the research, so there is the education component at the higher level within the universities. That graduate talent then goes into industry and transfers the knowledge into industry, so that is a direct technology transfer. And part of that intellectual property is with the individual.

As far as intellectual property that deals with patents and copyrights, those rights remain with the university, and it is the obligation of the university to see that those rights are broadly applied through licensing in the private sector. And I think, by and large, they do that quite well. Many universities are not looking for revenue. They are looking for applying those resources back into further research in order to refine those new technologies. So it really can work as a close partnership between the private sector and the academic sector.

But I am only making a point that I think public sector resources are being used very wisely and very effectively in supporting the private sector in their research objectives.

Mr. SODREL. I just wanted to understand how the relationship worked. And how—what do we do to ensure that the benefit that we derive from the research and development is not immediately exported to some of our world competitors?

Dr. BEMENT. I would think that is a two-way street. I don't think we have very much of a role in trying to either regulate or keep track of that, but there are any number of articles that deal with that. I would like to point out that a lot of the research is being

done by international students. And some of those students remain, and some of them go back to their home countries, so there is technology transfer happening both ways all around the world. And most of the large corporations that I know of bring in top talent, and they use them as hunter-gatherer technologists. Their role is to go around the world and scoop up anything they can get, bring it back home, add their own intellectual property, and then get an edge in the marketplace. So it is a worldwide game at the present time.

Mr. SODREL. Thank you. I just wanted to understand how the system worked, and thank you, Mr. Chairman.

Chairman INGLIS. Thank you.

Mr. Gutknecht.

Mr. GUTKNECHT. Thank you, Mr. Chairman.

Since everybody is talking about basketball, I don't know if the Colorado School of Mines is going to be in the NCAA tournament, but I think anybody who graduated from there is all right by me.

And Dr. Bement, I want to just change the course just a minute, and I apologize. Many of us have other meetings, but I think every Member of this committee takes the work of the National Science Foundation, particularly your work, very seriously. And we only wish that budget constraints weren't what they are. And so we are going to ask you to do more with less, and we apologize for that in advance.

I want to bring your attention, though, to an issue that I have a great concern about, and that is we have, over the last several years, essentially given you more, NSF, latitude in how they deal with agricultural research. And there is one area that I just want to call your attention to, and I am not going to try and ask you to take a position on this, but at least to have you consider this. And that is, within that smear of agricultural research, I hope that you will at least pay some attention to a growing concern that we have, and that is that the potential of viruses, we know this is happening now, where they literally leap from ducks to pigs to us. And there are a number of interesting research projects underway around the country, and I will be a bit parochial, in my District, in particular, and I would just encourage you to, you know, at least reflect on the fact that you do have that latitude, and we hope that you will use that wisely.

Dr. BEMENT. Thank you, Congressman Gutknecht.

Let me respond in this way.

We have now a robust program in plant genomics and also a grant program in microbial genomics, which we carry on in close cooperation with the Department of Agriculture, and that cooperation is to assure that there is not an excessive overlap and that those programs are mutually reinforcing.

In the area of bacterial and viral diseases, we do have a program in the ecology of infectious disease and also in prion diseases that we are also carrying out jointly with the National Institutes of Health and also the Department of Agriculture. So that—first of all, we are paying attention to these major national issues and problems. And secondly, we are trying to leverage our programs with other agencies, through interagency cooperation.

Mr. GUTKNECHT. I only have a second left, but just let me tell you that I would be more than happy to work with you and your office on all of those, because I do have a particular and a keen interest in those particular areas.

So thank you very much, Dr. Bement.

Dr. BEMENT. And we welcome that.

Thank you.

Mr. GUTKNECHT. Thank you.

Chairman INGLIS. We now have time for a second round of questions and then I would recognize Ms. Hooley.

Ms. HOOLEY. Thank you. Unfortunately, I have to say none of the Oregon teams are in the finals this year.

I have really just one question. Dr. Wrighton, in his testimony, indicated that NSF management has developed a draft corrective action plan in coordination with the IG's Office, which will be presented to the National Science Board. Dr. Bement and Dr. Boesz, is this the case, and when will this plan be available?

Dr. BEMENT. First of all, it is the case. We have been negotiating with our auditor, KPMG, on some of the issues that they have brought out in their audit a year ago. We feel we have a corrective action plan that satisfies most of the issues that we raised with them, but we haven't gotten complete closure. But we do plan to bring our progress before the National Science Board and the Audit and Oversight Committee, which Dr. Wrighton chairs, at the coming March meeting, which is later this month.

Ms. HOOLEY. You need to turn on your microphone.

Dr. BOESZ. I can add that my office received this corrective action plan about two or three weeks ago, and we are——

Ms. HOOLEY. Okay.

Dr. BOESZ.—actively in the progress of reviewing it right now. We do contract as part of the audit function with KPMG, and so they are also a part of this process. And we do expect to have this resolved by the time of the Board meeting at the end of this month.

Ms. HOOLEY. Okay. Thank you.

Just for all of you, I think. I am concerned about the cost of the Coast Guard icebreakers and what that will do to your budget. And I guess I am offering that if there is anything we can do to help with that particular issue, we want to make sure that the money is spent as wisely as possible and that this isn't something that ends up breaking your back.

Dr. BEMENT. Thank you very much. These icebreakers are nearing their end of life.

Ms. HOOLEY. Right. I understand that, which——

Dr. BEMENT. And the maintenance, as it gets closer to end of life, keeps going up each year. And if it gets beyond the resources we have set aside, then, of course, it has an impact on our logistics support and our research support in the polar programs. And I am charging myself to guard against that as much as I can, and that is going to mean that we are going to have to engage very cooperatively with the Coast Guard to determine what options will minimize icebreaker costs going forward. And that is what we are engaged in at the present time.

Ms. HOOLEY. Thank you.

Chairman INGLIS. I will, at this point, recognize myself for another round of questions.

And I want to follow up on Ms. Hooley's question just then, Dr. Bement.

I am concerned, as well, about the transfer, particularly if the $48 million turns into a negotiation for a $75 million transfer to operate what had been a $48 million program. How can we help?

Dr. BEMENT. I should call on Dr. Erb to qualify my answer. Part of that—most of that $75 million is for complete refurbishment. It is not for ongoing, recurring operation and maintenance.

Chairman INGLIS. Okay.

Dr. BEMENT. Whether we do that in one year or whether we do that in two years is something we really need to understand, but let me call on Dr. Erb to amplify that.

Dr. ERB. Mr. Chairman, I am Karl Erb, Director of the Office of Polar Programs at NSF.

We have been told by the Coast Guard in discussions last fall that they estimate a need of between $70 and $75 million a year for each of the next four or five years to keep the ships operational until they can go into what they call a service life extension program, which I believe they estimate as a $600 million activity. So we are talking with them now to see what our options are to, as Dr. Bement said, meet those requirements within our ability of the funds we have. And it is just much too early for me to predict how that is going to come out.

Chairman INGLIS. Well, I hope as it goes along that you will let us know how we might be helpful.

Dr. ERB. Thank you, sir.

Yes, sir.

Chairman INGLIS. And I appreciate your input here.

Dr. Wrighton, I wonder if—as the one who has involvement at the Board, what question have we not asked here today that we should be asking about the direction of NSF and what do you wish we had been asking?

Dr. WRIGHTON. I think you have shown great interest, and great questions have come forward already. I think, speaking for the Board, we see a great opportunity for the best to become better. And America's investment in science and engineering education and research has been strong.

But I think one of the issues that we face looking ahead is how competitive will we be in the world, considering essentially level funding? While I think we can do more with less, as was suggested, and all of us are anxious to improve efficiency, I think we need to be cognizant that the developing world, India and China in particular, are developing investments in science and engineering that are destined to be very competitive in the future.

So for us to sustain our preeminence in important areas of science and technology, I believe that we are going to have to make an even greater investment in finding not only the best science and engineering to support, but the highest impact science and engineering. And we, at the Board, are certainly interested in enhancing budgets. I think everybody acknowledges that probably no level of support for the Foundation would be adequate to support all of the great ideas that the investigators could come forward with. But

I think we need to keep our eye on those areas of special importance and setting the priorities for the investments will be very important. But overall, I think our competitiveness, as a Nation, will hinge on ramping up our investment in science and engineering in ways that allow us to remain preeminent. These investments are a source of innovation for America, and I think nothing will be more important than securing our economic well being.

Chairman INGLIS. Yes, and as we come to a close here, I just want to underscore that and point out that, you know, if we enter into free trade policies that basically mean that we are challenged on the manufacturing aspects and particularly where labor is a major input, then the answer is that we are the innovators, that we can stay ahead of the competition by innovation. Well, that means that we are looking to you all to help us innovate. And you are, of course, looking to us to get the appropriate resource level to be able to carry that out, because if we are going to stay, as you put in your testimony, preeminent in discovery and innovation, then you have got to spend money on it. And you have got to spend it wisely, as Dr. Boesz points out. And you have got to spend it with vision and creativity.

Thank you very much to our panel for being here today. Dr. Bement, Dr. Wrighton, and Dr. Boesz, we appreciate your time here this morning.

And if there is no objection, the record will remain open for additional statements from Members and for answers to any follow-up questions submitted that the Subcommittee may ask of the panelists. Without objection, that is ordered.

And the hearing is now adjourned. Thank you.

[Whereupon, at 11:20 a.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Arden L. Bement, Jr., Director, National Science Foundation

Questions submitted by Chairman Bob Inglis

Award Oversight and Management

Q1. Staffing shortages at the National Science Foundation (NSF) have impeded NSF's ability to conduct post-award management and to manage its portfolio of large facilities projects. Assuming the Foundation were provided adequate resources to address these staffing requirements, how many additional full-time-equivalents does NSF need to assign to each of these two areas?

A1. At any given time, the National Science Foundation (NSF) is managing an active portfolio of approximately 35,000 awards to over 2,000 institutions. Effective oversight is accomplished through the combined efforts of NSF's program, financial, and administrative staff. This oversight is not confined to one part of an award life cycle but follows a continuum from solicitation through the close out of the program activity.

NSF has identified certain factors that indicate a high potential for award and funding risk. To address this, NSF has, over the last several years, developed a program of on-site, post-award monitoring and oversight. A key element of the program is a dynamic multi-level risk assessment framework comprised of objective and subjective factors applied to the overall award universe; these may be technical, financial, or administrative. This risk framework helps guide decision making insofar as how best to deploy staff resources for more targeted oversight. Non-facility awards are addressed through the Post-Award Monitoring and Business Assistance Program Site Visit Review Guide led by the Division of Institution and Award Support, a division created to put additional focus on this issue. Large facilities are subject to a Total System Business Review.

As part of competitive sourcing initiative, NSF has identified a number of activities that support overall monitoring as suitable for contract assistance. Given that, and based on the to-date implementation of the monitoring program, the 23 FTEs requested in FY 2006 will be used to grow NSF's risk-based oversight efforts in a responsible, reasonable manner. This assumes that other resource demands remain constant. Note that because NSF's award monitoring and oversight is an agency-wide effort that involves program staff within the directorates as well as various administrative staff, the requested FTEs are to be allocated throughout the agency.

Post-award Monitoring

Q2. Post-award management is critical both to allow NSF program managers to be aware of the scientific results of NSF-funded research and to ensure that government funds are spent appropriately.

What changes is NSF making to its post-award monitoring processes in response to the recommendations of the Inspector General and the IBM reports on this topic?

A2. IBM's *Post-Award Monitoring Assessment Report* was prepared at NSF's request as a review and gap analysis of the Foundation's monitoring procedures and practices. Overall, IBM noted that NSF has a sound program of post-award monitoring but made several recommendations. In response, NSF management agreed to initiate a series of information exchanges with Office of Inspector General (OIG) Audit Staff and KPMG, the external auditor for the NSF Financial Statement Audit. Components of the NSF corrective action plan are below:

- NSF management has improved the FY 2005 risk assessment model and will evaluate it annually for potential improvements.
- NSF is proceeding with a plan to conduct *advanced monitoring,* which refers to targeted business system reviews carried out at institutions that manage high risk awards as determined through risk assessments (see answer below). Advanced monitoring supplements baseline monitoring done for all NSF awards.
- NSF is proceeding with a plan to conduct *baseline monitoring.* Baseline monitoring is carried out in a systemic and automated fashion for all awards; this is supplemented by standardized staff processes and specialized reviews. As an enhancement to baseline monitoring, NSF is contracting out for focused

reviews of Federal Cash Transaction Report data that will be drawn from a statistically valid sample of the medium and low risk universe.

- NSF is focusing on opportunities for improvement for advanced monitoring as identified in the IBM report and underscored by the independent auditors as being most significant. This includes addressing site visit duration, program participation, pre-visit communication, awardee feedback, follow-up and issue resolution, program and OIG input into site visit plans, communication and collaboration between NSF and OIG staff, dissemination of the annual monitoring plan, systems automation, post-award monitoring staffing, NSF cost to perform post-award monitoring, awardee cost to participate in post-award monitoring, contracting out certain post-award monitoring activities, cross training opportunities, formal post-award monitoring training, report writing, documentation, a database to maintain results, and dissemination of overall findings and lessons learned.
- NSF has increased the overall resources deployed for post-award monitoring and will continue these increases until management deems them to be sufficient.

Q3. Dr. Boesz testified that NSF provides extra scrutiny to high-risk projects. How do you define high-risk and what extra monitoring procedures do you follow for these projects? Have these procedures been effective? What protocols are in place to oversee lower- and medium-risk awards?

A3. All NSF awards are assessed annually for financial and administrative risk using objective criteria such as type of awardee organization, dollar amount of award, whether NSF is cognizant for federal oversight, whether the awardee is a new federal awardee, complexity of the award instrument, cost sharing, sub-awards, participant support, and equipment. High-risk awards are identified via a set of weighted objective factors applied to the award universe. Examples of such factors include dollar amounts of the award, sub-awards, and cost sharing. These factors are assigned point values, and the resulting point value, once all factors are accounted for and totaled, determine the classification of the award as low, medium or high risk. Objective criteria applied for the FY 2005 Risk Assessment model identified 252 awards made to 167 institutions as high risk.

After the objective assessment, high risk awards are further reviewed using subjective factors. These include programmatic, administrative, financial, and/or OIG concerns. Of the 167 institutions previously identified as high risk, 52 were eliminated because they were subject to Office of Budget, Finance, and Award Management site visits or OIG-conducted audits in the last four years, are currently on the OIG audit plan, are subject to total business systems reviews, or had OIG-conducted audit reports issued within the last four years. Also eliminated were 49 organizations whose high risk awards were due to expire.

Finally, of the 66 remaining institutions, NSF considered the total risk points assigned to an organization as well as its type. For example, organizations managing multiple high risk awards had higher risk points assigned. After applying both objective and subjective criteria as outlined in the Risk Assessment model, NSF selected 24 to 30 institutions for post-award monitoring site visits in FY 2005. This includes tribal colleges, school districts, nonprofit organizations, and academic institutions.

NSF has communicated this plan to NSF management and program staff as well as OIG. NSF will continue to assess its awards annually and will coordinate with programmatic, administrative, and financial staff as well as with OIG to ensure that high risk awards are closely monitored.

The monitoring procedures that NSF follows for high risk projects are contained in the *Post-Award Monitoring and Business Assistance Program Site Visit Review Guide.* The guide contains roles and responsibilities, pre-site visit activities and procedures, on-site review modules that can be tailored for each visit, post site visit activities, worksheet appendices, and correspondence appendices. On-site review modules include both core and targeted sections:

- Core modules (included in all site visit reviews) include general management, accounting and financial system review, and Federal Cash Transaction Report (FCTR) reconciliation.
- Targeted modules (used by site visit teams based on risk factors identified during the risk assessment) include time and effort records for personnel, fringe benefits, travel, consultants, cost sharing, participant support costs, indirect costs, procurement, sub-award and sub-recipient monitoring, and property and equipment.

The Post-Award Monitoring and Business Assistance Program Site Visit Reviews conducted by NSF over the last several years continue to mature as part of NSF's comprehensive program. Issues have been identified during these visits and follow up is conducted. For institutions that have had the benefit of this business assistance visit, indications are that procedures have been effective.

For lower and medium risk awards, NSF's baseline monitoring adheres to the Single Audit Act implemented by OMB Circular A–133. Audits performed by private CPA firms contain attestations on internal controls, compliance with federal regulations, and the schedule of federal financial assistance. In addition, OMB has designated cognizant federal agencies that have responsibility for overseeing institutions to ensure that the awardee financial systems and internal controls comply with federal requirements.

Baseline monitoring is conducted in a systemic and automated fashion for all awards including those that are lower- and medium-risk. This is supplemented by standardized staff processes and specialized reviews. As an enhancement to baseline monitoring, NSF is contracting out for focused reviews of FCTR data that will be drawn from a statistically valid sample of the medium and low risk universe.

Deputy Director for Large Facility Projects

Q4. What are the responsibilities of the Deputy Director for Large Facility Projects? How does he fit into NSF's process for selection and oversight of Major Research Equipment and Facilities Construction projects? What human and technology resources does he have? What authorities does he have?

A4. The Deputy Director for Large Facility Projects serves as the principal advisor on facility construction and project management to the Director of the Office of Budget, Finance, and Award Management (BFA), also known as the Chief Financial Officer. The Deputy is the day-to-day point of contact with senior agency officials, NSF program managers, and awardee managers on project management and oversight matters relating to NSF's large facility projects. The Deputy Director's responsibilities include:

- Advising the BFA Director on problem areas and opportunities, and recommending courses of action; identifying errors in judgment and/or time that could have serious effects on cost or schedule;
- Providing assistance to NSF program managers in planning, budgeting, constructing, and operating large facility projects—activities that extend from pre-conceptual design through engineering criteria, site selection, construction, and/or acquisition, operations, and decommissioning;
- Directing the development, initiation, and implementation of NSF policies, guidelines, and procedures for large facility projects;
- Representing NSF in meetings with other federal agencies, OMB, Congress, and other oversight or investigative bodies on all matters involving the business operations oversight aspects of large facility projects;
- Conducting independent cost, schedule, and management reviews of large facility projects; and,
- Managing the annual validation reviews for large facility projects for inclusion in the fiscal budget process.

The Deputy Director serves on all Project Advisory Teams (PAT), the NSF advisory group assembled by each program officer managing a large facility project. The PAT is composed of representatives from BFA, the Office of the General Counsel, program managers with experience and expertise in large projects, the Office of Legislative and Public Affairs, and the Office of International Science and Engineering. Through their expertise in grants management, contracts, legal, legislative, and international aspects of project management, the PATs provide facility program managers with advice on a regular basis.

NSF is currently re-evaluating this position to ensure that it has the right mix of responsibilities and authority to provide maximum benefit to the Foundation. The authority of the position is described above. The NSF Director fully supports this position and has charged the Deputy Director for Large Facility Projects with the authority to act in his name with respect to NSF's portfolio of large projects. The Director has specifically delegated to the Deputy Director for Large Facility Projects the authority to convene and conduct external reviews of any large facility projects when professional judgment indicates there is reason to do so.

The process of selecting facility projects to be funded in the Major Research Equipment and Facility Construction (MREFC) account begins with the NSF pro-

gram manager and the cognizant Division Director and Assistant Director recommending the project to the MREFC Panel. The MREFC Panel, chaired by the NSF Deputy Director and composed of NSF senior management including the Deputy Director for Large Facility Projects as a member *ex-officio,* reviews and recommends which projects are sent forward for final approval to the NSF Director and then to the National Science Board.

Presently, 1.5 FTEs report directly to the Deputy Director for Large Facility Projects. In addition, as a line manager within BFA, the Deputy Director can call on the resources of the entire BFA staff. Examples include: The Division of Contracts and Complex Agreements manages the award and administration of cooperative agreements for MREFC projects; the Policy Office is responsible for implementing and issuing proposal, award, and acquisition policy for NSF programs; the Division of Financial Management oversees financial policy and financial management of NSF; and the Budget Division coordinates development of NSF's annual budget to OMB and Congress. All divisions participate in activities related to management of large facility projects; the Deputy Director relies on their expertise in providing the best advice and guidance to NSF program officers in planning, budgeting, constructing, and operating large facility projects. NSF expects to fill two additional positions in the near future. The Deputy Director for Large Facility Projects requires no extraordinary technical resources.

NSF Business Analysis

Q5. NSF has contracted out for a multi-year, multi-million dollar Business Analysis of NSF workforce and procedures. What is the status of this project?

A5. In FY 2002, NSF initiated a comprehensive, multi-year Business Analysis, the outcomes of which are informing Organizational Excellence investments now and for the foreseeable future. The Business Analysis:

- Documented each of the agency's core *Business Processes* and defined its contribution to the NSF mission.
- Defined process effectiveness and efficiency improvements that leverage past experience, capitalize on best practices in the public and private sectors, and respond to emerging mission-related trends.
- Is developing future-looking *Business Process* scenarios and criteria for success.
- Defined a *Human Capital Management Plan* to provide next-generation human capital capabilities. The Plan identifies future-looking workforce competencies and describes human capital strategies and approaches to support the *Business Process* scenarios and to capitalize on opportunities afforded by *Technology and Tools* innovations.
- Is defining an *Integrated Technology and Tools Plan* (business infrastructure tools, knowledge bases, and technologies) that describes an overall integrated technical and information architecture for future systems and capabilities in support of the agency's *Business Processes.*

The outcome of NSF's Business Analysis will be a management and investment strategy focused on quality, efficiency, agility, and flexibility and was designed to realize the agency's Human Capital, Business Processes, and Technology and Tools goals.

Major products from the Business Analysis were delivered at the end of FY 2003, including a complete baseline documentation of the agency's core business processes, a first version of an agency-wide human capital management plan, and a first iteration of an enterprise architecture. This work underscores two fundamental challenges facing NSF as it becomes a fully integrated organization capable of working both within and across intellectual organizational boundaries: (1) maintaining the highest levels of quality in merit review and the award process, and (2) maintaining flexibility while promoting appropriate agency-wide standards.

During FY 2004, the Business Analysis effort addressed these challenges in a variety of ways. The Analysis identified alternative, more efficient methods for conducting the proposal review process that maintain the integrity of the process.

Q6. What does NSF hope to gain from the results? Have any recommendations been made to date? If so, what were they and what changes has NSF undertaken in response?

A6. Based on Business Analysis findings, the Foundation will develop more formal procedures for managing the technical risk of awards and assessing the contribution of NSF-funded projects to the advancement of science and engineering. Currently,

a series of opportunities for process improvement in both of the key business processes identified above are under review by agency management. Implementation is expected to begin this fiscal year.

NSF also capitalized on Business Analysis work (e.g., an employee workload survey and analysis) to effectively implement alternative human capital management approaches to increase the use and effectiveness of the workforce. In 2004, as a result of Business Analysis findings, NSF laid the groundwork for conversion from a task-based to a competency-based human resource management system and consolidated several hundred existing job titles into 40 job families. These changes directly link workforce planning, recruitment, development, and performance management activities to agency business strategy, and simplify and streamline these activities for NSF management and staff. The electronic jacket human capital pilot project identified a set of useful guidelines for change management at NSF that are being employed to facilitate the planning and introduction of new technologies and business process improvements.

The Administrative Functions Study, currently under way, is designed to address the impact of rapidly changing work processes, shifts in workload, and advances in technology on the Foundation's ability to efficiently perform its administrative duties. The study is examining the distribution of administrative functions among staff in the S&E Directorates and will recommend strategies to better align those functions in support of the NSF mission. The study will evaluate existing NSF staffing models; identify new or modified staffing models; define competencies for positions in the new models; and propose high level migration strategies to assist Divisions and Directorates/Offices in transitioning, as appropriate, to any chosen model. Ultimately, the result is alternative career paths and new learning maps and training plans for NSF staff who wish to manage opportunities for future career development. Also likely is that this study, in conjunction with other business analysis work, will recommend the realignment of some administrative functions within or among Divisions/Directorates/Offices.

The Business Analysis also provided a framework for integrating NSF's information technology (IT) systems across the agency and establishing agency-wide standards for IT security, functionality, and application development. Recent focus has been on the development of Baseline and Target Architectures, the Information Technology Implementation Plan, and The NSF Technology Governance Framework. The baseline architecture includes a complete inventory of NSF's major and non-major systems; identification of business processes, sub-processes, applications, technology, and data deployed at NSF; identification of major areas of short and long-term improvements and recommendations; and an analysis of business processes and services to identify redundancies and opportunities to introduce efficiencies.

The Target Technology Architecture, developed in 2004, focused on establishing the precepts of a service-oriented enterprise architecture (SOEA); provides a vision of NSF's future architecture; links together organizational goals, lines of business (BRM), Service/Capabilities (SRM), systems and technologies (TRM), data and people; and currently provides guidance for technology capital investments and several infrastructure initiatives including NSF's Portal, Directory Services and Identity Management.

The Integrated IT Implementation Plan provides the links between the baseline and the target architecture and is described in terms of 10 major IT projects. The IT Implementation Plan is currently being used to guide implementation decisions and sequencing of programs (e.g., the acquisition and implementation of expanded grants management capabilities via the Strategic Information Management and the NSF Identity Management and Directory Services system) and includes the constructs necessary to establish NSF's technology roadmap for the next five to seven years; essentially, the IT Implementation Plan includes the tools to "operationalize" NSF's Enterprise Architecture.

Prioritizing New Personnel Hires

Q7. In the past two years, NSF has requested and received slots for 50 new employees. What are your priorities for the categories of new personnel you have hired to date and plan to hire in the near future, and how did you determine those priorities?

A7. NSF's priorities for new personnel are in the two categories below:

Science and Engineering Staff—Science and engineering researchers and educators with extensive, relevant professional experience oversee assigned areas of the NSF portfolio. Their primary responsibilities are: a) to manage science and engineering programmatic resources within the context of NSF's Strategic Plan by developing forward-looking solicitations using a quality merit review process to identify

the most promising projects; and b) to implement comprehensive award management and oversight procedures to ensure that the agency's investments contribute optimally to the Nation's scientific and engineering leadership. Duties also include representing NSF in the global science and engineering community, participating in program development and evaluation activities, coordinating with other organizations and stakeholder groups, and ensuring diverse participation in review and funding procedures.

Business, Operations, and Information Staff—Business, operations, and information professionals create and support state-of-the-art business processes and procedures within the agency. They provide contemporary administrative leadership and support within NSF as well as the broader stakeholder community of grantee organizations, principal investigators, and reviewers. Additionally, they analyze and contribute to the development of agency policy, provide essential project management capabilities, and perform an array of administrative functions. These professionals uphold the agency's robust merit review, award, and financial management processes, monitor grants and cooperative agreements, implement and oversee the evolution of the enterprise architecture, recruit and train agency staff, and ensure the ongoing health and security of agency assets and resources, financial systems, and internal controls. Like science and engineering professionals who cross traditional disciplinary boundaries, the agency's business, operations, and information professionals provide both breadth of expertise across all business processes and procedures and depth in key existing and emerging technical, legal, and administrative areas.

Q8. What role is the Business Analysis report playing in your decisions?

A8. The NSF Business Analysis played a key role in determining these staffing priorities. In FY 2002, NSF initiated a comprehensive, multi-year Business Analysis study, the outcomes of which are informing Organizational Excellence investments for the foreseeable future. This study is a key element of NSF's Administration and Management strategy, a concurrent analysis of human capital, business practices, and technology, which is now part of the Organizational Excellence strategic goal.

The Business Analysis identified Workload of Science and Engineering and Business, Operations, and Information Staff as a strategic area to be addressed by NSF. An increase in the volume and complexity of proposals impacts the effectiveness of Program Directors and other Science and Engineering staff. NSF proposal workload increased by 48 percent from 2000 to 2004; the volume of interdisciplinary proposals requiring cross-directorate coordination (e.g., nanotechnology, biocomplexity in the environment, and cyberinfrastructure) increased by more than 50 percent over a three-year period. In addition, the agency-wide effort to improve the effectiveness of management and oversight of NSF awards increases workload demand on both Science and Engineering and Business, Operations, and Information staff across the Foundation.

In hiring new staff to address these pressing and immediate needs, NSF continues to emphasize the recruitment and training of staff who are adept at crossing boundaries between disciplines, traditionally stove-piped career fields, and organizations. These individuals will both create and respond to emerging scientific and business opportunities. New staff members are contributing to the attainment of NSF's organizational excellence goal, enabling quality merit review, award management, and operations for an increasing number of proposals and increasingly complex projects.

Math and Science Partnership

Q9. In May 2004, the Office of the Inspector General completed its audit of the Math and Science Partnership (MSP) Program at NSF. Among the findings, the audit determined that the contract for evaluation of the overall program had not been released and it appeared that milestones, target dates and deliverables for completing the evaluation were absent or still under development. The audit also found that some of the individual MSP projects did not have the systems in place to effectively evaluate their progress in improving teaching and learning.

What is the status of both the overall program evaluation and the evaluation of individual projects?

A9. On May 18, 2004, NSF released a Request for Proposals (DACS–040017) for the *Program Evaluation of the Math and Science Partnership Program (MSP–PE).* In September 2004 COSMOS Corporation, in partnership with Vanderbilt University, George Mason University and The McKenzie Group, was awarded the overall program evaluation contract. The contract specified the milestones, target dates, and

deliverables necessary to accomplish the evaluation process at the program level. COSMOS has begun its work, which is ongoing.

The overall program evaluation (MSP–PE) contract awarded in September 2004 is but one aspect of a much larger and more comprehensive package of MSP data collection and evaluation. The MSP–PE builds on and uses: (a) the existing MSP Management Information System (MSP–MIS), previously awarded by contract to Westat; and (b) the extensive quantitative and qualitative data collected and reported by each funded Partnership project since the project's initial funding. The MSP–MIS is a critical component of the overall MSP evaluation package, in that it brings consistency to the overall MSP data effort through the collection across all funded Partnerships of common quantitative and qualitative data, including student achievement data and teacher data. The MSP–MIS is the primary data source for the MSP–PE and, because of that function, its role in an overall MSP evaluation is at least as important as that of the program evaluation contract.

For individual projects, the status of their evaluations is one of ongoing strengthening. Since the first awards were made at the end of FY 2002, the MSP has been incrementally increasing its oversight of project evaluation through the use of additional external review of evaluation plans and evaluator credentials, as well as through the ongoing critical site visits required of all Comprehensive MSP projects. The OIG Audit of the MSP program focused on a small sample of Partnership projects funded in the first competition. The Audit Report acknowledged (p.3) that NSF had been, in later solicitations, more explicit in articulating requirements about quantitative measurements and independent evaluators. Consonant with the nature of a Research and Development effort, all aspects of MSP evaluation have been continually strengthened since the program began.

Retention of Science and Engineers Majors

Q10. Surveys of college freshmen show a high level of interest in science and engineering (S&E) fields, with approximately 25–30 percent of students intending to major in these areas. However, during the course of their undergraduate years, many students move out of S&E and into other majors or out of college.

What is NSF doing to improve the retention of S&E majors, and how will these efforts be maintained in light of level or declining budgets?

A10. Many programs at NSF are aimed to improve the retention of undergraduate S&E majors. NSF supports many collaborative alliances between different types of institutions that are designed to provide a seamless transition for undergraduate students as they move through their initial years as majors in S&E fields. These programs and alliances are active in all 50 states, the District of Columbia, and three U.S. territories; at approximately 900 different universities; and with over 20,000 undergraduate students involved (FY 2004 data). Efforts will be made to continue the thrust of these programs and alliances in light of tight budgets and competing priorities.

One of these programs is the STEM (Science, Technology, Engineering and Mathematics) Talent Expansion Program (STEP), which has a goal of increasing the number of students graduating with associate and baccalaureate degrees in STEM fields. Projects supported by STEP use a variety of creative approaches to attract and retain students in S&E fields. As an example of this program's impact, estimates are that the nineteen projects supported by STEP in FY 2004 will, by the end of the grant period, graduate 1,640 additional STEM majors annually beyond those graduated in FY 2003.

NSF undergraduate scholarship programs, such as the Computer Science, Engineering and Mathematics Scholarship (CSEMS) program (funded by H1–B visa fees), the Federal Cyber Service: Scholarship for Service (SFS) program, and the Robert Noyce Scholarship program, help to retain science and engineering students who otherwise would not stay in college due to financial difficulties. The projects that supply student scholarships also provide mentoring and other academic and student-support programming that helps to retain students.

NSF programs that address the quality of undergraduate education also potentially have an impact on the retention of undergraduate students in S&E fields. The Course, Curriculum and Laboratory Improvement (CCLI) program supports development of new S&E learning materials and tools and creative teaching methods and strategies that increase student learning. These new materials and approaches will engage a broader group of students, increase their academic success, and enhance retention of students. Similarly, the Advanced Technological Education (ATE) program provides grants to strengthen the education of students in technologically oriented associate degree programs.

Questions submitted by Representative Darlene Hooley

Graduate Fellowships and Traineeships

Q1. NSF has increased the size of stipends for graduate fellowships and traineeships to $30,000 per year.

What has been the effect on numbers of applications for fellowships and traineeships as a result of increasing stipends, and in particular, the effect on the number of applications from individuals from under-represented groups?

A1. The total number of applications for the Graduate Research Fellowship (GRF) has consistently increased in recent years. The number of applications from women and minorities has also increased, although in differing proportions. Between 2002 and 2004, applications from women rose by 35 percent and from under-represented minorities by 27 percent. However, it is important to note that as a percentage of the total applicant pool, women and minorities decreased slightly during the same period. (The program is able to report numbers representing only those who identified themselves as members of under-represented groups).

The overall GRF offer acceptance rate (percentage of students who accept the GRF award) has increased with the increase in stipend levels.

Fiscal Year	Number of Applications	Underrepresented Applications	Applications From Women	Overall GRF Offer Acceptance Rate
2002	6,556	730	3,034	93.9%
2003	7,788	820	3,575	95.9%
2004	9,271	932	4,093	96.5%

While an overall increase in applications accompanied the improvement in the absolute amount of stipends, other factors may account for the increase. This includes economic factors and the relative size of the NSF stipends as compared to other fellowships.

Q2. On what basis do you determine the proportion of funding for the fellowship program versus the traineeships programs? How do the goals of these two types of graduate support programs differ?

A2. The goals of the NSF fellowship program and the two traineeship programs are complementary. They seek to attract high quality domestic students to study in the science and engineering fields and to broaden and strengthen their preparation for career success.

Within the Division of Graduate Education, budgets for the traineeship and fellowship programs are fairly close, reflecting the importance of both approaches to furthering NSF's goals in the preparation of future scientists and engineers. In 2005, the NSF budget is $96.53 million for the Graduate Research Fellowships (GRF) program and $118.86 million for two traineeship programs ($68.97 million for the Integrative Graduate Education and Traineeship (IGERT) and $49.89 million for the Graduate Teaching Fellows in GK–12 Education (GK–12); both of these programs make awards to institutions, not directly to individuals).

Fellowships are awarded to individuals directly and they are portable. Students submit applications to NSF for awards to support their masters and Ph.D. graduate study. Over 9,000 applications are submitted annually to the GRF program; approximately 950 new awards are made each fiscal year.

For fellowships, panels of experts review applications. Selected students may take the award to an appropriate institution of the student's choice. If the student is studying in the U.S., the award is given to the institution annually and consists of a $30,000 stipend for the student and $10,500 for the cost of education that remains with the institution. If studying abroad, the award is provided directly to the student.

Traineeships are awarded in clusters as part of a grant to an institution. The institution selects students to participate as trainees. Both IGERT and GK–12 provide the same amount as the GRF program for stipends and cost of education allowance. The GK–12 program emphasizes communication skills and prepares graduates to share their scientific expertise with a wide audience and for a variety of scientific careers. IGERT traineeships prepare graduate students to be the scientists and engineers of the future, prepared for careers of the 21st century.

Q3. Does NSF have a goal for the proportion of fellowships and traineeships relative to graduate research assistantships, which are funded under individual research grants?

A3. The National Science Board has addressed the issue of distribution of support for graduate students on a number of occasions. The 2003 NSB report *The Science and Engineering Workforce: Realizing America's Potential* includes conclusions drawn by a 1996 NSB Task Force on Graduate and Postdoctoral Education (1996). Specifically, the Task Force reported that, ". . .despite extensive study, we find inadequate data to compel a recommendation of a major shift in funding mode among fellowship, research assistantships, teaching assistantships, and traineeships for supporting graduate education in science and engineering" (National Science Board, *The Science and Engineering Workforce: Realizing America's Potential,* p. 25, 2003).

The proportion of fellowships and traineeships relative to graduate research assistantships is determined to a major degree by the number and size of research grants. Changes in the budget for NSF's Research and Related Activities account are accompanied by similar changes in the number of research assistantships supported because they are important features of those grants. University applicants for research grant funding often include graduate student funding in their proposals.

Research assistantships are not restricted to U.S. citizens and have no specific stipend requirement; by contrast, fellowships and traineeships are restricted to U.S. citizens or permanent residents and require a specific stipend plus an amount budgeted for tuition and fees. NSF supports (indirectly) almost five times as many students with research assistantships as fellowships and traineeships. Because fellowships and traineeships are typically not given for the full duration of a graduate student's doctoral education, recipients of fellowships and traineeships often work as research assistants at some point during their doctoral studies.

High-End Computing and Cyberinfrastructure

Q4. How have the findings and recommendations of the interagency High-End Computing Revitalization Task Force influenced your fiscal year (FY) 2006 budget decisions, and how does high-end computing, particularly making leading edge supercomputers available to the research community, fit into your cyberinfrastructure plans?

A4. High-end computing (HEC) is one essential component in the national cyberinfrastructure. HEC systems and services are critical to discovery, learning, and innovation in many science and engineering domains. Consequently, NSF remains firmly committed to making HEC resources and services available to the open science community. Recognizing that research challenges in different science and engineering domains are best served by different HEC systems, the agency pursues an architectural diversity strategy for HEC. For example, leading-edge HEC systems configured with high input/output bandwidth and moderate interconnect latencies meet the data-intensive computational challenges inherent in many biological and biomedical fields. The needs of the climate modeling and cosmology/astrophysics communities are best met with tightly-coupled leading edge HEC architectures configured with high interconnect bandwidths.

Since the HEC needs of the national science and engineering communities are diverse, NSF currently supports a range of HEC systems and related services provided via a number of provider organizations, including the National Center for Atmospheric Research, the National Center for Supercomputing Applications, the Pittsburgh Supercomputing Center, Purdue University, the San Diego Supercomputing Center, and the Texas Advanced Computing Center. Some of the resources provided by a number of these organizations have been integrated into the NSF-funded Extensible Terascale Facility (ETF). ETF uses advanced technology to provide a unified user environment in which researchers and educators can easily access a variety of cyberinfrastructure architectures and services, including HEC, that are furnished by spatially distributed providers. Other cyberinfrastructure resources, including some HEC resources, are provided by these organizations outside of ETF—these resources remain accessible through the traditional access mechanisms with which researchers and educators have become familiar.

The High-End Computing Revitalization Task Force (HECRTF) report "A Federal Plan for High-End Computing" describes alternative approaches and planning strategies for three HEC components: HEC Research and Development, HEC Resources, and Procurement. Some of the approaches and planning strategies discussed are more directly relevant to NSF's cyberinfrastructure plans than others. However

since HEC is a key element of cyberinfrastructure, all are likely to have some bearing on NSF's future cyberinfrastructure activities.

The agency recognizes that effective interagency coordination and collaboration is essential to progress in HEC. NSF continues to work closely with its sister agencies on HEC issues. Most notably, NSF staff are working with colleagues at the Department of Energy (DOE). The two agencies are partners in the ETF (DOE is providing resources to the open science community via NSF's ETF platform), and are collaborating in the investigation of the leadership-class Cray Red Storm HEC system currently being deployed at the Pittsburgh Supercomputing Center by NSF, and at Sandia National Laboratory (SNL) by DOE. The architectures of these systems are slightly different due to the classified nature of the work to be done on the SNL-deployed system, but many features are identical. As another example, NSF staff remain fully engaged in collaborations with DARPA in that agency's High Productivity Computing Systems program.

Cyberinfrastructure

Q5. Have you developed, or are you developing, an NSF-wide plan to first identify and then to meet the cyberinfrastructure needs of the scientific and engineering research communities? What are the roles and responsibilities of the Computer and Information Science and Engineering Directorate and the other scientific directorates in developing the plan, budgeting for it, and implementing it?

A5. In March 2005, NSF established the Cyberinfrastructure Initial Implementation Working Group (CIIWG) consisting of representatives from all research and education directorates and offices, and including the Director of the Division of Shared Cyberinfrastructure (SCI) from the Computer and Information Science and Engineering (CISE) Directorate. The CIIWG is charged to identify roles and goals for NSF's cyberinfrastructure investments, and to recommend management structures and strategies needed to support integrative and long-term planning that will lead to the development of an NSF-wide Cyberinfrastructure Plan.

In preparing these recommendations, the CIIWG is to ensure the involvement of NSF program staff from all offices and directorates, to receive input from science and engineering research and education communities, and to frame the recommendations to build on past and current investments. The CIIWG will also provide insight into the current context of NSF efforts with respect to the activities of others, including research and education communities, other agencies, commercial enterprises, and international activities.

Recommendations from the CIIWG will be used to develop the NSF management structure that will carry out long-term planning and management of NSF's cyberinfrastructure investments. The CIIWG report will be reviewed and considered for implementation by a newly established Cyberinfrastructure Council (CI Council). This council consists of the Assistant Directors heading each research and education directorate and office. Dr. Bement chairs the group. The CI Council will establish policy, principles, and priorities for the NSF-wide cyberinfrastructure investments and approve the integrated NSF cyberinfrastructure plan that will be established and implemented through the NSF-wide integrated management structure. The NSF plan will include investments through research and education directorates, offices, and the SCI Division in CISE. This management structure will be in place early in the summer of 2005.

National Nanotechnology Initiative

Q6. The Nanoscale Science and Engineering priority area received an increase of 32 percent for FY 2005 and seeks a two percent increase for FY 2006. However, the breakout of funding for the initiative by research directorate shows a 40 percent decrease in funding in the Social, Behavioral and Economic Sciences Directorate from FY 2004 to FY 2005 to a level of only $1.56 million. The FY 2006 request is frozen at that level.

Explain why research related to the societal implications of nanotechnology appears to be de-emphasized within NSF's nanotechnology research program.

A6. In FY 2006, funding for the Nanoscale Science and Engineering priority area declines, consistent with the planned phase-out of the priority area. At the same time, funding for the National Nanotechnology Initiative (NNI) activities increases by about two percent. The NNI funding request for FY 2006 has been re-organized based on Program Component Areas (PCAs) to align it with the NNI Strategic Plan published in December 2004. The PCA component on Ethical, Legal, and other Social Implications (ELSI) will be funded through several directorates. SBE is funding

societal implications at an increasing level, with $5.5 million estimated for FY 2004, $7.4 million estimated in FY 2005, and $7.5 million requested for FY 2006.

The SBE Directorate's funding for ELSI includes a specific program solicitation that has remained at $1.56 million from FY 2004 through FY 2006. However, additional funds for societal implications of nanotechnology are funded through core programs in SBE. These are expected to increase in FY 2006 in competition with other core proposals. SBE spent about $2.59 million for nanoscale science, engineering, and technology projects in FY 2004.

The FY 2006 NSF request for societal dimensions of nanotechnology includes not only the ELSI program component area but also includes environmental, health and safety (EHS) and educational components. FY 2006 funding for the societal dimensions of nanotechnology as a whole will increase to a total of $60 million.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Mark S. Wrighton, Chairman of the Committee on Audit and Oversight, National Science Board; Chancellor, Washington University, St. Louis

Question submitted by Chairman Bob Inglis

Q1. How does the Deputy Director for Large Facility Projects fit into the National Science Board's processes for selection and oversight of Major Research Equipment and Facilities Construction projects?

A1. The National Science Board feels strongly that the Deputy Director for Large Facilities Projects (LFP), Office of Budget, Finance, and Award Management must have significant oversight and coordination responsibility for the construction and financial management aspects of all LFPs. The Board has previously discussed this issue with the National Science Foundation Director, Dr. Arden Bement, who has confirmed to the Board that the LFP Deputy Director position does have oversight authority for construction related and financial management of LFPs. The Board is currently completing a report on its own oversight responsibilities with respect to major research facilities, which will be implemented this fall. This report with include all the steps on how the Board approves and monitors these projects as they go through their life cycle, and the role of the Deputy Director for LFPs in that process.

Questions submitted by Representative Darlene Hooley

Q1. The National Science Foundation (NSF) budget request funds only close out costs for the Math and Science Partnership Program. This action is exactly counter to the recommendation of the National Science Board (NSB) in NSB–04–42, which was issued following the initial proposal to end the program in the FY 2005 budget proposal. Has the position of the Board changed from that expressed in its statement from last year, and if not, does the Board intend to press for continuation of the Math and Science Partnership Program?

A1. The National Science Board reaffirms its previous statement (NSB–04–42), and continues to support the Mathematics and Science Partnership Program at NSF as essential to the development of stronger linkages between K–12 and undergraduate education, and for the advancement of knowledge on what is effective in STEM education. NSF has long-term experience in such large-scale experiments in K–12 education in STEM fields through its Systemic Initiatives.

Q2. In general, what is the current position of the NSB on NSF's role in K–12 math and science education and does the Board support a policy change that would lead to the de-emphasis, or abandonment, by NSF of instructional materials development and teacher training and professional development activities?

A2. The NSB has stated its support for high quality teacher training for K–12 STEM teachers, improvements in instructional materials development, and professional development in its reports, *Failing Our Children* (1998) (NSB–98–154) and *Preparing Our Children* (1999) (NSB–99–31) and reaffirmed them in the Board's recent report, *The Science and Engineering Workforce: Realizing America's Potential* (2003) (NSB–03–69) as critical to world leading capabilities in STEM fields for our future workforce.

Q3. The FY 2006 budget request makes a substantial cut (-43 percent) in the education research component of the Research, Evaluation and Communication division in the Education and Human Resources Directorate. In its December 2003 report to Congress, "Fulfilling the Promise," the National Science Board stated that a "particularly urgent need" included support for research that enhances understanding of learning and teaching at the K–12 and undergraduate level. Explain how this budget decision squares with the Board's statement of priorities.

A3. The NSB policy positions on K–12 and undergraduate education in the 2003 report to Congress are consistently affirmed by the Board in its policy studies on education and the workforce. In its written testimony to this Subcommittee on Research, the Board states: "We. . .know that the education of all our citizens in the fundamentals of math, science and engineering must be addressed if the U.S. is to remain eminent in S&T when we enter the 22nd century." Though the budget request of $5.605 billion is a 2.4 percent increase over the FY 2005 budget, it is nevertheless below the level of the 2004 NSF operating budget. Should the subcommittee

determine that additional funds, beyond the Administration's request, can be made available to NSF in FY 2006, the Board recommends among its top priorities support for a strong and growing role for NSF in the Nation's investment in science and engineering education. The most recent NSB study on the K–16 system, *Preparing Our Children* (1999) (NSB–99–31), states: "The Board believes that stakeholders must develop a much-needed consensus on a common core of mathematics and science knowledge and skills to be embedded consistently in classroom teaching and learning" and recommends, "Overall, the investment should increase—by the Federal Government, private foundations, and other sponsors—in research on schooling, education systems more generally, and teaching and learning of mathematics and science in particular. To focus and deepen the knowledge base, an interagency Education Research Initiative, led by NSF and the Department of Education, should be implemented. It should be distinguishable as a joint venture within the agencies' respective research missions, and cooperatively funded." The more recent Board report, *The Science and Engineering Workforce: Realizing America's Potential* (2003) (NSB–03–69) reaffirms "the necessity of a strong curriculum in mathematics, science, engineering and technology from the earliest grades to build the knowledge needed by citizens and members of the workforce" and recommends that, "To improve effectiveness of precollege teaching, stakeholders must collaborate to. . .support research on learning that better informs K–12 mathematics and science curricula and pedagogy development." The Math and Science Partnership Program and other education research programs at NSF are designed to address these objectives. NSF will focus the remaining resources on priorities for education research; however, there is no question that reduced funding for research will likely reduce the advances in knowledge that would otherwise be possible with higher levels of support. The Board expects to issue a formal letter to Congress on this issue at its May 2005 meeting.

Q4. Under the Administration's funding projects for NSF, which are for flat or declining budgets, what factors will the NSB consider in determining the appropriate balance between support for research projects versus support for major research facilities and other research infrastructure? In general, is there a target level for the proportion of the budget devoted to research infrastructure versus research project support?

A4. In view of the increasing importance of infrastructure to performing cutting edge science and engineering, maintaining excellence in federally funded research requires a higher level of funding for infrastructure support. For that reason, the Board recommended in its recent report, *Science and Engineering Infrastructure for the 21st Century: The Role of the National Science Foundation* (2003) (NSB–02–190), "Increase the share of the NSF budget devoted to S&E infrastructure in order to provide individual investigators and groups of investigators with the tools they need to work at the frontier" and argues with respect to the NSF budget for "a share closer to the higher end of the historic range (22–27 percent)." However, the Board has further argued that the higher infrastructure investment should be addressed through growth of the NSF budget, rather than reducing research project support.

At the request of Congress, and consistent with Board discussions during our recent retreat, the Board will undertake the development and establishment of a new vision for NSF for the 21st century. This visionary document will also include overarching goals with both long- and short-term priorities, and address the balances between research projects and facilities support, that take into account federal fiscal realities. We expect to work closely with the NSF Director and finalize this effort by the end of 2005.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Christine C. Boesz, Inspector General, National Science Foundation

Question submitted by Representative Darlene Hooley

Q1. Your testimony included the statement that "realignment of certain management priorities would ease some of the burden" in the absence of having all the resources otherwise needed by NSF to address its post-award administration challenges. What are some examples of realignment that you had in mind?

A1. The business of the National Science Foundation (NSF) is funding basic research and educational initiatives in science, mathematics, and engineering. Over the years NSF management has focused on pre-award activities, improving the application process and streamlining review activities. NSF has invested in high-quality electronic communications and processing systems that are the backbone of its operations. However, NSF has not applied the same rigor to developing a robust post-award monitoring process. NSF has relied heavily on the goodwill of its institutional partners for the day-to-day monitoring of NSF grants. While this strategy has merit, it is not enough to safeguard the billions of tax dollars that NSF invests in research and education.

NSF has put in place an Award Monitoring and Business Assistance Program, with limited coverage of its award portfolio. By focusing on high-risk awards, the effort is too narrow and the effect is limited. NSF could broaden the scope of its monitoring activities by implementing cost-effective monitoring procedures such as desk reviews of reports from awardees and computer assisted screening of A–133 audits.

It is my judgment that NSF needs a minimum of five qualified individuals dedicated to post-award administration. An annual budget of approximately $1 million would be needed to support these individuals for salaries, benefits, normal office requirements, travel, and contractor services to assist in the monitoring function. These five individuals would coordinate the myriad functions that constitute postward administration. They would draw on other NSF program and financial personnel as needed to carry out their monitoring functions.

Current management priorities include a Business Analysis study that is costing NSF approximately $12 million dollars. This project started in FY 2002 and yet NSF is still deciding on what and how to implement improvements in the work force. This effort at strategic planning has actually become an obstacle to taking urgently needed actions. Therefore, my first suggestion is to reallocate resources from this effort to pay for contract services, travel and other necessary monetary expenses associated with post-award administration.

In addition, because of efficiencies gained by moving payroll functions to the Department of Interior, four full-time equivalent positions could be used for post-award administration. Another full-time equivalent position could become available by realignment of the existing financial personnel responsible for indirect rate negotiation and audit resolution.

NSF has repeatedly stated that it has a shortage of personnel. An alternative approach would be to re-program $1 million from science, engineering, and education projects to establish this unit. The benefits gained would be cost-effective in that fewer dollars would be misspent by awardees.

Appendix 2:

Additional Material for the Record

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE
SUITE 2320 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–6301
(202) 225–6371
TTY: (202) 226–4410
http://www.house.gov/science/welcome.htm

April 13, 2005

Dr. Arden Bement
Director
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Dr. Bement:

I am writing to ask you to clarify statements that you made at a recent hearing before our Subcommittee on Research concerning the education mission and programs of the National Science Foundation (NSF). As I said at the hearing, I am an unabashed cheerleader for the Foundation and, as you know, I see education at all levels as an integral part of the Foundation's mission. I strongly believe that NSF needs an active and focused set of programs in K-12 education; the research directorates should indeed contribute to K-12 education, but that is not their primary focus, and NSF cannot rely on them to adequately discharge its K-12 responsibilities.

For these reasons, I strongly oppose the proposed cuts to the education budget of the Foundation, but those cuts are not the subject of this letter. Rather, I want to get a better sense of your general views on the role and nature of education programs within NSF, regardless of the level at which they are funded.

In answering questions before the Subcommittee, and in other forums, you have offered several thoughts about your education programs that I consider problematic. First, you have indicated that the Math and Science Partnership Program is merely an extension of NSF's Systemic Initiative programs under another name. Second, you have suggested that because of a few of the more successful Systemic Initiatives we now know what works in science and math education and all that is left to do is to propagate the successes. Third, you have implied that therefore NSF's work in education is done except perhaps for some work on education research. Fourth, relatedly, you have implied that NSF has no role in funding operational education programs.

I think that these thoughts are, frankly, all off the mark. While several of the Math and Science Partnership awards have been won by entities that were funded under the Systemic Initiatives, the focus and approach of the programs is different, and they should not be seen as (or operated as) the same program. To be more specific, the Partnerships should have greater involvement from colleges and universities (and particularly from their math, science and engineering departments) and they should be much more tightly focused and evaluated than were the broad, systemic initiatives. We need a wide range of approaches to be tested through the Partnerships precisely because we still do not have a good idea of what works in science and math education and what works for one school or one student may not work everywhere or for everyone. For that reason, NSF must continue to fund (and evaluate) a wide variety of educational efforts, including programs in school districts, teacher training programs and curriculum development efforts. Obviously, the Department of Education with its far greater funding and formula programs will have to be involved in ensuring that successful efforts are replicated. And NSF and the Department of Education must coordinate their programs – something I have pushed for more than a decade. But NSF cannot abdicate its own education responsibilities in the vain expectation that the Department of Education will somehow carry out the Foundation's mission.

I would appreciate your thoughts on these comments so that the Science Committee can have a fuller sense of how you intend to lead NSF in the area of education. As always, I appreciate the strong relationship we have that allows for direct discussions like this one, and I look forward to continuing to work with you.

Sincerely,

SHERWOOD BOEHLERT
Chairman

Let's work together on this!

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

May 23, 2005

OFFICE OF THE
DIRECTOR

The Honorable Sherwood Boehlert
Chairman
Committee on Science
United States House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

Thank you for the opportunity to respond to your letter of April 13, 2005. It is important that we continue to dialogue on the critical topic of science education, and those programs within the National Science Foundation's Education and Human Resource Development Directorate (NSF/EHR).

We remain committed to a robust and strong Education component at NSF. We recognize the historical role we play in working from kindergarten through post-doctoral levels with students, teachers, and professors in formal and informal settings. Through third party and second party evaluations, we have been made keenly aware of the impact our programs have had on Science Education and the STEM workforce. Be assured, it is not our intent to step away from that history or mission; rather, we are moving to have greater impact on students and practioners through greater cross- Directorate involvement.

Each of our research and research-related activities are developing coordinated programs that support the education mission of the Foundation and are doing so in a more content oriented fashion with the help of the EHR. This collaborative approach allows the Foundation to integrate research and education into the entirety of NSF and improve the level of funding for educational investment. By combining efforts we will continue to recognize similar growth throughout the Education portfolio.

Now, let me respond to each of your questions.

Is the Math and Science Partnership an extension of the Systemic Initiative Program under a different name?

No. The Math Science Partnership (MSP) is truly a unique program whose genesis is anchored in education research and pragmatic learning theory. Much of that theory came from the many programs "that work" in EHR. The relationship Math Science Partnerships have with the Systemic Initiatives is at best synaptic, in that there are some logical progressions from one to the other. The MSP initiative is illustrative of how to achieve improved outcomes in learning, when broad partnerships are utilized to drive those outcomes. In great respect, the Math Science Partnerships are, indeed more tightly focused and more broadly conceptualized than the Systemic Initiatives.

In the early years of the MSP, a small number of awards went to sites that had previously housed the large Systemic Initiatives. This was not unusual, since those were among the sites that had previously built large-scale capacity to work in K-12 mathematics and science education. The MSP, however, differs substantially in its core principles and expectations from the large Systemic Initiatives and from other prior educational work in the Directorate for Education and Human Resources.

The MSP calls for partnerships among institutions of higher education, state departments of education, K-12 districts, business/industry and others, *with particular emphasis on the engagement of university departments and faculty from mathematics, the sciences, and engineering.* Their substantial intellectual engagement in funded Partnerships is a core principle that distinguishes the MSP program from other programs seeking to improve K-12 student outcomes in mathematics and science.

MSP-funded Partnerships are further anchored by a set of common, key features and expectations to show clear and substantial progress in the domains of: (1) teacher quality, quantity and diversity; (2) challenging courses and curricula at all educational levels, including pre-service education; (3) evidence-based design and outcomes; and (4) institutional change within both higher education and K-12 necessary for achieving Partnership goals and for long-term sustainability.

Finally, the scrutinies under which MSP exist are emblematic of what excellent research, assessment and evaluation should be. The framework for the aforementioned assessment will lend credence to the efforts funded and offers a wealth of data, information and strategies to impact the myriad of learning situations in which the nation's children find themselves.

Given the success of some Systemic Initiatives, is there more to do than propagate the successes?

Yes. There is much more to do. There were immediate and long lasting successes with the Systemic Initiatives. They offered strategies for improving math and science through a systemic approach. With this valuable experience and after careful review of that work, we recognized there were more complete and effective strategies that could be implemented. Many of the Systemics' effective strategies and methods were shared through publication and workshop and have since been adopted. But new work must continue as the frontier of science and engineering moves forward and the technology- driven, twenty-first century student meets that frontier. Our task is to talk about what works and continue to refine practices while developing new ones, through our new initiatives such as Math Sciences Partnerships.

Our continued charge is to work closely with other agencies, specifically the Department of Education, in areas where our mission and programs overlap. By leveraging our resources and planning, we can insure greater continuity of effort in moving America's Future forward through such partnerships. It is critically important that we find ways to promulgate what has been proven to work as broadly as possible though our education systems.

Is there more work to be done in education research? And if so, what should be NSF's role?

Yes, there is more work to be done in education research. The frontier of knowledge in Science and Engineering continues to project from the arc of the future, and that projection foretells rapid Science and Engineering change, brought on by global competition and competence. Our challenge is twofold. Ultimately, we must help lead in developing new science and engineering. Consistent with that challenge, we must work with the public and private sector to attract and retain a workforce capable of meeting that frontier and future. To do so, the Foundation must have a vigorous education research component emanating from EHR that invests in finding the answer to questions about teaching and learning of STEM from Kindergarten through postgraduate studies. The focus should be on what works, how we know it works, how it can work for a broader population, and finally, how we improve upon current strategies.

Is there a role for NSF in funding the operation of education programs?

NSF through EHR is determined to engage in educational research and development programs that arrive at strategies, through incisive, interrogative and rigorous evaluative activities. While we do not have the requisite funding to fully impact large numbers of school districts and universities, we do invest in long-term targeted investment of successful programs over five, ten and fifteen year cycles. The purpose of these long-term investments is not to operate education programs, but to fully test models of educational engagement over time with differing audiences. In many cases the longitudinal nature of our investment allows us to scale-up some projects and test them in multiple sites. That strategy helps to make manifest documental strategies that can then be utilized in school districts, universities and other venues with confidence. It is hoped that efforts that bring about increases in students' competence can more completely be tested in collaboration with the Department of Education and other agencies within the framework of local school districts, partnerships and alliances, especially with university science and engineering faculty and students.

Throughout the year we have increased the coordination with the Department of Education. The Tiger Team, a major component in our collaborative efforts with the Department of Education, is now back in operation and meetings will be held on a more regular basis when a permanent member for the Department of Education is identified. The Director, NSF, is a statutory member of the National Board for Education Sciences of the Department of Education. As you may also be aware, Dr. Thompson, the acting Assistant Director of EHR, co-chairs the National Science and Technology Council Sub-Committee on Education and Workforce with his counterpart at the Department of Education. In that capacity he meets with his Department of Education counterpart on a monthly basis to plan the strategies for improving education and workforce strategies across more than ten federal agencies.

A number of NSF Division Directors and more than fifteen program officers from EHR serve on Department of Education committees or planning groups. In addition, we have proposal/panel review teams comprised of members from both agencies who review both solicitations and submitted proposals, thus solidifying connections with the Department of education programs across strategic lines.

Rest assured, Mr. Chairman, that under my leadership, the Foundation will continue to invest its resources to improve the teaching and learning of science, technology, engineering and mathematics (STEM) at all levels throughout our nation. I, too, appreciate the relationship we have developed and anticipate with great sincerity our future cooperation to tackle the important topics in the national STEM education arena.

Sincerely,

Arden L. Bement, Jr.
Director

National Science Board Members 2005

National
Science

NSB National Science Board

National Science Board

The National Science Board and the National Science Foundation

The National Science Foundation (NSF) was established by Congress through the National Science Foundation Act of 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense." NSF is active in the national and international science and engineering research and education communities through support for over 10,000 new grants funded each year; more than 200,000 students, teachers, and researchers at 2,000 U.S. research organizations; cooperative projects between U.S. scientists and engineers and their foreign colleagues; and NSF's scientific and engineering research infrastructure.

As an independent Federal agency, NSF does not fall under any cabinet department. Rather, NSF's activities are guided by the National Science Board (the Board). Congress established the Board in 1950 and gave it dual responsibilities:

- oversee the activities of, and establish the policies for, NSF; and
- serve as an independent national science policy body to render advice to the President and Congress on policy issues related to science and engineering research and education.

What the National Science Board Does

The Board oversees NSF as it carries out its statutory responsibility to promote the health of the Nation's science and engineering enterprise by funding research in all the basic and applied sciences and engineering. NSF also supports innovative education programs from kindergarten through

graduate school, preparing future generations of scientists and engineers and contributing to a more scientifically literate workforce and society.

In its role as policy making and oversight body for the NSF, the Board develops a long-term vision for NSF, establishes NSF policies, and identifies issues that are critical to NSF's mission. Additionally, the Board approves NSF's strategic budget directions, annual budget submissions to the Office of Management and Budget, major new programs, and large major awards. The Board analyzes NSF's budget to ensure progress and consistency along the strategic direction it sets for NSF and to ensure balance between new initiatives and core programs.

In its role as policy advisor to the President and Congress, the Board initiates and conducts studies on a broad range of policy topics related to science and engineering research and education, presents the results and Board recommendations in reports and policy statements to the President and Congress, and makes these documents available to the research and educational communities and the general public. On a biennial basis, the Board publishes *Science and Engineering Indicators*, a detailed examination of the state of science and engineering in the United States.

Through its major policy studies, the Board makes important contributions to the national policy debate on critical issues in science and engineering. Examples of recent reports include *Environmental Science and Engineering for the 21st Century – The Role of the National Science Foundation* (2000), *Toward a More Effective Role for the U.S. Government in International Science and Engineering* (2001), *Federal Research Resources: A*

Process for Setting Priorities (2001), *Science and Engineering Infrastructure for the 21st Century: The Role of the National Science Foundation* (2003), *The Science and Engineering Workforce/Realizing America's Potential* (2003), and *Broadening Participation in Science and Engineering Faculty* (2004).

The Board is also responsible for several annual national honorary awards. The Board presents the Vannevar Bush Award to a person who has made outstanding contributions to the national welfare through public accomplishments in science and technology. The Board's Public Service Award is presented to a person and to a group in recognition of their contributions toward increasing public understanding of science or engineering. The Board also approves the Alan T. Waterman Award, which the NSF Director presents to an outstanding young researcher for support of further research and study.

Members of the National Science Board

The Board is composed of 24 part-time members appointed by the President and confirmed by the Senate. The NSF Director, who is also a presidential appointee confirmed by the Senate, serves on the Board *ex officio*. The members are selected on the basis of their distinguished service in science and engineering research and education. Board members are chosen to be representative of scientific and engineering research and education leadership throughout the Nation.

Members are appointed for 6-year terms. One-third of the Board is appointed every 2 years, and no member may serve more than two consecutive terms. The Board Chair and Vice Chair are elected from the membership to serve 2-year terms.

How the National Science Board Works

The Board takes action during regularly scheduled meetings, usually six times a year. In accordance with the Government in the Sunshine Act, meetings of the Board, its committees, subcommittees, and task forces are open to the public, and announcements of forthcoming meetings appear on the Board's Web page and in the *Federal Register*.

Also in accordance with the Government in the Sunshine Act, discussions of certain topics, such as personnel matters, budget development, NSF awards and agreements, and Board honorary awards, take place in sessions closed to the public. The outcomes of these discussions are usually reported in open sessions, as appropriate.

The Board accomplishes much of its background work through standing and *ad hoc* committees, subcommittees, task forces, and commissions that are established as needed for specific assignments.

The Executive Committee is the only Board committee established by legislation. By statute, the NSF Director chairs the committee, and four other members are elected from the Board. By custom, the Board's Chair and Vice Chair are elected as members of the Executive Committee. The committee acts for the Board, if necessary, between Board meetings and in the absence of a Board quorum.

The Board's four standing committees are Audit and Oversight, Education and Human Resources, Programs and Plans, and Strategy and Budget. There are two standing subcommittees: the Subcommittee on Science and En-

gineering Indicators under the Education and Human Resources Committee, and the Subcommittee on Polar Issues under the Committee on Programs and Plans. *Ad hoc* administrative committees oversee the processes related to honorary awards and nominations for appointment to the Board. Other *ad hoc* committees and task forces analyze major policy issues to bring before the Board, with recommendations for action.

The Board's Executive Officer, who reports directly to the Board Chair, serves as Director of the National Science Board Office (NSBO). The NSBO is the focal point for coordinating the development and analyses of a broad range of policy-level issues and strategies requiring Board attention and/or action. The NSBO also provides staff support and administers Board operations.

The National Science Board Web Site

Information about the Board and its work is available from the Board's Web site. This Web site includes information on upcoming and recent events, agenda and minutes of recent Board meetings, committee charges and membership, Board reports and testimony, information on the Board's honorary awards, biographies of current Board members, and a list of former Board members and their affiliations, as well as other items of interest.

Web site address: http://www.nsf.gov/nsb

Contact information for the National Science Board

Telephone, general information:	703-292-7000
Text Telephones for the Deaf (TTY):	703-292-5090
Federal Information Relay Service (FIRS):	800-877-8339
Fax:	703-292-9008
Mailing address:	National Science Board 4201 Wilson Boulevard Room 1225 Arlington, VA 22230 USA

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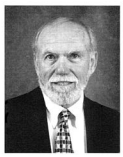

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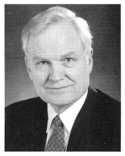
Maxine and Ronald Linde
Professor of Physics and
Director, LIGO Laboratory
California Institute of Technology
Pasadena, California



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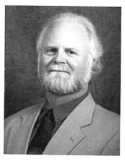
Dr. Arden L. Bement**
(NSB Member *Ex Officio*)
Director
National Science Foundation
Arlington, Virginia

* * * * * *



Dr. Michael P. Crosby
Executive Officer
National Science Board
-and-
Director,
National Science Board Office
Arlington, Virginia

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Chester I. Barnard†	1951-1955
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Thomas B. Day	1988-1990
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E. R. Piore†	1968-1970
Ralph W. Tyler†	1966-1968
Philip Handler†	1964-1966
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Edwin B. Fred†	1950-1953

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Warren Weaver†
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Charles E. Wilson*†
Patrick H. Yancey, S. J.*†
Richard N. Zare
James H. Zumberge†

* Charter Member
‡ Deceased

NSB 05-22

20% Post-Consumer Waste

March 2005