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OFFICE OF
INSPECTOR GENERAL

October 14, 2005

MEMORANDUM

To: Dr. Warren Washington
Chair, National Science Board

Dr. Arden Bement
Director, National Science Foundation

From: Tim Cross for Dr. Christine C. Boesz
Inspector General, National Science Foundation

Subject: Management Challenges for NSF in FY 2006

In accordance with the Reports Consolidation Act of 2000, I am submitting our annual statement summarizing what the Office of Inspector General (OIG) considers to be the most serious management and performance challenges facing the National Science Foundation (NSF). We have compiled this list based on our audit and investigative work, general knowledge of the agency's operations, and the evaluative reports of others, such as GAO and NSF's various advisory committees, contractors, and staff.

This year's management challenges are organized under seven broad issue areas: award administration; human capital; budget, cost and performance integration; information technology; procurement; U.S. Antarctic Program; and merit review. Ten challenges remain from last year's list, most of which reflect areas of fundamental program risk that are likely to require management's attention for years to come. We are pleased to note that NSF has made significant progress this past year on several longstanding challenges.

Five new management challenges appear this year: project reporting, contract monitoring, environmental liabilities in the Antarctic, unfunded proposals, and promoting integrity. One challenge pertaining to the management of the Math and Science Partnership has been removed from this year's list, as the agency has successfully managed the program through its critical early stages and has implemented recommendations OIG made in its July 2004 audit report.

If you have any questions or need additional information, please call me at 703-292-7100.

Award Administration

Post-award administration policies. During the past year, NSF has made progress toward strengthening its post-award monitoring of grantee institutions, but has not yet established an effective program for monitoring high-risk institutions. The agency has improved its documentation procedures, and expanded its monitoring program to cover low and medium risk grantees, in addition to those that are considered high-risk. It has also developed standard operating guidance for monitoring all grants and cooperative agreements, and two components of advanced post-award monitoring: the Award Monitoring and Business Assistance Program (AMBAP) which guides the reviews of awardees with high-risk grants; and Total Business System Reviews (TBSR) that apply to Federally Funded Research and Development Centers (FFRDCs) and large facilities.

However, NSF's program does not ensure that all high-risk institutions are adequately monitored. Although NSF identified 167 institutions that are high-risk, it conducted only 25 site visits during the past year. While some of the remaining 142 institutions are in the last year of their NSF award period and may not warrant a site visit, most will receive additional awards, and a number of them have recently had audits that identify grant management problems. The agency has not specified how or whether it intends to monitor high-risk institutions that are not visited. NSF has performed 60 evaluations of high-risk awards under AMBAP over the past two years, and plans to conduct TSBRs of each of NSF's four FFRDCs over a 4-year cycle. Since both types of advanced post-award monitoring rely on on-site evaluations for which the availability of travel funds has been problematic in the past, the effectiveness of the new policies is still being assessed.

Management of large infrastructure projects. NSF's management of large science infrastructure projects has been listed as a management challenge since two OIG audits conducted several years ago found weaknesses in their financial management.[1] In response to audit recommendations to enhance organizational accountability, provide better financial guidance, and capture more information about project costs, NSF established a Large Facility Projects Office (LFPO) and hired a Deputy Director to coordinate its activities. Last December, OIG assessed the progress made by LFPO in developing and implementing its project management guidelines and central cost-tracking system.[2] We found that progress toward issuing the guidance and providing oversight of current large facility projects has been slow, constrained by workload and staffing issues. The assessment found that LFPO had only two permanent staff.

These findings were similar to those that appeared in separate reviews by two other groups. A report by the National Academies last year concluded that the LFPO "needs adequate and experienced project construction and management staff, access to qualified consultants and contractors, and the institutional authority to oversee the design engineering, construction, and operation phases adequately."[3] In May 2005, NSF's

[1] Audit of the Financial Management of the Gemini Project, December 15, 2000, OIG 01-2001
Audit of Funding for Major Research Equipment and Facilities, May 1, 2002, OIG 02-2007
[2] Survey of Large Facility Projects Management and Oversight Division, December 29, 2004, OIG 05-6002
[3] Setting Priorities for Large Research Projects Supported by the National Science Foundation, p.31.

Advisory Committee for Business and Operations (AC/B&O) reviewed NSF's progress and said: "the implementation of adequate project management methods for MREFC projects during the Development Stage seriously lags the National Academies Report recommendations as well as NSF policy guidance."[4] The Committee also criticized NSF's "under-investment" in engineering, cost-estimating, and project management support during the development stage when baseline project definitions are being formulated. The agency has stated that testing of the cost-tracking system will be completed during the first quarter of FY 2006.

Cost-sharing. While federal guidelines require that cost-shared expenses be accounted for in a manner consistent with federal expenditures, our audit work has revealed that in practice many awardees do not adequately document or substantiate the value of cost-shared expenditures, raising questions about whether required contributions are actually being made. Concerned that NSF's policy allowing cost-sharing gave an unfair advantage to wealthier institutions in competing for awards, the National Science Board voted in October 2004 to eliminate program-specific, cost-sharing requirements and maintain only the statutory cost-sharing of one percent. As a result, the amount of new cost-sharing commitments declined in FY 2005 and this trend is likely to continue.

However, remaining commitments entered into before the new policy was implemented still represent a significant amount, and recent investigations and audit reports indicate that cost-sharing problems have not declined despite NSF's efforts to provide greater oversight in its risk assessment protocol and site reviews. Cost-sharing was an issue in two recent high-profile investigations of institutions. Also, in our March 2005 Semiannual Report to Congress, we reported on audits of awards that included approximately $14 million in promised cost-sharing. Shortfalls of $6.8 million were reported for these awards. Since the awards were contingent on the contributions of the awardees, and the new policy was not implemented retroactively, NSF should continue to be vigilant in ensuring that awardees live up to their commitments. To treat these awards otherwise would require NSF to finance a significant additional cost, and/or risk not completing or reducing the original scope of the research project.

Promoting integrity. The research community is again debating whether integrity in research is eroding as science enters the 21st century. A recent survey[5] found that one-third of NIH-supported researchers surveyed acknowledge engaging in activities that are best described as questionable research practices. The authors concluded that the "range of questionable practices . . . are striking in their breadth and prevalence." We have observed the types of practices these scientists admitted to during our investigations and concluded they are not unique to NIH-supported researchers. They can reasonably be expected to be practiced by scientists supported by other federal agencies. Separate from the more serious behaviors defined as research misconduct (falsification, fabrication, and plagiarism) these questionable practices damage the integrity of science and erode the

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[4] Letter dated May 25, 2005 to Anthony Arnolie and Thomas Cooley from the Committee for Business and Operations.

[5] Martinson, B.C.; Anderson, M.S. and R. de Vries; Scientists behaving badly; *Nature:* Vol. 435 pp. 737-738, 9 June 2005.

trust one scientist places in another, which can in turn undermine the reliance NSF's merit review system places in the quality of the proposals it receives.

HHS, through its Office of Research Integrity, has embarked on an effort to require institutions to instruct HHS-supported personnel (students, faculty, support staff) in key elements of its Responsible Conduct of Research program to formalize and standardize training and create baseline expectations and rules for integrity throughout the enterprise. Similarly, we discuss these elements in our outreach to the research and education community as part of our mission to prevent and detect fraud and abuse. However, unlike, HHS, NSF has no parallel, standardized effort to reinforce its expectations for high scholarship and integrity throughout its proposal and award systems.

From our perspective, the opportunities to commit research misconduct and the pressures to do so are certainly increasing. The survey authors found "significant associations between scientific misbehavior and perceptions of inequities in the resource distribution processes in science." Such perceptions have significant potential for harm to the research enterprise, and thus present a management challenge to NSF to seek new opportunities and means to ensure integrity within the research community and within the pipeline of students NSF is charged with educating.

Human Capital

Workforce planning. Strategic workforce planning refers to a process of determining the appropriate number of employees and competencies needed to carry out the agency's strategic goals. NSF's growing workload has kept workforce planning a formidable management challenge. In FY 2004, the number of proposals NSF received increased to 43,851, up 49 percent since FY 2000. However during this time period the number of program officers, who determine which proposals are funded, actually *declined* from 396 to 385. As a result, the average number of proposals each program officer handles per year has increased from 74 to 113, during a time when proposals are becoming more complex and reflect a more multidisciplinary orientation.

In 2002, NSF contracted for a multi-year, multi-million dollar *Business Analysis*, to review NSF's management of human capital, business processes, and use of technology. An important part of the project was the development of a Human Capital Management Plan to enable NSF to make informed and timely decisions about the type, number and required competencies of NSF positions. During the past year, the human capital project managers have focused on streamlining and refining the agency's core competencies and redesigning administrative jobs. Although the *Business Analysis* was scheduled for completion at the end of FY 2005, the agency was not able to fully fund it during some years and has extended the completion date.

Three years into the *Business Analysis* project NSF has still not achieved its goal of establishing a strategic workforce planning process. This past year, the agency decided to pursue workforce planning on a separate track from the *Business Analysis* with the assistance of another contractor. NSF is hopeful that it can implement the new process

during the next year. However, in the short term, workforce plans will continue to be based on the best estimates of NSF's senior managers, as it has in past years. As indicated by the growing disparity between the science and engineering workforce and the proposal workload, the need for informed and effective workforce planning grows increasingly urgent.

NSF's non-permanent workforce. NSF's workforce includes a significant number of non-permanent or visiting personnel on loan from their home institutions or agencies. In FY 2004, 50 percent of NSF's program officers were non-permanent employees commonly referred to as *rotators*. The rotators make a valuable contribution to NSF by providing the directorates current knowledge of their disciplines and a different perspective formed by their recent experiences as researchers. They enable NSF to achieve its goal of investing in the best science.

However, the employment of rotators poses an administrative challenge that requires careful planning and management. More frequent recruiting, hiring, and training are required for their support and replenishment. In addition, rotating staff serving in more senior levels lack needed institutional knowledge and are less likely to make long-term planning a priority. It is important that the agency recognize the areas in which rotators need additional management support and provide it. Also, in July 2004, OIG conducted an audit of the costs associated with visiting personnel and made three recommendations for resolving issues related to their employment and compensation. While NSF concurred with each recommendation, corrective actions are not yet complete.

Administrative infrastructure. The size and effectiveness of NSF's workforce are limited in some ways by the agency's administrative infrastructure. Internal control reviews performed by the agency in response to the Federal Managers' Financial Integrity Act (FMFIA) continue to indicate that key administrative needs of agency managers are not being met. This year many of the comments made by managers cite a lack of adequate support in the area of human resource management. As it takes longer for hiring actions to be processed, there is a growing perception within the agency that the personnel area is not adequately staffed to provide needed support. Many managers also reported problems in using *e-recruit* and *Quick Hire*, two systems that are intended to simplify and streamline the hiring process.

As in the past, many of the managers' internal control certifications emphasized a particular need for more office space and travel funds. One Assistant Director stated "space remains a critical issue, impeding recruitment of high quality staff and limiting the ability to store sensitive documents." Another said that resources to "support travel to monitor on-site performance remain inadequate in an environment that places increasing emphasis on program impact, project yield, and the monitoring of fraud, waste and abuse." These shortages impede the ability of staff to do its job.

Budget, Cost, and Performance Integration

GPRA reporting. For an agency engaged in funding basic research, implementing the Government Performance and Results Act (GPRA) is intrinsically challenging because the knowledge acquired through its funding may not lead to practical application for many years, if at all. In 1999, the National Academies Committee on Science, Engineering, and Public Policy indicated in a report that federal research programs could best be evaluated by a process of expert review that uses three criteria: quality, relevance, and leadership.[6] NSF has long consulted with external experts through its independent advisory committees and committee of visitors programs that periodically evaluate each part of the organization on its performance against operational and strategic goals. More recently it has integrated these practices with GPRA and Program Assessment Rating Tool, a method of program evaluation developed by the Office of Management and Budget (OMB). The agency is to be commended for the effort it has invested in continually improving its GPRA program, one that is in many respects a model for the federal community.

The Advisory Committee on GPRA, which assesses NSF's performance on its strategic objectives, found that the agency demonstrated significant accomplishment on 15 of its 16 strategic goals related to People, Ideas, and Tools. It worked with the Advisory Committee for Business and Operations to evaluate NSF's remaining strategic goals related to Organizational Excellence and decided that the agency had significantly accomplished these strategic goals as well. However the committee suggested NSF could improve its GPRA reporting process if it did a better job of demonstrating the relevance of its accomplishments to its outcome goals. It stated, "In the absence of more contextual information, we are often left wondering how strong the linkage is between the accomplishments and the outcome goals."[7] NSF should respond to this recommendation by better demonstrating the relevance of its accomplishments to its objectives.

Cost information. NSF does not track the cost of its internal business processes or utilize to best advantage measures to assess the efficiency and cost-effectiveness of these business processes. The agency has worked with OMB during the past two years to enable its cost accounting system to track the cost of its strategic goals as well as its 10 investment categories that are subject to OMB evaluation. This information is important in evaluating program results. However the agency does not know how much it costs to perform a routine activity such as reviewing a proposal or administering a grant. Such basic information is equally important in managing NSF's operations.

As NSF staff struggle to keep up with a growing workload, the issue for the agency is not whether it is working hard, but whether it is working efficiently. Information about the cost-effectiveness and efficiency of its workforce and work processes is critical to finding solutions. As an example, the agency employs several different methods of merit review,

[6] Evaluating Federal Research Programs: Research and the Government Performance and Results Act
[7] Report of the Advisory Committee for GPRA Performance Assessment, July 25, 2005; p.57

which may vary in terms of cost and effectiveness. A cost/benefit analysis of each method could provide valuable information about how best to handle the work.

Improving the efficiency of government agencies has been an important priority of present and past administrations. NSF states that its historic overhead rate of 5-6 percent indicates that it is operating efficiently, and that it is more important for managers to focus on results than costs to ensure quality. We believe that both costs and results are important and that management should reconsider its use of measures for efficiency and cost effectiveness as a means to set funding priorities and maximize its limited resources.

Project reporting. A recent OIG audit uncovered weaknesses in NSF's collection of project reports, which captures information on the progress and results of awards. Project reports not only provide NSF with important scientific information, but also enhance accountability for federal funds by serving as a permanent record of what was purchased with taxpayers' money. Auditors found that over a five-year period approximately 47 percent of the 151,000 final and annual reports required by the terms and conditions of NSF's awards and cooperative agreements were submitted late or not at all. Of 43,000 *final* project reports, 8 percent were never submitted and 53 percent were submitted an average of 5 months late. Moreover, although NSF has a policy of not making new awards to Principal Investigators (PIs) who have not submitted final project reports, there were 74 instances (13%) in which delinquent PIs inappropriately received new funding. NSF agreed with the report's recommendations and is taking corrective action.

Information Technology

Information security. A strong and effective information security program is crucial to the success of virtually all of NSF's activities and operations. As GAO recently stated: "Federal agencies rely extensively on computerized information systems and electronic data to carry out their missions. The security of these systems and data is essential to prevent data tampering, disruptions in critical operations, fraud, and inappropriate disclosure of sensitive information."[8] As we have reported over the past several years, NSF has made good progress in strengthening its information security program.

However, the constantly changing nature of security risks and threats makes IT security an ongoing challenge. An effective IT security program should above all be adaptable to the changing environment. Recognizing the pervasive nature of information security problems within federal agencies, Congress passed the Federal Information Security Management Act (FISMA) in 2002. FISMA requires agencies to develop, document, and implement an agency-wide information security program to provide security for the information and information systems that support the operations and assets of the agency, including those provided or managed by another agency, contractor, or other source.

FISMA requires inspectors general to conduct annual evaluations of their agency's information security program. In our 2005 FISMA Independent Evaluation Report, we noted that NSF has continued to strengthen its security program but needed to make

[8] GAO Report 05-552

improvements in the areas of personnel background investigations, the U.S. Antarctic Program information security program, access controls, security plans, risk assessments, disaster recovery testing, change controls, and incident response procedures. An ever changing information security environment requires all federal agencies to maintain a strong, effective, and vigilant security program.

Procurement

Contract monitoring. NSF's FY 2004 financial statement audit identified a reportable condition[9] that the agency does not adequately review public vouchers submitted by contractors who receive advance payments. Without a proper review, over $150 million of NSF's annual contract expenditures may be subject to error or impropriety. NSF limits its review of vouchers to a comparison of the reported quarterly expenditures with the cumulative advance request amount and does not assess the validity, propriety, or accuracy of the actual incurred cost. Neither the contracting officer nor their technical representative reviews the voucher documents. Federal law requires that responsible officials review the public vouchers for accuracy and propriety, and to ensure that the reported costs are for authorized purposes under the contract.

A recent audit of Raytheon Polar Services Company (RPSC) that questioned $33.4 million in claimed expenditures underscores the large sums of money that are subject to advance payment and therefore at risk of misuse. Of the amount questioned, $21 million was charged as direct costs when it should have been recovered through RPSC's indirect cost rate, a violation of Cost Accounting Standards and RPSC's disclosed federal accounting practices. RPSC also claimed $6.7 million that exceeded limitations specified in the contract. If NSF had adopted a policy requiring a more active review of vouchers, it is possible that the erroneous payments would have been caught at a much earlier point. The large amount of questioned costs resulting from this audit indicates that more scrutiny of advance payments and more internal control reviews are warranted. NSF is evaluating its options for resolving the questioned costs.

United States Antarctic Program

Long term planning. An audit of the USAP's Occupational Health & Safety and Medical Programs performed in 2003 identified a need for long-term planning to assure that necessary capital assets are replenished on a regular basis and not pressed into service past their useful lives. The audit report cited examples of an aging infrastructure at McMurdo Station, which could pose unnecessary risks to the health and safety of program participants and recommended a separate line item in the budget dedicated to funding a capital asset management plan. In its response to the report, NSF said that its current practices were adequate and expressed concern that a dedicated fund would restrict financial flexibility needed to respond to the needs of researchers.

[9] A reportable condition is defined as a significant deficiency in internal controls that could adversely affect the agency's ability to report financial data.

However, a recent Committee of Visitors (COV) Report charged with evaluating the Polar Research Support Section also cited the need for improved long-term planning. The report said that scientists who are aware of the existing logistical limitations in Antarctica rarely submit proposals requesting support that is difficult to provide. The result is that cutting edge science projects may well be limited by logistics capabilities. It recommends that the agency consider developing a long-term planning process that would involve scientists so that the agency could learn about the new ideas and consider attendant logistical challenges at the cutting edge of Antarctic science before they reach the proposal stage. The report also calls upon the agency to improve its projections of the actual costs of doing field and lab science in Antarctica to assure that novel but expensive science can be successfully planned for. The agency has responded positively to both COV recommendations.

Accounting for environmental liabilities. NSF's accounting practices may not be consistent with the intent of applicable accounting standards for the recognition and reporting of environmental liabilities in the Antarctic because of the unique status of the treaty that governs NSF's activities there. The *Antarctic Treaty and the Antarctic Science, Tourism and Conservation Act of 1996* governs NSF's roles and activities in the Antarctic and states that NSF is responsible for the review, oversight, and remediation of environment incidents. Although NSF's General Counsel has argued that the agency does not have a *legal* liability related to environmental clean-up costs in Antarctica, the auditors suggest that the language of the treaty places the ultimate responsibility with NSF and recommended that NSF's responsibility for recording such liabilities should be reviewed by the Federal Accounting Standards Advisory Board (FASAB) to ensure that they are correctly reported. Depending on how FASAB decides the issue, NSF's environmental liability obligations may be understated in its financial statements.

Merit Review

Broadening participation. The Foundation is committed to broadening the participation of women and minorities in all NSF programs and activities. Increasing the number of applicants, awardees and reviewers from underrepresented groups that participate in the merit review process is a key objective, and is carefully monitored by the agency. Underrepresented groups made progress in FY 2004 in several respects. While the total number of awards made by NSF decreased, the number of awards made to women and minorities each increased. The number of proposals received from women and minorities also increased by 15 and 19 percent respectively compared to 9 percent among the overall population. Although, the success rates for the underrepresented groups both decreased, the declines were generally proportional to the overall population.

NSF has also continued to work to improve the number of merit reviewers who self-report demographic information. This year 17 percent of reviewers volunteered information, up from 9 percent in FY 2002. Thirty-five percent of those who responded indicated that they were part of an underrepresented group. Reviewer diversity ensures that the merit review process benefits from a wide variety of perspectives in arriving at its

decisions, while raising awareness among those who participate about the grant-making process.

In this year's report on broadening participation in the sciences and engineering, the Committee on Equal Opportunities in Science and Engineering (CEOSE) noted the increase in grant applications among underrepresented groups since FY 2000, and cited three possible causes: 1) NSF's embedded diversity policy of 1999 which made diversity a part of each research and education directorate; 2) a FY 2000 policy change requiring all proposals to address societal impacts and; 3) the implementation of outreach activities aimed at increasing awareness among women and minorities of NSF's programs.[10] CEOSE also observed that "evaluation of NSF programs with respect to broadening participation is uneven" and recommended that NSF expand its systematic and objective evaluation efforts by continuing to obtain, refine and disaggregate data and factors related to persons from underrepresented groups in STEM education and careers.[11]

Unfunded proposals. The rate at which NSF funds proposals (i.e., success rate) has declined significantly from 33 percent four years ago to 24 percent in FY 2004, the lowest in 15 years. Among proposals that undergo the competitive merit-review process[12] the funding rate is just 21.6 percent. During the past year, the rate of decline accelerated, as some key research directorates such as Computer and Information Science and Engineering were able to fund just 16 percent of the proposals they receive. Of particular concern is the increasing number of quality proposals for which there are no funds. The amount of money represented by these proposals that were rated as high as the average NSF award, increased by 46 percent in just one year from $1.44 billion requested to $2.1 billion in FY 2004.

As the agency notes, the decline of the success rate is a concern because declined proposals represent a rich portfolio of unfunded research and education opportunities. An unfavorable success rate may also discourage innovation and risk-taking among researchers who believe more risky projects are less likely to be funded. In addition, there is a significant economic cost to both NSF and the community in generating, processing and reviewing each research proposal. On average NSF conducts six reviews per proposal, a voluntary investment of time by scientists that is estimated to be in the tens of millions of dollars. Scientists must divert time from their research, training and education activities and spend more time on proposal development.[13] Ironically, the success rate has been adversely affected by NSF's efforts to increase grant size and duration, a policy initiated to reduce the amount of time scientists spend on writing proposals.

[10] Broadening Participation in America's Science and Engineering Workforce, CEOSE 04-01, p. 32
[11] Ibid. p.101
[12] 1,457 proposals were not externally reviewed, including those for SGER awards and grants for travel and symposia. Approximately 1,236 awards were made from this group.
[13] According to the *National Science Foundation Report on Efficiency of Grant Size and Duration,* the average grant proposal requires 157 hours to prepare.

NSF is considering a number of ways of improving the success rate, including 1) reducing the number of proposals submitted by making requests for proposals more focused and technically specific, and 2) implementing a two-tiered proposal submission process that includes pre-proposals. NSF may also want to reconsider its rationale for increasing grant size and duration.