Chapter 3

Appendices (Other Information)

SUMMARY OF FY 2022 FINANCIAL STATEMENT AUDIT AND MANAGEMENT ASSURANCES

Table 3.1 – Summary of Financial Statement Audit

Effectiveness of Internal Control over Financial Reporting (FMFIA § 2)					
Audit Opinion	*Unmodified*				
Restatement	*No*				
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Ending Balance
Total Material Weaknesses	*0*	-	-	-	*0*

Table 3.2 – Summary of Management Assurances

Effectiveness of Internal Control over Financial Reporting (FMFIA § 2)						
Statement of Assurance	*Unmodified*					
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
Total Material Weaknesses	*0*	-	-	-	-	*0*
Effectiveness of Internal Control over Operations (FMFIA § 2)						
Statement of Assurance	*Unmodified*					
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
Total Material Weaknesses	*0*	-	-	-	-	*0*
Conformance with Federal Financial Management System Requirements (FMFIA § 4)						
Statement of Assurance	*Systems conform to financial management system requirements*					
Non-Conformances	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
Total non-conformances	*0*	-	-	-	-	*0*
Compliance with Section 803(a) of the Federal Financial Management Improvement Act (FFMIA)						
	Agency	Auditor				
Federal Financial Management System Requirements	*No lack of compliance noted*					
Applicable Federal Accounting Standards	*No lack of compliance noted*					
USSGL at Transaction Level	*No lack of compliance noted*					

Management Challenges for the National Science Foundation in Fiscal Year 2023

AT A GLANCE

Management Challenges for the National Science Foundation
in Fiscal Year 2023
October 14, 2022

WHY WE DID THIS REPORT

The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of the National Science Foundation's "most serious management and performance challenges facing the agency … and the agency's progress in addressing those challenges."

WHAT WE FOUND

Each year, we identify NSF's most serious challenges based on our audit and investigative work, knowledge of NSF's operations, independent sources such as U.S. Government Accountability Office reports and NSF's advisory committees, and discussions with NSF senior staff and contractors. This year, we identified eight areas representing the most serious management and performance challenges facing NSF:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

We are encouraged by NSF's progress in its efforts to address critical management and performance challenges. Effective responses to these challenges will promote the integrity of NSF-funded projects, help ensure research funds are spent effectively and efficiently, and help maintain the highest level of accountability over taxpayer dollars.

AGENCY RESPONSE TO *MANAGEMENT CHALLENGES FOR FISCAL YEAR 2022*

Following the issuance of this report, NSF will include its Management Challenges Progress Report and its response to *Management Challenges for the National Science Foundation in Fiscal Year 2022* in its Agency Financial Report.

FOR FURTHER INFORMATION, CONTACT US AT OIGPUBLICAFFAIRS@NSF.GOV.

National Science Foundation • Office of Inspector General
2415 Eisenhower Avenue, Alexandria, Virginia 22314

MEMORANDUM

DATE: October 14, 2022

TO: Dr. Dan Reed
Chair
National Science Board

Dr. Sethuraman Panchanathan
Director
National Science Foundation

FROM: Allison C. Lerner Allison C. Lerner
Inspector General
National Science Foundation

SUBJECT: Management Challenges for the National Science Foundation in Fiscal Year 2022

Attached for your information is our report*, Management Challenges for the National Science Foundation in Fiscal Year 2023*. The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of the "most serious management and performance challenges facing the agency … and the agency's progress in addressing those challenges." A summary of the report will be included in the National Science Foundation Agency Financial Report.

We appreciate the courtesies and assistance NSF staff provided during the completion of this report.

If you have questions, please contact me at 703.292.7100.

Attachment

Table of Contents

Introduction

The National Science Foundation is an independent federal agency that supports fundamental research and education in all the non-medical fields of science and engineering. With a budget of approximately $8.8 billion (FY 2022), NSF funds about 25 percent of all federally supported basic research at the Nation's colleges and universities, and supports about 200,000 scientists, engineers, educators, and students each year. NSF's goals include advancing the frontiers of knowledge, cultivating a broadly inclusive science and engineering workforce, expanding the scientific literacy of all citizens, building the nation's research capability through investments in advanced instrumentation and facilities, and supporting excellence in science and engineering research and education.

The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of NSF's "most serious management and performance challenges … and the agency's progress in addressing those challenges." Each year, we identify these challenges based on our audit and investigative work, knowledge of the Foundation's operations, independent sources such as U.S. Government Accountability Office reports and NSF's advisory committees, and discussions with NSF senior staff and contractors. We identify management challenges as those that meet at least one of the following criteria:

- The issue involves an operation that is critical to an NSF core mission.[1]
- The issue presents a risk of fraud, waste, or abuse to NSF or other government assets.
- The issue involves strategic alliances with other agencies, the Office of Management and Budget, the Administration, Congress, or the public.
- The issue is related to key initiatives of the President.

It is important to note that identifying an issue as a "management challenge" does not necessarily mean NSF is having difficulty addressing it; instead, it means we identify the issue as one of the top challenges facing NSF and report on NSF's progress in addressing it, as required by the Act.

This year, we have identified eight areas representing the most serious management and performance challenges facing NSF:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

This year, we are introducing one new challenge area, Addressing Harassment in the Academic Community. We added this challenge because recent reports and legislation indicate harassment is pervasive in institutions of higher education and a deterrent to participation in science, technology, engineering, and mathematics (STEM) fields.

[1] The *National Science Foundation Act of 1950* (Pub. L. No. 81-507) sets forth the mission: "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."

In addition, we renamed two prior challenge areas to better reflect the challenges they describe: "Overseeing NSF-Funded Research Infrastructure" expands the prior challenge "Overseeing Major Multi-User Research Facilities" to include overseeing mid-scale research infrastructure. "Mitigating Threats to Research Security" expands upon the challenge titled "Mitigating Threats Posed by Foreign Government Talent Recruitment Programs" in prior years.

Finally, we did not include last year's challenge "Managing Transformational Change" in this year's report; instead, we have included information about NSF's progress in managing transformational change in the other challenge areas.

NSF has continued to demonstrate its ability to achieve its mission in an ever-changing environment. As the agency moves into FY 2023 and beyond, it is well positioned to address both familiar and new challenges it may face with acuity, agility, and adaptability.

This computer cluster provides the main hardware resource for the Apt, an NSF-funded precursor to CloudLab, located at University of Utah's Downtown Data Center. *Credit: Chris Coleman, School of Computing, University of Utah*

Increasing Diversity in Science & Engineering Education and Employment

Increasing diversity in science and engineering education and employment continues to be a high-priority goal of NSF, the National Science Board (NSB), the Executive Branch of the federal government, and Congress. In *Vision 2030*, the NSB emphasized the need to develop more diverse STEM talent to remain competitive globally. In the *FY 2022-2026 NSF Strategic Plan*, NSF listed as its top goal the empowerment of STEM talent to fully participate in science and engineering. In addition, Congress authorized initiatives in the *CHIPS and Science Act of 2022* (CHIPS Act, Pub. L. No. 117-167) to promote diversity, equity, inclusion, and accessibility (DEIA) in STEM, and the Administration has issued multiple Executive Orders[2] to enhance DEIA government wide.

NSF has taken steps to increase participation in STEM among populations that have been under-resourced and under-served. For example, NSF:

- Expanded its Broadening Participation in STEM portfolio, including the NSF Eddie Bernice Johnson INCLUDES program;
- Responded to the NSB's February 2021 resolutions to broaden participation[3] by offering training videos on unconscious bias and other topics to merit review panelists, and by piloting the inclusion of Broader Impacts experts in Committees of Visitors; and
- Requested $247 million in its FY 2023 Budget Request — a 23.5 percent increase over the actual funding in FY 2021 — for its Established Program to Stimulate Competitive Research (EPSCoR) program, which seeks to enhance research competitiveness in jurisdictions (U.S. states, territories, and the Commonwealth of Puerto Rico) that have historically received a small share of NSF grant dollars by strengthening STEM capability and capacity.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission.
- Increasing diversity in science and engineering education and employment continues to be a high-priority goal of NSF, the NSB, and the federal government.
- NSF requested 23.5 percent more funding in FY 2023 for EPSCoR, a program that seeks to enhance research competitiveness in jurisdictions that have historically received a small share of NSF grant dollars by strengthening STEM capability and capacity.
- NSF is addressing known barriers in growing research capacity for emerging research institutions.

NSF convened a Racial Equity Task Force to examine the potential for racial barriers and recommend how NSF can address such barriers both internally, for the NSF workforce, and externally, for program delivery. In addition, NSF prepared a DEIA strategic plan in response to Executive Order 14035 to improve DEIA internally.

As NSF recognizes, "It is more important now than ever that we measure and evaluate our outcomes and analyze and distill this evidence to … create a clear data-driven picture of what's working …."[4] In evaluating outcomes, it will need to determine the baseline goals and metrics to assess progress[5] and obtain relevant, reliable data. In FY 2023, we will monitor NSF's progress in measuring and evaluating the

[2] Relevant Executive Orders include 13985, 13988, 14020, and 14035.
[3] NSB-2021-10, NSB-2021-11
[4] *Enhancing Mission Success through Evidence: Perspectives from NSF Leaders*, April 25, 2021
[5] NSB Meeting, May 19, 2021, Vision 2023, Implementation

A research project at the University of Nebraska-Lincoln, supported by an NSF EPSCoR award, focuses on ensuring global food security by improving crop resilience. *Credit: University Communication / University of Nebraska-Lincoln*

outcomes of its policies and programs to increase diversity in the NSF workforce, as well as for program delivery, in areas such as merit review.

Key Completed Actions

- Issued FY 2022-2026 Strategic Plan with Strategic Goal 1, "to promote inclusion in the research community and STEM workforce, access to STEM learning and training and widespread STEM literacy."
- Issued FY 2022-2026 Learning Agenda and FY 2023 Annual Evaluation Plan to measure progress in achieving the FY 2022-2026 Strategic Plan Goal 1.
- Staff-convened Racial Equity Task Force released report with recommendations to increase racial equity internally and externally.
- Issued NSF's Diversity, Equity, Inclusion and Accessibility Strategic Plan 2022-2024.
- Expanded NSF Eddie Bernice Johnson INCLUDES program and its other broadening participation portfolios.

Key Ongoing Actions

- Implementing NSF's Diversity, Equity, Inclusion and Accessibility Strategic Plan, 2022-2024.
- Addressing recommendations from staff-led Racial Equity Task Force's report.
- Addressing known barriers in growing research capacity for emerging research institutions.
- Fostering geographic diversity with the NSF Engines and expanded EPSCoR programs.
- Piloting and assessing initiatives to provide merit review panelists with a video on broader impacts and unconscious bias, and including broader impacts experts in Committees of Visitors.

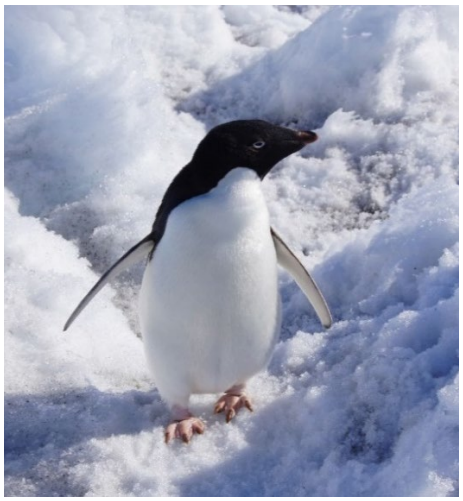
Overseeing the United States Antarctic Program (USAP)

NSF, through the United States Antarctic Program (USAP), manages U.S. scientific research in Antarctica. Leidos Innovations Corporation holds the Antarctic Support Contract for USAP logistical support. It is NSF's largest and most visible contract, valued at $2.3 billion over 13 years. Through this and other contracting vehicles, NSF is also starting a long-range infrastructure investment program across the program, including the three U.S. Antarctic stations (McMurdo, Palmer, and South Pole). The Office of Polar Programs (OPP) monitors performance of the contract, with several other NSF offices collaborating to manage the USAP more broadly.

The COVID-19 global pandemic added unprecedented complexity and uncertainty to USAP operations and construction projects, which were already hampered by Antarctica's remote location, extreme environment, and the short period each year during which the continent is accessible. For example, deployments in the 2020–2021 and 2021–2022 seasons were limited to only those necessary for health and safety or to preserve long-term data sets. In addition, construction at McMurdo under the Antarctic Infrastructure Modernization for Science (AIMS) project and the Information Technology and Communications primary addition was put on hold. NSF plans to resume construction in October 2022, and it has worked to re-baseline the Information Technology and Communications primary addition and the first two components of AIMS, as well as to implement a new approach that will use NSF's Antarctic Infrastructure Recapitalization program to address needed long-term infrastructure improvements, including consideration of the unfunded components of AIMS.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- The Antarctic Support Contract is NSF's largest and most visible contract, valued at $2.3 billion over 13 years.
- Due to COVID-19, construction at McMurdo under the AIMS project and the Information Technology and Communications primary addition was put on hold.
- Recent information security audit findings have identified challenges.
- NSF commissioned a sexual assault and sexual harassment risk assessment in the USAP environment.



Additionally, recent information security audit findings[6] have identified challenges in USAP's implementation of authentication and incident response requirements. These findings, first identified in FY 2019, demonstrate the extended time needed to fully enact security measures for the USAP network consistent with those of NSF. OPP is working with various NSF offices to identify and enact the right approach for personnel screening and to issue contract modifications and procure solutions as necessary. For example, OPP has modified its process to follow federal requirements for vetting and credentialing contractors that require elevated access to USAP systems and data.

Adelie penguin just out of the ocean.
Credit: Elaine Hood, NSF

[6] FISMA *Audit of NSF's Information Security Program for FY 2020*, November 20, 2020

In addition, OPP is working to address audit recommendations related to incident detection and monitoring, as well as implementation of Personal Identity Verification (PIV) for USAP contractors. OPP has also added technical resources to support its monitoring program and worked with the contractor to develop a Cybersecurity Roadmap. However, due to the challenges of operating in this remote environment and the time necessary to implement changes to USAP contracts, USAP remains at an increased risk of negative impacts to personnel, systems, and data.

Finally, the recently issued assessment[7] of the risk for sexual assault and sexual harassment in the USAP environment further demonstrates the wide-ranging challenges facing NSF as it continues to manage the USAP.

Key Completed Actions

- Accepted new AIMS baseline; unfunded components to be evaluated along with other infrastructure priorities.
- Established a Project Execution Plan to implement PIV for non-privileged access to USAP applications.
- Cleared the backlog of NSF personnel security adjudications for contractors in elevated risk positions.
- Identified a critical need to 1) improve communication, 2) increase engagement, 3) enhance education and training, 4) strengthen reporting infrastructure and accountability, 5) provide support to victims, and 6) probe more deeply into policies and mechanisms aimed at prevention of sexual assault/harassment.

Key Ongoing Actions

- Monitoring AIMS via the NSF Office of the Director's Watch List.
- Implementing the risk-based Cybersecurity Road Map to address audit findings.
- Implementing a new process for NSF adjudication of all Antarctic support contractors.
- Distributing PIV cards to employees with privileged access to USAP systems and employees who do not require privileged access.
- Implementing enforcement of PIV credentials for USAP locations outside the U.S.
- Hosting a series of listening sessions to get community feedback on sexual assault/harassment prevention and reporting.
- Identifying ways to provide additional support to victims of sexual assault/harassment.
- Establishing a Sexual Assault/Harassment Prevention and Response Support Office to (i) provide necessary resources including on-the-ground personnel in Antarctica, (ii) support deployed personnel on matters relating to sexual assault and harassment, and (iii) remove barriers, as well as provide an independent line of reporting for victims of sexual assault/harassment matters in the USAP.

[7] Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022

Overseeing Grants in a Changing Environment

Making grants to support promising scientific research is a key element of NSF's mission. Among other things, the CHIPS Act officially authorized the Directorate for Technology, Innovation and Partnerships (TIP); requires significant expansion of programs aimed at increasing the diversity of participation in STEM; and authorizes NSF's budget to more than double within 5 years from $8.8 billion to nearly $19 billion.

TIP, the agency's first new directorate in more than three decades, will strive to accelerate the pace of innovation and translation in emerging technologies, address the societal and economic challenges facing the nation, and engage diverse talents nationwide. TIP also seeks to ensure the nation remains at the forefront of competitiveness by establishing partnerships across a broad array of stakeholders: other federal agencies; state, local, and tribal governments; academics; the private sector; nonprofits; civil society; and investors. By FY 2024, TIP's budget is authorized at $3.35 billion, which accounts for more than 21 percent of NSF's total authorization.

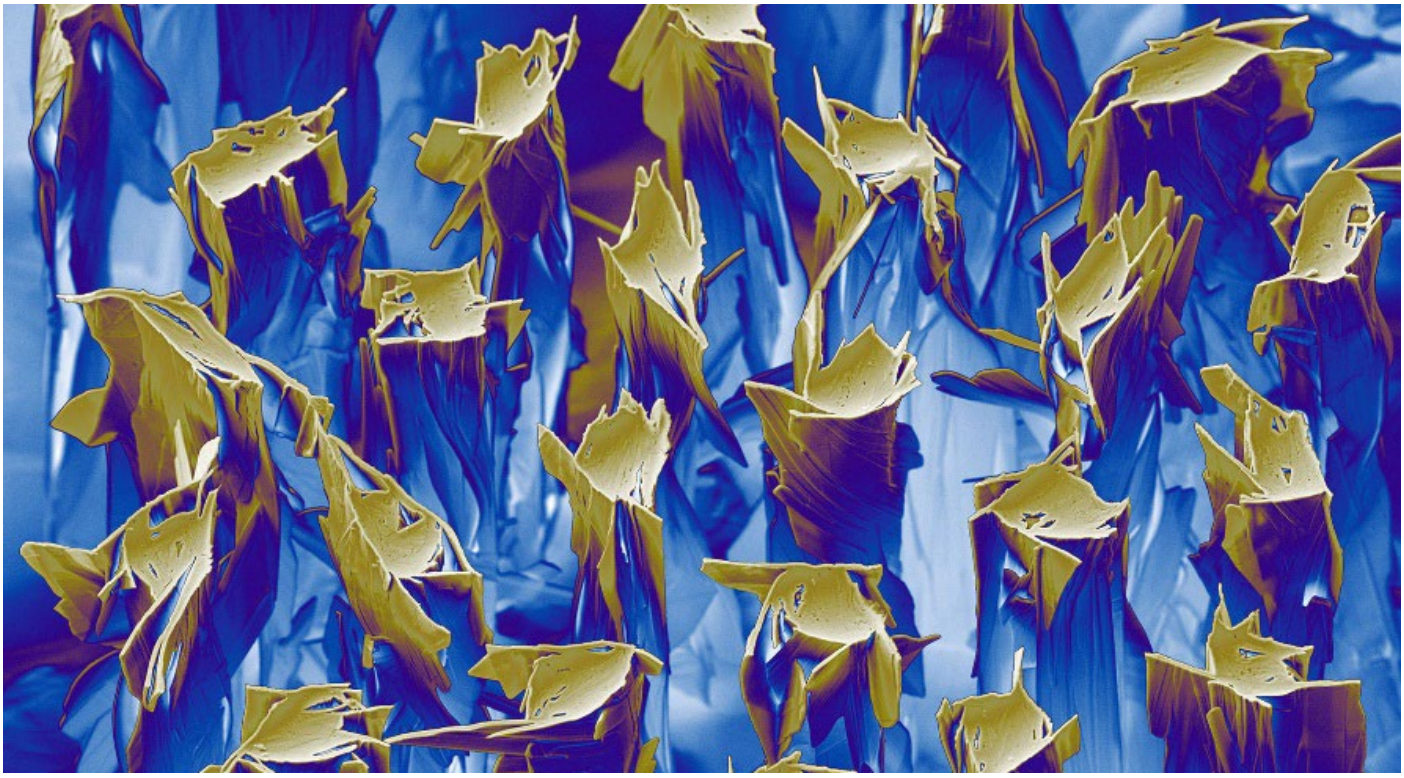
KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- The CHIPS Act authorized the Technology, Innovation, and Partnerships Directorate, requires significant expansion of programs aimed at increasing diversity in STEM, and authorizes NSF's budget to more than double within 5 years, to nearly $19 billion.

TIP represents a transformational change to NSF's traditional mission by expanding its emphasis on applied and use-inspired research and includes the authority for NSF to use new funding methods. A dramatic increase in funding coupled with new award vehicles and a new mission will bring inherent challenges in ensuring proper stewardship and accountability of award funds.

The CHIPS Act also creates new requirements related to the long-time NSF priority of increasing diversity in the STEM workforce and expanding both the institutional and geographic diversity of federal award recipients. As previously discussed, NSF's EPSCoR is directed to grow — from about 12 percent in FY 2021 to 15.5 percent of NSF's budget in FY 2023 and to up to 20 percent by FY 2029. The Act also directs NSF to establish a program to build research capacity at institutions outside the top 100 recipients of federal research funding over the prior 3 years and for NSF to expand its investment in improving STEM instruction in rural schools. In addition, it requires NSF to further the overall goal of increasing diversity in the STEM workforce. Finally, the CHIPS Act also builds upon the research security requirements established by *National Security Presidential Memorandum 33* (NSPM-33) and creates additional obligations for NSF and its award recipients.

The Act established funding targets over the next 5 years that seek to eventually double NSF's budget. However, future appropriated funds might not match authorized amounts, creating fiscal uncertainty and challenges in meeting some of the Act's goals. NSF must continue to adapt to effectively manage this complex and changing environment over the next several years.



Macrosocopic look at superconducting wire Bi-2212. *Credit: Peter J. Lee*

Key Completed Actions

- Assembled the Project Reporting Improvement Team to implement actions to improve compliance on the timely submission of grant project reports across the agency.
- Implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs.
- Continued emphasis on its enterprise risk management process to enhance monitoring and oversight of award recipients.
- Completed triennial Payment Integrity Information Act risk assessment.

Key Ongoing Actions

- Assessing new and ongoing requirements of the CHIPS Act.
- Monitoring portfolio composition and potential increases of small and mid-size award recipients.
- Refining enterprise risk profiles around the NSF grants portfolio to account for future environment changes.
- Executing annual advanced monitoring site visits and desk reviews.
- Conducting annual baseline payments testing.

Managing the Intergovernmental Personnel Act Program

As part of its workforce strategy, NSF provides scientists, engineers, and educators the opportunity to temporarily serve as NSF program directors, advisors, and senior leaders. Most non-permanent staff members are individuals assigned under the *Intergovernmental Personnel Act* (5 U.S.C. §§ 3371 – 3376), who are not federal employees but are funded through grants and remain employees of their home institutions. These individuals — referred to as IPAs or rotators — bring in fresh perspectives from all fields of science and engineering to support NSF's mission. As we have previously reported, IPAs may have a higher risk of conflicts of interest while working at NSF because most come from institutions receiving NSF awards.[8] In addition, IPAs can spend up to 50 days each year on Independent Research/Development, and their salaries are not subject to federal pay and benefits limits.[9]

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- IPAs or rotators are non-federal employees who temporarily serve as NSF staff.
- IPAs bring in fresh perspectives but may have a higher risk of conflicts of interest because most come from institutions receiving NSF-funded awards.
- Our ongoing audit work has found challenges with the IPA vetting and hiring process. In response, NSF established a working group to improve the vetting of IPAs.

Our ongoing audit work shows that challenges remain with IPA program oversight. Increased coordination across the varying offices involved in the vetting and hiring process would further reduce the risks inherent to the IPA program and strengthen the control environment. This includes reducing the risk of hiring individuals who are ineligible to serve as IPAs, verifying IPA salary and employment history before appointment, and promptly adjudicating suitability and fitness determinations. In response to our audits, NSF has established an IPA Candidate Vetting Working Group to make recommendations to the NSF Chief Operating Officer regarding the approach to vetting candidates for IPA positions at NSF. It has also made changes intended to improve the process for vetting IPA candidates for Assistant Director positions.

We previously reported on NSF's pilot and implementation of its cost share policy, effective January 31, 2020, requiring that institutions provide at least 10 percent cost share for every full-time IPA agreement. NSF reported that in FY 2020, 90 percent of all IPA assignments had a cost share. NSF continues to seek ways to improve its management of the IPA program and monitor the costs of and participation in the Independent Research/Development program. NSF also continues to evaluate the cost and effectiveness of the IPA program, such as through its Evaluation and Assessment Capability Section's June 2022 report.[10]

[8] OIG Report No. 17-2-008, NSF Controls to Mitigate IPA Conflicts of Interest, June 8, 2017
[9] Management Challenges for the National Science Foundation in Fiscal Year 2018, October 12, 2017
[10] Freyman, Christina. 2022. Rotator Study. Alexandria, VA: National Science Foundation.

NSF headquarters in Alexandria, VA. *Credit: Maria B. Barnes/NSF*

Key Completed Actions

- Established IPA Candidate Vetting Working Group.
- Made changes to improve the process for vetting IPA candidates for Assistant Director positions.
- Migrated Program Director and Executive IPAs to the USA Performance system for managing performance plans.
- Submitted the IPA Program Annual Report covering the prior fiscal year to NSF Director.

Key Ongoing Actions

- Addressing potential national and economic security threats, conflicts of interest, and improving the overall vetting process through the IPA Candidate Vetting Working Group.
- Continuing to develop and monitor internal controls related to the Independent Research/Development Program, including clear communication about program participation and policies.
- Applying enterprise risk management concepts to the IPA Steering Committee's risk environment to monitor metrics related to participation, demographic characteristics, annual costs, and cost share value.

Overseeing NSF-Funded Research Infrastructure

As part of its mission, NSF funds the development, design, construction, operation, and disposition[11] of research infrastructure; see Figure 1. Such awards include major multi-user research facilities (major facilities), like telescopes and ships, which cost more than $100 million to construct or acquire, and mid-scale research infrastructure (mid-scale) projects, including equipment and upgrades to major facilities, which cost between $4 and $100 million.

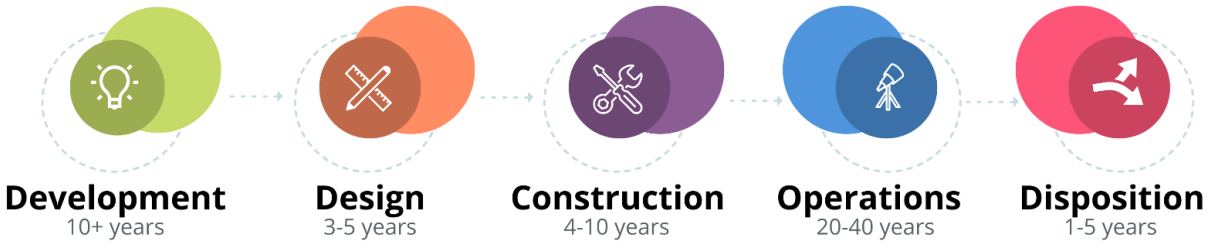
Major facilities and mid-scale projects are inherently risky because the infrastructure is one-of-a-kind and technically complex, and construction and operating costs are high. In FY 2021, NSF spent more than $160 million constructing and $967 million operating major facilities, and more than $180 million on mid-scale projects.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- Major facilities and mid-scale projects are risky because of their uniqueness, complexity, and high costs.
- With a decade of corrective actions implemented, NSF's major facilities program is a model program.
- NSF is applying some of its major facility controls to its mid-scale projects.

As we reported in *Management Challenges for the National Science Foundation in FY 2022*, NSF has cemented its major facilities program as a model program, implementing corrective actions over the past decade. NSF's centralized investment in mid-scale projects is newer, however, with the first awards issued in FY 2019. NSF's Office of Budget, Finance, and Award Management is developing the capacity needed to oversee these awards, and it is drawing upon its experience in the management of major facility projects to develop the appropriate approaches for mid-scale projects. NSF is taking a more flexible approach in applying some of the major facility controls to its mid-scale projects as deemed appropriate. We will continue to review management requirements in mid-scale solicitations, controls for mid-scale projects, and training and experience of NSF staff responsible for making and overseeing mid-scale awards.

Figure 1. Major Facilities Life Cycle



Source: NSF OIG-depiction of NSF-provided data

[11] NSF previously referred to the disposition stage as "divestment."

Key Completed Actions

- Finished the Major Facilities Oversight Reviews standard operating guidance.
- Produced reports to track COVID-19 impacts on facilities' construction and operations.
- Implemented standard operating guidance on oversight and monitoring of property in the custody of recipients.
- Completed the major facilities portfolio workforce gap analysis.

Key Ongoing Actions

- Continuing to develop and implement the Program Management Improvement Accountability Act Course Curriculum Tool.
- Continuing to evaluate title to property (federally owned versus recipient-titled) and develop property transition plans, as necessary.
- Developing policies and processes to improve the planning and management of facility dispositions.

Star trails take shape around the 14-story Mayall Telescope dome at Kitt Peak National Observatory, a program of NSF's National Optical-Infrared Astronomy Research Laboratory (NOIRLab), in this long-exposure image.
Credit: NRAO/AUI/NSF, Jeff Hellerman (Creative Commons Attribution 3.0 Unported -- CC BY 3.0)

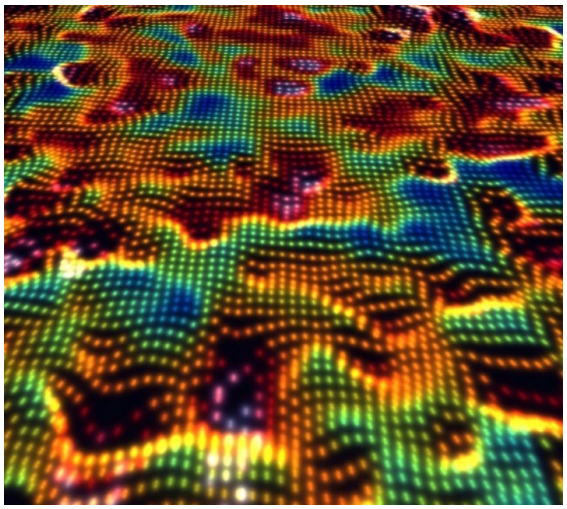
Mitigating Threats to Research Security

Safeguarding the U.S. research enterprise from threats of inappropriate foreign influence continues to be of critical importance. While significant challenges remain, U.S. funding agencies and academia have made progress in combating undue foreign influence, while maintaining an open research environment that fosters collaboration, transparency, and the free exchange of ideas.

NSF, and other agencies that fund research, continue to face challenges from foreign talent recruitment programs. According to the Office of Science and Technology Policy, a foreign government-sponsored talent program is an effort directly or indirectly organized, managed, or funded by a foreign government to recruit science and technology professionals in targeted fields. Nondisclosure of relationships with any such program adversely affects NSF decision-making on proposals. Although some of these programs are legitimate, many encourage or direct unethical and criminal behaviors, including the deliberate nondisclosure of the recruit's foreign position and associated foreign scientific funding. Contracts for participation in some programs include language that creates conflicts of commitment and/or conflicts of interest for researchers, such as requirements to attribute U.S.-funded work to a foreign institution; recruit or train other talent recruitment program members; circumvent merit-based processes; and replicate or transfer U.S.-funded work to another country.

KEY FACTS

- The issue presents a risk of fraud, waste, and abuse of NSF or other government assets.
- Federal agencies and academia have made progress in combating undue foreign influence on the U.S. research enterprise.
- NSF has worked to mitigate these threats, such as by developing guidelines for strengthening research security and created an Office of Research Security Strategy and Policy.
- NSF also has expanded research security training and educated the research community.



Electrons in a semiconductor distribute on surface in fractal patterns. *Credit: Roushan/Yazdani Research Group*

Over the past 4 years, NSF has taken meaningful action to mitigate threats posed by these programs. It strengthened disclosure requirements and processes is working to develop guidelines to strengthen research security. NSF has also provided compliance recommendations to U.S. academic institutions to ensure accurate disclosures to U.S. funding agencies. Further, it created an Office of Research Security Strategy and Policy, which has taken a leading role in the efforts of the federal government to combat this threat. It has expanded research security training and educated the research community. NSF should continue to assess and refine its controls in this area and ensure that it has sufficient staff and resources to address this challenge.

Key Completed Actions

- Created a Chief of Research Security Strategy and Policy (CRSSP) position in 2020, which was codified in the CHIPS Act.
- Created Chief Data Officer position.
- Launched the Research Security Strategy and Policy Group. Developed and implemented research security data analytics capability that captures nondisclosure of foreign affiliations, sources of funding, and collaborations that present conflicts of commitment or capacity.
- Communicated express prohibition of Foreign Talent Plan membership for all NSF staff, including rotators.
- Developed and implemented mandatory research security training for staff and rotators in direct communication with recipient organizations and principal investigators.
- Educated the research community about risks and compliance with NSF's policies and procedures.
- Strengthened disclosure requirements and processes, including implementing two new vehicles for submitting post-award information.
- Revised term and condition for foreign collaboration considerations in major facilities.
- Developed and implemented a new award term and condition for previously undisclosed information.
- Served as steward of the development of harmonized disclosure requirements for proposers and grantees that have been adopted by the U.S. government interagency community.
- Increased collaboration with NSF OIG, the Federal Bureau of Investigations, and other relevant stakeholders.

Key Ongoing Actions

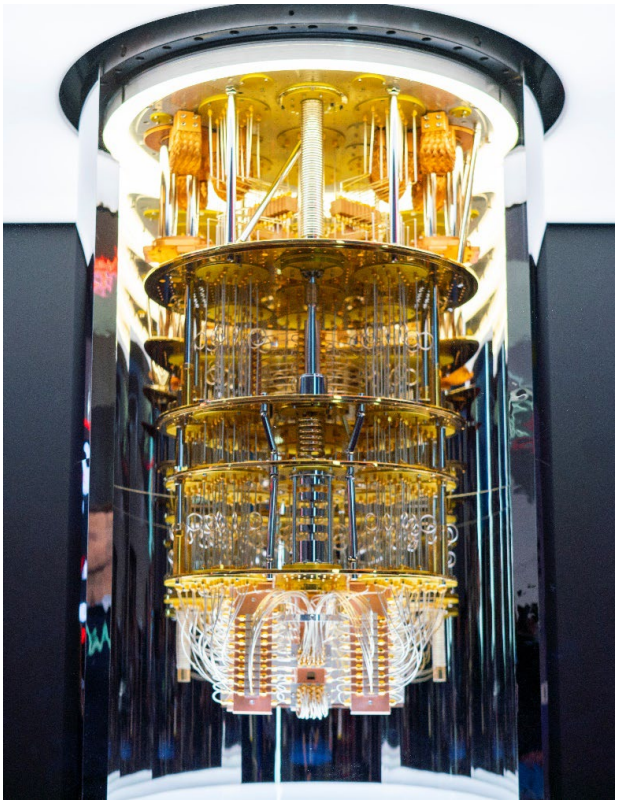
- Overseeing operations of the Research Security Strategy and Policy Group.
- Capturing nondisclosure of foreign affiliations, sources of funding, and collaborations that present conflicts of commitment or capacity.
- Continuing to conduct and monitor mandatory research security training for staff and rotators in direct communication with recipient organizations and principal investigators.
- Continuing education of the research community about risks presented by foreign talent recruitment programs and the importance of compliance with NSF policies and procedures.
- Continuing stewardship of harmonized disclosure requirements for proposers and grantees that have been adopted by the U.S. government interagency community.
- Maintaining collaborative relationships with NSF OIG, the Federal Bureau of Investigations, and other relevant stakeholders.
- Developing guidelines for strengthening research security.

Mitigating Threats Posed by the Risk of Cyberattacks

Federal agencies need information technology (IT) systems and electronic data to carry out operations and to process, maintain, and report essential information. The security of these systems and data is vital to public confidence and national security, prosperity, and well-being. NSF continues to make progress on improving the security of its data and systems and implementing a zero-trust architecture (ZTA) in response to EO 14028.[12] However, new cybersecurity risks remain on the horizon. For example, recent developments in quantum computing have created threats to long-trusted public key cryptography. Decryption that used to take traditional supercomputers more than 2 days can now be accomplished by quantum computers in about 3 minutes. With the large-scale increase in NSF's resources and staffing authorized by the CHIPS Act, as well as more personal devices connecting to the NSF network due to the post-pandemic shift to hybrid workspaces, NSF will need increasingly effective measures to ensure the availability, integrity, and confidentiality of data.

KEY FACTS

- This challenge is related to key initiatives of the President.
- The security of IT systems and data is vital to national security.
- NSF continues to make progress on improving IT security and implementing a zero-trust architecture, but new cybersecurity risks remain.
- Growing use of personal devices that connect to the NSF network may increase security risks.



Researchers programmed an IBM quantum computer to become a type of material called an exciton condensate. *Credit: Photo by Andrew Lindemann/IBM*

The U.S. Department of Homeland Security has provided guidance[13] to agencies to begin preparing for a transition to post-quantum cryptography. NSF could further prepare for this transition by identifying critical data and cryptographic technologies, identifying which public key cryptography is quantum vulnerable, and prioritizing systems for replacement based on mission requirements.

Our FISMA[14] audits have found that NSF has an effective information security program under current standards. NSF, however, could enhance its cybersecurity by implementing a Security Information and Event Management solution for its USAP network; implementing the use of PIV cards by USAP contractors; implementing security controls related to untrusted removable media devices; implementing a

[12] *Improving the Nation's Cybersecurity*, May 12, 2021
[13] *Policy Directive 140-15*, September 17, 2021
[14] *Federal Information System Modernization Act of 2014*, Pub. L. No. 113-283

formal monitoring program for the USAP employee screening process; and fully automating the annual recertification process for its service accounts.

Also, as NSF increases staffing in response to the CHIPS Act and continues to develop its post-pandemic hybrid approach to workspaces, it should assess its Virtual Private Network (VPN) and Virtual Desktop Infrastructure (VDI) capabilities to determine if changes or enhancements are needed to improve the availability, integrity, and confidentiality of NSF data.

Key Completed Actions

- Identified critical software.
- Implemented Login.gov as a multi-factor authentication option for external customers using Research.gov.
- Developed counterfeit detection awareness training for employees and contractors responsible for hardware and software acquisitions.
- Ensured USAP contractors who need privileged access to the USAP network are fully vetted.

Key Ongoing Actions

- Implementing a password review tool and updating the password policy.
- Identifying and analyzing potential vendors that can provide additional controls to prevent downloading, storing, and transferring sensitive data, including Personally Identifiable Information, to removable storage devices.
- Vetting and credentialing USAP contractors who need non-privileged access to the USAP network.
- Enforcing PIV use in all USAP locations.

Addressing Harassment in the Academic Community

Recently issued legislation and reports identify harassment in science as a pervasive issue, affecting participation in STEM. The CHIPS Act requires NSF to:

> expand research efforts to better understand the factors contributing to, and consequences of, sex-based and sexual harassment affecting individuals in the STEM workforce, including students and trainees; and to examine approaches to reduce the incidence and negative consequences of such harassment. The goal of this and other requirements is to combat harassment in science.[15]

The legislation includes findings from a National Academies of Sciences, Engineering, and Medicine 2018 report titled *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*, which concluded that "sexual harassment is pervasive in institutions of higher education."

Additionally, as previously discussed, NSF received a report it commissioned, titled *Sexual Assault/Harassment Prevention and Response*, in June 2022, which detailed a needs assessment and recommended an implementation plan to address sexual harassment and sexual assault in the USAP. The report highlights a concern that providing effective oversight of awardee compliance may be particularly difficult for NSF in Antarctica and its associated research vessels and field sites due to lack of trust and reporting mechanisms.

KEY FACTS

- This issue involves an operation that is critical to an NSF core mission.
- The issue is related to key initiatives of the President.
- Recent reports and legislation indicate harassment is pervasive in institutions of higher education and a deterrent to participation in STEM.
- NSF commissioned a report highlighting concerns about providing effective oversight of awardee compliance in the USAP due to lack of trust and reporting mechanisms.
- NSF has taken additional action, such as implementing an award term and condition about reporting harassment or sexual assault; developing a USAP Code of Conduct; and setting expectations that research organizations establish and maintain clear and unambiguous standards of behavior.

NSF has stated it expects all research organizations to establish and maintain clear and unambiguous standards of behavior to ensure harassment-free workplaces wherever science is conducted.

NSF has taken additional action to address harassment by issuing statements to the academic community that harassment will not be tolerated and by implementing an award term and condition, effective October 22, 2018, requiring award recipients to notify the agency of any findings/determinations of sexual harassment, other forms of harassment, or sexual assault by an NSF funded Principal Investigator or co-Principal Investigator.[16] Additionally, NSF has developed a USAP Code of Conduct, and its current *Proposal & Awards Policies &Procedures Guide* states that NSF expects all research organizations to establish and maintain clear and unambiguous standards of behavior to ensure harassment-free workplaces.

[15] Subtitle D, SEC. 10534, (a)
[16] This term and condition is being evaluated by the Evaluation and Assessment Capability Section, as stated in Focus Area #1 of the NSF Equity Action Plan, "Efforts to Address Sexual and Other Forms of Harassment."

Sunset on the Weddell Sea in Antarctica. *Credit: Photo by Mia Wege*

It is imperative that NSF continue working to address harassment in the academic community and undertake prevention and response efforts. As previously discussed, this will also help ensure NSF meets its strategic goal to empower STEM talent to fully participate in science and engineering.[17]

Key Completed Actions

- Implemented terms and conditions requiring institutions report to NSF findings of harassment or assault by an NSF funded principal investigator or co-principal investigator.
- Reaffirmed/reinforced NSF's stance on sexual harassment in the awardee community.
- Developed USAP Code of Conduct.
- Updated Proposal & Awards Policies & Procedures Guide.

Key Ongoing Actions

- Reviewing policies and procedures to identify areas for improvement.
- Identifying next steps based on the developed implementation plan.
- Evaluating terms and conditions as part of its Focus Area #1 of the NSF Equity Action Plan.

[17] NSF Strategic Plan for Fiscal Years (FY) 2022-2026

Additional Resources

Introduction/Multiple Challenges

- NSF, FY 2023 Budget Request to Congress, May 2022
- NSF, Draft FY 2022 Progress Report on OIG Management Challenges, Undated
- NSF OIG, Management Challenges for the National Science Foundation in FY 2022, October 12, 2021
- NSF, FY 2021 Agency Financial Report, November 2021

Increasing Diversity in Science & Engineering Education and Employment

- NSF, Diversity, Equity, Inclusion, and Accessibility (DEIA) Strategic Plan 2022-2024
- NSF, NSF Strategic Plan for Fiscal Years (FY) 2022-2026, March 28, 2022
- NSF, National Science Foundation Learning Agenda FY 2022-FY 2026, March 2022
- NSF, National Science Foundation Annual Evaluation Plan, FY 2023, March 2022
- NSB-2020-15, Vision 2030, May 2020

Overseeing the United States Antarctic Program (USAP)

- NSF OD-22-18, Establishment of a Director's Task Force for Implementation of Measures to Combat Sexual Assault and Harassment in the United States Antarctic Program (USAP), October 3, 2022
- NSF Director Statement on USAP SAHPR Report and Follow-on Actions, undated
- NSF Action Plan (in response to SAHPR report), September 27, 2022
- Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022
- NSF OIG Report No. 22-6-004, NSF Vetting of United States Antarctic Program Contractors, March 18, 2022
- NSF OIG Report No. 22-2-003, Performance Audit of NSF's Information Security Program for FY 2021, November 17, 2021

Overseeing Grants in a Changing Environment

- Pub. L. No. 117-167, HR 4346 – CHIPS and Science Act of 2022, August 9, 2022

Managing the Intergovernmental Personnel Act Program

- OIG Report No. 17-2-008, NSF Controls to Mitigate IPA Conflicts of Interest, June 8, 2017
- NSF OIG, Management Challenges for the National Science Foundation in Fiscal Year 2018, Oct. 12, 2017
- Freyman, Christina. 2022. Rotator Study. Alexandria, VA: National Science Foundation.

Overseeing NSF-Funded Research Infrastructure

- NSF OIG Report No. 22-2-006, Audit of NSF's Divestment of Major Facilities, Sept. 2, 2022
- NSF 21-107, Research Infrastructure Guide, December 2021
- NSF OIG Report No. 20-2-007, Audit of NSF's Monitoring of Government-Owned Equipment Purchased on NSF Awards, August 26, 2020

Mitigating Threats to Research Security

- U.S. Government Accountability Office (GAO), Protecting Federal Research from Foreign Influence, January 2021
- GAO-21-130, Federal Research: Agencies Need to Enhance Policies to Address Foreign Influence, December 2020
- The White House Office of Science and Technology Policy, Enhancing the Security and Integrity of America's Research Enterprise, June 2020

Mitigating Threats Posed by the Risk of Cyberattacks

- Pub. L. No. 117-167, HR 4346 – CHIPS and Science Act of 2022, August 9, 2022
- The White House, National Security Memorandum on Promoting United States Leadership in Quantum Computing While Mitigating Risks to Vulnerable Cryptographic Systems, May 4, 2022
- Thomas Corbett and Peter W. Singer, China May Have Just Taken the Lead in the Quantum Computing Race, April 14, 2022
- 22-2-003, Performance Audit of NSF's Information Security Program for FY 2021, Nov. 17, 2021
- Department of Homeland Security Policy Directive 140-15, Preparing for Post-Quantum Cryptography, September 17, 2021
- The White House, Executive Order on Improving the Nation's Cybersecurity, May 12, 2021

Addressing Harassment in the Academic Community

- NSF OD-22-18, Establishment of a Director's Task Force for Implementation of Measures to Combat Sexual Assault and Harassment in the United States Antarctic Program (USAP), October 3, 2022
- NSF Director Statement on USAP SAHPR Report and Follow-on Actions
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- Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022
- NSF, NSF Strategic Plan for Fiscal Years (FY) 2022-2026, March 28, 2022
- NSF OIG Report No. 22-6-004, NSF Vetting of United States Antarctic Program Contractors, March 18, 2022
- NSF 2201, Proposal & Award Policies & Procedures Guide, Effective Oct. 4, 2021
- NSF, National Science Foundation Agency Equity Action Plan
- National Academies of Sciences, Engineering, and Medicine. 2018. Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine. *Washington, DC: The National Academies Press.*
- OOP-POL_6000.01, National Science Foundation Office of Polar Programs Polar Code of Conduct, Effective July 2018

Staff Acknowledgments

Key contributors to this report include Mark Bell (Assistant Inspector General for Audits), Elizabeth Argeris Lewis (Executive Officer and Communications Analyst), Kevin Brown, Heather Gallagher, Javier Inclán, Elizabeth Kearns, Bill Kilgallin, Ken Lish, Melissa Woolson Prunchak, Laura Rainey, Kelly Stefanko, Lisa Vonder Haar, Megan Wallace, Nacole White, Emily Woodruff, and Vashti Young.

About NSF OIG

We promote effectiveness, efficiency, and economy in administering the Foundation's programs; detect and prevent fraud, waste, and abuse within NSF or by individuals who receive NSF funding; and identify and help to resolve cases of research misconduct. NSF OIG was established in 1989, in compliance with the *Inspector General Act of 1978*, as amended. Because the Inspector General reports directly to the National Science Board and Congress, the Office is organizationally independent from the Foundation.

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National Science Foundation
Office of The Director

MEMORANDUM

DATE: October 19, 2022

TO: Ms. Allison Lerner, Inspector General, National Science Foundation

FROM: Dr. Sethuraman Panchanathan, Director, National Science Foundation

SUBJECT: Acknowledgment of the Inspector General's Fiscal Year (FY) 2023 Management Challenges Report and Transmittal of NSF's Progress Report for the FY 2022 Management Challenges

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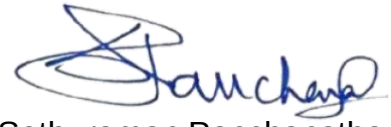
As Director of the National Science Foundation (NSF), I work each day to realize the agency's vision of, "a nation that leads the world in science and engineering research and innovation, to the benefit of all, without barriers to participation." I recognize the importance of assessing and mitigating risks and properly stewarding taxpayer dollars to the success of this work. The statutorily required report on Management Challenges that the Office of Inspector General (OIG) issues annually illustrates both the obstacles NSF faces in achieving its mission and vision, such as threats to research security and cyberattacks, as well as the strong processes the agency has in place to appropriately manage risk. The attached Progress Report for OIG Management Challenges for Fiscal Year (FY) 2022 outlines many of these processes and expresses our continued commitment to address challenges going forward, including in response to the FY 2023 OIG Management Challenges that your office shared October 14, 2022, as follows:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

The COVID-19 pandemic provided a stress-test for NSF's established risk management processes, which proved effective in addressing both ongoing and unforeseen risks. NSF pivoted to performing oversight of awards through virtual site visits and desk reviews, and developed new analytic approaches to identify potential oversight issues. It is through this same adaptability, innovation, and steadfast commitment to stewardship that NSF will effectively oversee new programs and awards resulting from the landmark CHIPS and Science Act of 2022 and the new Directorate for Technology, Innovation and Partnerships.

NSF will maintain its strong performance in oversight and management of awards, the Intergovernmental Personnel Act (IPA) program and research infrastructure, as we redouble our efforts on continued improvement in areas such as increasing diverse representation in science and preventing sexual assault and harassment. Among my highest priorities for NSF are ensuring accessibility and inclusivity, and creating a safe, harassment-free workspace and collegial culture in which research can thrive.

As always, NSF remains committed to serving the research community effectively, to continually improving stewardship across the agency, and to safeguarding Federal funds awarded by NSF in support of the agency's mission. We look forward to continuing to work with your office to achieve those goals.



Sethuraman Panchanathan

Attachments

cc: Chair, National Science Board
Chair, National Science Board, Committee on Oversight
Chief Financial Officer

National Science Foundation (NSF)
FY 2022 Progress Report on OIG Management Challenges

MANAGEMENT CHALLENGE 1: Increasing Diversity in Science and Engineering Education and Employment

NSF Leads: Sylvia Butterfield, Deputy Assistant Director, Directorate for Education & Human Resources[1] and Alicia Knoedler, Office Head, Office of Integrative Activities

Summary of OIG Identified Challenge

NSF's April 2021 *Women, Minorities, and Persons with Disabilities* report[2] stated that women, persons with disabilities, and certain minority groups are underrepresented in the nation's science and engineering education and workforce. The National Science Board (NSB)'s *Vision 2030* report[3], echoed this, noting that for the U.S. to lead globally in science and engineering (S&E), and to remain competitive, by 2030 the number of women in the S&E workforce must nearly double, the number of Black or African Americans must more than double, and the number of Hispanics or Latinos must triple compared to the respective numbers in the 2020 S&E workforce.

To address this challenge, NSF created the Racial Equity Task Force in September 2020 to focus on the missing millions in science, technology, engineering, and mathematics (STEM). In addition, NSF has taken numerous steps to address requirements in multiple Executive Orders on diversity, equity, inclusion, and accessibility (DEIA), including creation of an Equity Team of 14 agency leaders and providing input to a government-wide gender strategy. NSF maintains a comprehensive portfolio of programs to increase diversity in S&E. In doing so, there are opportunities to monitor NSF's efforts to develop strategies and programs to increase diversity in science and engineering education and employment, as well as measure their effectiveness over time. As discussed in OIG's Management Challenge on "Managing Transformational Change," NSF must also continue to provide resources and opportunities to strengthen and advance DEIA across its own employees as it transitions to a hybrid workforce model and grows as an agency.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

In his introduction to the new NSF Strategic Plan, the NSF Director, Dr. Sethuraman Panchanathan, notes: "while NSF has long invested in efforts to broaden participation in STEM, it is more important now than ever to underscore that the inclusion of all people in STEM is vital to the nation's health, security and global

[1] The name Directorate for Education and Human Resources (EHR) was changed to Directorate for STEM Education (EDU) in FY 2023.

[2] Women, Minorities, and Persons with Disabilities in Science and Engineering, available at https://ncses.nsf.gov/pubs/nsf21321/

[3] The NSB *Vision 2030* report outlines efforts to increase support for and impact of investments in fundamental science and engineering and a STEM-educated workforce. The full report can be accessed at https://www.nsf.gov/nsb/NSBActivities/vision-2030.jsp

leadership. We need young inspiring scientists from every background to be part of a STEM community full of diverse perspectives that can drive the research enterprise to new breakthroughs and innovations and help solve our most pressing challenges."[4]

Since its founding[5], NSF has recognized the importance of increasing diversity in science and engineering education and employment. Today, these efforts warrant unprecedented urgency given the national and economic concerns, and the global science and engineering trends outlined in the NSB's *Vision 2030* report, which note that "women and underrepresented minorities remain inadequately represented in science and engineering relative to their proportions in the U.S. population." NSF also recognizes the grand scale of these issues and the pressing need to recognize and embrace the full scope of challenges they bring. This will require the agency to leverage its broad sphere of influence and to act deliberately when developing and deploying all available strategies and programs. As such, NSF will intensify its efforts to ensure all sectors of society have the opportunity to contribute to the scientific enterprise. To underscore this, the new NSF Strategic Plan explicitly incorporates its commitment to ensuring accessibility and inclusivity into the agency's vision statement.[6] The Strategic Plan also establishes a new Agency Priority Goal that seeks to increase proposal submissions from investigators underrepresented in STEM and underserved institutions.[7]

In addition, the first strategic goal in the new plan is: "Empower STEM talent to fully participate in science and engineering," which aligns directly with this management challenge. This strategic goal emphasizes that to accelerate the advancement of discovery and learning and prepare for a world in which work is increasingly reliant upon scientific and technological skills, all citizens must share in the benefits that flow from research, and we must promote inclusion in the research community and STEM workforce, access to STEM learning and training, and widespread STEM literacy.

NSF takes a proactive, strategic management approach to its efforts to address the OIG Management Challenge of Increasing Diversity in Science and Engineering Education and Employment. Top agency leadership is addressing this challenge, dedicating resources to multiply capacity and demonstrate accountability and progress.

Top Leadership Commitment

The NSF Director has articulated and demonstrated a strong commitment to addressing this Management Challenge. He was the architect of the new NSF vision that centers accessibility and inclusivity. In FY 2022 the Director convened an NSF Leadership Retreat on broadening participation in the STEM enterprise. Dr. Panchanathan's actions have ensured that NSF's Leadership Team is coordinating the agency's numerous external activities, internal actions, and programmatic thrusts that exist across the agency. This has led to the formal framing of the "NSF Equity Ecosystem," which encompasses efforts to significantly impact equity and achieve demonstrable outcomes for broadening participation.[8] Through this framework, Dr. Panchanathan has appointed senior leaders responsible for how NSF policies, staff, and programs intersect

[4] NSF's Strategic Plan for FY 2022-2026, *Leading the World in Discovery and Innovation, STEM Talent Development Delivery of Benefits from Research* may be accessed at https://www.nsf.gov/pubs/2022/nsf22068/nsf22068.pdf

[5] Chapter 4 of the NSF blueprint, *Science: The Endless Frontier* (https://nsf.gov/od/lpa/nsf50/vbush1945.htm), identifies "The Renewal of Our Scientific Talent" as a priority for the then-nascent foundation, with a specific focus on removing the barriers that prevent major segments of society from participating in the scientific enterprise.

[6] The NSF Strategic Plan for FY 2022-2026 may be accessed at https://www.nsf.gov/pubs/2022/nsf22068/nsf22068.pdf; the vision and pillars are on page 9.

[7] Information on this Agency Priority Goal is available at: https://www.performance.gov/agencies/NSF/apg/goal-1/

[8] An NSB presentation of NSF top leadership explaining the Equity Ecosystem may be accessed at https://youtu.be/A643zjcFb1o?t=3707

and how the agency leverages shared knowledge, advocacy, and decades of Broadening Participation research[9] and practice.

Capacity

To be successful in supporting all who are underrepresented in STEM, including NSF employees and the broader STEM community, an expansion of champions and leaders is critical and must encompass those who can thrive in complex environments while navigating NSF's goals of supporting the workforce and delivering on the mission. NSF has similarly harmonized its activities at the program level by establishing an agency-wide knowledge sharing group focused on broadening participation that includes over 100 program officers and other officials and enables them to share best practices for broadening participation in STEM. The group's responsibilities include keeping the Broadening Participation website current and increasing internal awareness of upcoming activities and events. Similarly, NSF INCLUDES[10], an initiative to catalyze the STEM enterprise to work collaboratively for inclusive change, has continued to leverage its national network of awardees, other programs in the NSF Broadening Participation portfolio, other federal agencies and private sector institutions across the nation to fortify NSF capacity in this regard.

Demonstrated Progress

By building upon analysis and understanding of root causes and drivers, NSF has established clear performance measures and other mechanisms for strategic monitoring and oversight. For example, the FY 2022-2026 Learning Agenda[11] and associated FY 2023 Annual Evaluation Plan[12] identify relevant assessment and evaluation questions that relate to this challenge, and they provide detailed information about technical approaches for building the evidence needed to monitor progress and determine success. In addition, the NSF INCLUDES Shared Measures platform[13] presents findings and lessons learned from the national effort to broaden participation in STEM. By documenting the achievements and progress of the STEM community, this resource identifies noteworthy best practices and raises the visibility of NSF INCLUDES and other STEM Broadening Participation initiatives. It also documents, at a project level, the use of design elements in collaborative infrastructure and provides an inventory of broadening participation, institutional transformation, and system change indicators.

Managing Transformational Change

While NSF is striving for the types of transformational changes needed to increase diversity in the S&E community more broadly, the agency is also taking steps to improve DEIA among NSF staff and applicants. The NSF Racial Equity Task Force report developed a set of recommendations aimed at improving DEIA among NSF's workforce, and NSF is building upon this work as it responds to Executive Order 14035,

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[9] The Broadening Participation research portfolio consists of funding opportunities across all Directorates, which use different approaches to build STEM education and research capacity, catalyze new areas of STEM research, and develop strategic partnerships and alliances. For more information see: https://beta.nsf.gov/funding/initiatives/broadening-participation

[10] Information on NSF INCLUDES may be accessed https://beta.nsf.gov/funding/opportunities/inclusion-across-nation-communities-learners-underrepresented-discoverers#:~:text=The%20NSF%20INCLUDES%20National%20Network%20is%20composed%20of%3A,of%20society%20to%20build%20an%20inclusive%20STEM%20workforce.

[11] The NSF Learning Agenda for fiscal years 2022-2026 may be accessed at https://www.nsf.gov/od/oia/eac/PDFs/NSF_FY22-FY26%20Learning%20Agenda%20Final.pdf

[12] The NSF FY2023 Agency Evaluation Plan can be accessed at https://www.nsf.gov/od/oia/eac/PDFs/NSF%20Annual%20Evaluation%20Plan%20FY2023%20Final.pdf

[13] The NSF INCLUDES Shared Measures Platform can be accessed at https://networksharedmeasures.org/

"Diversity, Equity, Inclusion, and Accessibility in the Federal Workforce." In addition, NSF has recently published a DEIA Strategic Plan[14].

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

- NSF has taken a variety of budgetary approaches to broaden participation across its many programs with investments ranging from capacity building, research centers, partnerships and alliances to the use of co-funding or supplements to existing awards in the core research programs.[15]
- Provided robust funding for programs in FY 2021 to broaden participation, totaling $1.19 billion.[16]
- Developed and provided annually to Congress the Report on Funding to Minority-Serving Institutions, as required by the NSF Authorization Act of 2002 (P.L. 107-368).[17]
- Established the Racial Equity Task Force in June 2020, charged to identify institutional and other barriers to full inclusion in STEM and to make recommendations to eliminate those barriers – both inside NSF and in the community it serves.
- Conducted dissemination activities related to the *Women, Minorities, and Persons with Disabilities in Science and Engineering* reports.
- Supported the NSF INCLUDES National Network via a five-year cooperative agreement to the NSF INCLUDES Coordination Hub. The Hub collaborates with NSF to connect broadening participation stakeholders across the nation who are engaging in systems change to advance diversity, equity, and inclusion in STEM education and careers; catalyze collaborative action; and curate resources, measures, research findings, and expertise. The goal is to build Network members' capacity to effect change toward the goal of a more diverse, equitable, inclusive STEM workforce.
- Co-chaired the Federal Coordination in STEM Interagency Working Group on Inclusion in STEM and contributed to the publication "Best Practices for Diversity and Inclusion in STEM Education and Research: A Guide by and for Federal Agencies."[18]
- Provided data and program information to Committee of Equal Opportunities in Science and Engineering (CEOSE)[19] for their 2019-2020 biennial report, Making Visible the Invisible, that was transmitted to Congress in September 2021, recommending that NSF demonstrate, support, and reward bold leadership actions to create, integrate, and make visible efforts, promising practices,

[14] The NSF Diversity, Equity, Inclusion, and Accessibility (DEIA) Plan can be accessed at https://www.nsf.gov/od/oecr/reports/DEIA_Strategic_Plan_2022.pdf

[15] The full Broadening Participation Portfolio is available at https://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp

[16] The annual NSF Programs to Broaden Participation Budget Summary Table for the FY 2023 Budget Request to Congress can be accessed at https://www.nsf.gov/about/budget/fy2023/tables.jsp

[17] Annual reports to Congress on Funding to Minority-Serving Institutions may be accessed at https://www.nsf.gov/od/broadeningparticipation/bp_investments.jsp.

[18] The National Science and Technology Council's Committee on STEM Education via the IWGIS FC-STEM education subcommittee published the "Best Practices for Diversity and Inclusion in STEM Education and Research: A Guide by and for Federal Agencies" report in September 2021. It can be accessed at https://www.whitehouse.gov/wp-content/uploads/2021/09/091621-Best-Practices-for-Diversity-Inclusion-in-STEM.pdf

[19] CEOSE is a Congressionally mandated advisory committee, established in 1980 to advise NSF on policies and programs to encourage the full participation by women, underrepresented minorities, and persons with disabilities within all levels of America's science, technology, engineering, and mathematics (STEM) enterprise. Every two years the Committee prepares and submits a report to the NSF Director who transmits the report to Congress. More information on CEOSE can be accessed at https://www.nsf.gov/od/oia/activities/ceose/index.jsp

and impacts within and across its programs to broaden participation of groups underrepresented in STEM.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Released NSB Policy Brief, *The U.S. is a Keystone of Global Science & Engineering*, January 2022.[20]
- Released new strategic plan for fiscal years 2022-2026 on March 28, 2022, which explicitly incorporates accessibility and inclusivity into the NSF vision as its central pillar.
- Continued to respond to 2021 Executive Orders by complying with all requirements set forth in Executive Orders 13985, 13988, 14020, and 14035. Additionally, to further these Executive Orders and agency priorities, NSF
    - submitted an action plan[21] to address inequitable barriers in agency policies and programs (Executive Order 13985),
    - finalized and distributed within NSF the Racial Equity Task Force report in fall 2021, comprised of employee perspectives, recommendations, ideas, and potential strategies for racial equity growth and development, both internal and external to NSF;
    - reviewed the applicable documentation (Executive Order 13988);
    - Participates in the White House Gender Policy Council and has submitted input to the Government-wide Gender strategy (Executive Order 14020);
    - Published a DEIA strategic plan (Executive Order 14035);
- Took steps toward enhancing the merit review process and strengthening the broadening participation element of the Broader Impacts criterion by initiating pilots/exploratory work that:
    - Offers a "reviewer orientation" video available to all reviewers, which provides tips on structuring analytical reviews, information on the Broader Impacts review criterion, and ways to reduce the impact of unconscious cognitive associations;
    - The Division of Civil, Mechanical and Manufacturing Innovation (CMMI) in the Directorate for Engineering is piloting a reviewer training program called Game Changer Academies for Advancing Research Innovation. It aims to improve group dynamics during panel discussions, increase awareness of bias and identity, and enhance understanding of high-risk, high-reward ideas. Once trained, "Panel Fellows" will bring enhanced skills and awareness when they participate in panel discussions during NSF merit review. The Game Changer Academies grew out of a 2019 NSF-funded pilot project aimed at increasing reviewer risk tolerance.
    - In FY 2022, CMMI conducted an analysis to explore whether watching the reviewer orientation video improves the quality of reviews written by reviewers and trained over 300 panelists in the first two cohorts of CMMI Panel Fellows.
    - Launched a pilot to add Broader Impacts experts to Committees of Visitors (COVs).[22] The pilot will be ongoing throughout the remainder of FY 2022 and into FY 2023. Organizations conducting COVs during the pilot are asked to include at least one Broader Impacts expert on the COV. NSF is also providing COV members with an analysis of the proposed Broader Impacts for the proposals covered by the four-year period under review by the COV and conducting a post-COV survey of COV members. At the end of the pilot, NSF will do a

[20] The Keystone Policy Brief may be accessed at https://www.nsf.gov/pubs/2020/nsb20222/nsb20222.pdf
[21] The NSF Equity Action Plan Summary is available at https://www.whitehouse.gov/wp-content/uploads/2022/04/NSF-EO13985-equity-summary.pdf
[22] More information on NSF's Committee of Visitors process is available at https://www.nsf.gov/od/oia/activities/cov/

comparative analysis of COV reports submitted prior to the pilot and during the pilot. Progress in FY 2022 includes:

- Finalized development of a repeatable method for analyzing the distribution of proposed Broader Impacts in a portfolio.
- Collaborated with eight divisions to plan FY 2022-23 pilot COVs.
- Developed COV member survey.
- Conducted two pilot COVs to date with 3 more scheduled in FY 2022.

- Published the NSF Learning Agenda for FY 2022-2026 in March 2022 to ensure that evidence-building efforts pursued across the agency inform the extent to which the goals and objectives of the strategic plan are achieved. Specific to this challenge is Strategic Goal 1, to empower STEM talent to fully participate in science and engineering, and the corresponding guiding question – how can NSF help grow STEM talent and opportunities for all Americans most equitably?
- Convened CEOSE meetings three times per year and received key biennial reports and recommendations.
    - Publicly shared NSF's response to CEOSE's recommendations focused on implementing a shared accountability framework for NSF INCLUDES and increasing support for co-creation of research projects from diverse communities.
- Expanded the NSF INCLUDES portfolio with additional alliances focused on increasing equity and broadening participation in STEM; enhanced Build and Broaden 2.0 by clarifying eligibility requirements to increase the extent to which underrepresented groups and organizations may be engaged; and expanded the Broadening Participation portfolio with new funding opportunities:[23]
    - Inclusion across the Nation of Communities of Learners of Underrepresented Discovers in Engineering and Science (NSF 22-622)
    - Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI) (NSF 22-611)
    - HSI Program Network Resource Centers and Hubs (HSI-Net) (NSF 22-602)
    - Dear Colleague Letter: Supporting Impactful Research, Undergraduate Education and Capacity Building at Historically Black Colleges and Universities (HBCUs) (NSF 22-069)
    - Build and Broaden 3.0 (NSF 22-530)
    - Computer and Information Science and Engineering Minority Serving Institutions Research Expansion Program (NSF 22-518)
    - Partnerships for Research and Education in Chemistry (NSF 21-620)
    - Cultural Transformation in the Geoscience Community (NSF 22-562)
    - MPS-Ascend External Mentoring (NSF 22-524)
    - Building Research Capacity of New Faculty in Biology (NSF 22-500)
    - Emerging Frontiers in Research and Innovation Planning Grants to Promote Diverse Participation (NSF 22-019)
    - Racial Equity Program Description (PD 21-191Y)
    - Dear Colleague Letter: Persons with Disabilities – STEM Engagement and Access (NSF 21-110)
    - Dear Colleague Letter: Research to Improve STEM Teaching, Learning, and Workforce Development for Persons with Disabilities (NSF 21-114)
    - Advancing Informal STEM Learning (AISL) (NSF 22-626) (re-released as Broadening Participation Focused Program)

[23] The full Broadening Participation Portfolio is available at https://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp

- Delivered a presentation to NSB in February 2022 on the Equity Ecosystem at NSF[24] and initiated strategic discussions to define and develop outcome and impact goals for NSF around the Missing Millions.
- Released *2022 Science & Engineering Indicators: The State of U.S. Science & Engineering*, on January 18, 2022, showing that strengthening the U.S. S&E enterprise is critical to maintaining the U.S. position as a lead performer and collaborator of science and technology activities globally.[25]
- Completed a Strategic Review about the new Growing Research Access for Nationally Transformative Equity and Diversity Initiative and presented to NSF Leadership on April 28, 2022.
- Conducted listening sessions with 259 individuals across 143 MSIs, two-year colleges, and primarily undergraduate universities to "design in" considerations of DEIA in programming for the new Directorate for Technology, Innovation and Partnerships.

NSF's Ongoing Actions

NSF management developed the following anticipated milestones in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- Implement, strategically monitor and oversee the FY 2022-2023 Agency Priority Goal Action Plan, which will improve representation in the scientific enterprise by making changes that will lead to an increase in proposal submissions from applicants underrepresented in STEM and underserved communities.
- Leverage the expertise of the Broadening Participation Knowledge Sharing Group via a sharing of best practices and offering solutions to mitigate risk in efforts to broaden participation.
- Initiate the new Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED) initiative, which aims to improve the Nation's research support and service capacity at emerging and underserved research institutions. The GRANTED initiative will use a variety of mechanisms to further NSF's reach in advancing the geography of innovation and engaging groups underrepresented in STEM.
- The NSF Regional Innovation Engines (NSF Engines) program will further the goals of the geography of innovation by boosting capacity at specific institutions and in specific regions that have been underfunded to date.[26]
- Adopt the NSF Learning Agenda study plans designed to 1) inform how NSF can increase the participation of underrepresented groups in the STEM workforce and 2) elucidate the ways in which the COVID-19 pandemic influenced the participation of different groups in the NSF portfolio of programs and activities.
- Continue the work of the NSF Racial Equity Task Force, including planning implementation of the recommendations made. Efforts will also include further barrier analysis to include data challenges. The recommendations currently under development include, but are not limited to, procurement of a civil rights case management system, a non-discrimination clause included in the *Proposal & Award Policies & Procedures Guide*, and removing supervisory approval as a requirement to apply for internal details.

[24] The Equity Ecosystem NSB presentation may be accessed at https://youtu.be/A643zjcFb1o?t=3707

[25] Science and Engineering Indicators 2022 may be accessed at https://ncses.nsf.gov/pubs/nsb20221

[26] More information on the NSF Engines program is available at https://beta.nsf.gov/funding/initiatives/regional-innovation-engines/resources-and-contact-information#:~:text=Learn%20about%20NSF's%20Regional%20Innovation,creation%2C%20and%20cultivate%20regional%20talent.

- Continue the work of NCSES and EAC to examine the challenges of limited data in terms of studying small groups of people who are underrepresented in STEM, as well as less studied groups, e.g., sexual orientation/gender identification, who may be underrepresented and would enhance diversity in the science and engineering workforce.
- Evolve and continue outreach to and engagement with tribal communities and tribal governments through the Tribal Consultation and Engagement Working Group. In FY22, the working group defined recommendations for internal resourcing and clarifications to NSF policies and procedures and worked to develop externally-facing resources to enable greater access and inclusion of tribal communities to NSF opportunities.
- NSF considers geographic diversity as part of our Broadening Participation DEIA work and part of our ongoing work is to receive input from the research community about increasing research and learning capacity in US states and territories that are underfunded throughout NSF's portfolio. In FY 2022, NSF has received a report on the Future of NSF EPSCoR through the CEOSE advisory committee, which provides recommendations to NSF around future directions for the NSF EPSCoR program as well as opportunities for geographic engagement and innovation throughout NSF.

MANAGEMENT CHALLENGE 2: Overseeing the United States Antarctic Program (USAP)

NSF Lead: Roberta Marinelli, Director, Office of Polar Programs

Summary of OIG Identified Challenge

NSF, through the United States Antarctic Program (USAP), manages U.S. scientific research in Antarctica. Leidos Innovations Corporation (Leidos) currently holds the Antarctic Support Contract (ASC) for USAP logistical support, valued at $2.3 billion over 13 years. Through this and other contracting vehicles, NSF is also implementing a long-range infrastructure investment program across the three U.S. Antarctic stations (McMurdo, Palmer, and South Pole). The Office of Polar Programs (OPP) monitors Leidos' performance under the contract, with several other NSF offices, including the Office of Budget, Finance, and Award Management (BFA) and the Office of Information and Resource Management (OIRM).

The onset of COVID-19 in 2020 added unprecedented complexity and uncertainty to USAP operations, including limiting deployments to only those deemed most critical, and halting on-ice construction at McMurdo for the Antarctic Infrastructure Modernization for Science (AIMS) project and the Information Technology and Communications (IT&C) primary addition project. Additionally, recent information security audit findings have identified challenges in USAP's implementation of authentication and incident response requirements and the onboarding and vetting process for ASC contractors.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

Antarctica's remote location, extreme environment, and the short period of time each year during which the continent is accessible present challenges above and beyond those typically encountered for domestic construction projects and science operations. COVID-19 dramatically increased these challenges. Throughout the pandemic, USAP ensured the safety of deployers, prevented any cases of COVID-19 infection from reaching NSF stations, avoided the loss of many millions of dollars related to research infrastructure investments, and maintained the integrity of decades-long data sets.

USAP's recovery from the drastic curtailment of activity during the pandemic is now underway along three lines of thrust – executing a temporary surge in logistics support to clear the backlog of delayed science and construction work, replanning major construction projects to establish new cost and schedule baselines for monitoring contractor performance, and pivoting our recapitalization approach to an enduring program rather than a single major effort. To provide effective government oversight of these activities, the Antarctic Infrastructure and Logistics Section in OPP continues to mature financial management, performance monitoring, and planning processes.

Regarding information security, USAP has been working towards modernizing our processes, resources, and tools following a period of less-than-adequate investment. Some of these efforts have included a monthly cyber security risk discussion with USAP leadership that is based on formal metrics with trend analysis, a more robust Acceptance of Risk program, addition of technical resources to support government oversight

of contractor performance, implementation of personal identity verification (PIV) credentialing, and increased rigor in vetting of elevated-risk contractors.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

For ongoing operations, USAP's risk mitigation approach for the last two years was based on applying the best available medical advice to guide agency deployment decisions, and then working closely with authorities in the logistics gateways – New Zealand and Chile – to implement those decisions. The OPP brought on-board a medical doctor and a gateway liaison who were vital throughout the pandemic. Through a combination of reductions in the number of deployers and pre-departure testing and quarantine protocols, two seasons were successfully completed with no COVID-19 infections at U.S. stations.

For construction projects, deployment of crews to McMurdo during the pandemic presented too great a risk for a COVID-19 outbreak that could have led to severe, long-term health and safety consequences on the continent. Instead, with close collaboration between OPP and BFA, the major projects – AIMS and IT&C primary addition – were put on hold and are now being re-baselined. Safe deployment of construction workers to Palmer Station was possible, and the Palmer Pier Reconstruction Project moved forward.

For information security, with close collaboration between OPP and OIRM, the primary actions that reduced risk were formalizing monthly metrics and trend analysis with the ASC, increasing the breadth and rigor of USAP's Acceptance of Risk program, and establishing a risk-based project execution plan for implementing PIV credentialing.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Included an increase in the Antarctic logistics budget in the President's FY 2023 request to fund a surge in logistics support for the post-COVID-19 operational recovery effort.
- Accepted a new AIMS project baseline following an external panel review, an independent cost assessment by the US Army Corps of Engineers (USACE), and successful Earned Value Management System (EVMS) acceptance and surveillance reviews.
- Improved audit logging capability to support acquisition of security information and event monitoring tools for the USAP network.
- Documented an Acceptance of Risk and Corrective Action Plan for contractor vetting concerns identified by the OIG and cleared the backlog of over one hundred contractors in elevated risk positions requiring NSF adjudication.
- Achieved initial and final operating capability for enforcing PIV credentials in the Denver-based offices of Leidos and at our inter-agency partner, NIWC. Achieved initial operating capability for USAP locations outside the U.S.
- Began implementation of a new process for NSF adjudication of all contractors on the ASC.

NSF's Ongoing Actions

NSF management developed the following anticipated actions in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- Continue monitoring and oversight of the AIMS project in accordance with established internal management and project execution plans, including external panel reviews and EVMS surveillance reviews.
- Leverage the expertise within the USACE to provide quality assurance through design and constructability technical reviews, on-ice construction observation, cost estimating services, and schedule and cost review.
- To augment NSF oversight activities, AIMS has been added to the Office of the Director's Watch List which elevates visibility and monitoring of this important project as it goes through the crucial period of returning to construction.
- USAP has begun initiating an Antarctic Infrastructure Recapitalization program that will allow ongoing renewal of critical infrastructure with a well-defined annual budget and according to priorities established by USAP stakeholders. The program may include AIMS work not funded under the re-baselined project scope, as well as critical infrastructure needs across all stations and logistical gateways. The program is managed according to an Internal Management Plan and in collaboration with a dedicated NSF Integrated Project Team.
- Cybersecurity improvements will continue to be implemented, using a risk-based prioritization approach that ensures effective cybersecurity in the unique environment of the USAP network. Activities will include executing an acquisition strategy to procure a managed security service provider to automatically detect malicious network events, continuing personnel screening adjudication of unprivileged and non-sensitive positions and update the Leidos ASC Section H to include appropriate security and privacy requirements, establishing a project to address removable media concerns within the USAP network environment (depending on FY 2023 project approval), and continuing to implement a trusted internet connection for the USAP network.

MANAGEMENT CHALLENGE 3: Overseeing Grants in a Changing Environment

NSF Lead: Janis Coughlin-Piester, Chief Financial Officer and Office Head, Budget, Finance, and Award Management

Summary of OIG Identified Challenge

Although NSF executed a strong response to measure and mitigate the impacts of the pandemic, institutions continue to confront mounting fiscal constraints, related in part to lower-than-anticipated tuition revenue and declining support from state governments, endowments, or other funding sources. These factors could influence awardees' abilities to comply with award terms and conditions and exercise proper stewardship of federal funds.

NSF is focused on growing the STEM workforce and increasing participation from currently underrepresented groups. This could increase the proportion of small to mid-size institutions, which may have less experience managing federal funds, or may need to strengthen their controls to account for more funding. This evolving grants management environment may increase the risk that recipients will misuse funds, which in turn, would increase the need for NSF to strengthen the community's understanding of grant management guidance and monitor how the community responds to these risks.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

Overview

NSF's current advanced monitoring activities and Enterprise Risk Management (ERM) programs provide a strong foundation for effective oversight over the agency's grant portfolio. ERM provides a framework for NSF to objectively evaluate the need for new or enhanced controls by monitoring potential changes in portfolio composition, or other emerging risks in the research community, such as fiscal constraints and student enrollment challenges. NSF is currently assessing the risk and control environment related to grants award, oversight and monitoring, and closeout processes to confirm controls are operating effectively against the evolving risk environment. Testing will help uncover any areas of weakness where controls should be added or strengthened to help ensure ongoing compliance with award terms and conditions and proper use of federal funds.

A summary of completed and ongoing actions is presented in the below subsections.

Strong Foundational Improper Payment Compliance and Controls

The NSF OIG recently completed its performance audit for the Payment Integrity Information Act of 2019 (PIIA). NSF conducted both qualitative and quantitative risk assessments over its grant and cooperative agreement program to assess improper payment risk, with particular focus over heightened risks due the COVID-19 pandemic. In the final PIIA audit report, the independent auditor determined that NSF's risk assessment conclusion that the overall low improper payment risk level for its grant and cooperative agreement programs was reasonable, and also determined that NSF adequately concluded the programs have low risk of making improper payments above the statutory threshold. There were no findings and

recommendations within the draft report, and this audit serves as a strong baseline for assessing future changes in portfolio composition—e.g., an increase in small to mid-size grantees—or new risks to fiscal stewardship in the external grantee environment, and will inform how NSF can monitor how such change may impact improper payment risk. In FY 2022, NSF also conducted exploratory payment testing over its Graduate Research Fellowship Program (GRFP), in consultation and collaboration with the Directorate for Education and Human Resources (EHR).[27] NSF conducted this exploratory testing to assist in estimating the rate of improper payments within GRFP and evaluating the current control environment. NSF concluded from this testing that GRFP also had low risk of improper payments above the statutory threshold.

Enhanced Project Reporting Oversight

To further enhance its portfolio oversight, NSF assembled the Project Reporting Improvement Team (PRIT) to implement actions to improve compliance on the timely submission of grant project reports across the agency. Bringing together expertise in policy, NSF business systems, award monitoring, and project reporting, the PRIT's significant collaborative efforts have included data analytics; listening sessions with university system senior administrators through the Federal Demonstration Partnership (FDP); pilot testing new processes, systems, and outreach mechanisms; and direct communications with the research community. The PRIT has worked collaboratively to increase compliance with NSF's project reporting requirements using a multi-pronged approach that includes communications and preventative strategies. Severely overdue reports (i.e., those more than 120 days overdue) have proven particularly difficult to obtain. However, since December 2021, Top 20 institutions have submitted over 400 reports that were at least 120 days overdue. Over 100 of these were over a year overdue. Overdue reports on awards that ended more than a year ago decreased overall by 15 percent since December 2021, but the Top 20 institutions accounted for 62 percent of the observed reduction in this category. In June 2022, NSF issued a second round of Top 20 notices that resulted in another nearly 400 reports submitted to date. NSF has also started to direct some targeted communications to recipients on an award-by-award basis to encourage their compliance with the reporting requirements in 2 CFR 200.344 Closeout. Additionally, the PRIT has recommended policy and procedure clarifications regarding project reporting. These implemented enhancements will solidify NSF's controls around result-oriented accountability, enabling the agency to better scale its processes to integrate additional small and medium institutions under future, more substantial budget increases and increased emphasis on awards to currently underrepresented groups.

Grant Recipient Assessment and Monitoring Tools

NSF has recently implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs along with additional fact sheets on various topics. These tools allow awardee organizations to independently self-assess compliance in the areas of participant support and sub-recipient risk assessment and monitoring. Additional business assistance tools are in progress including the development of FAQs to support recipient oversight and management of subawards. In addition, enhancements to the participant support self-assessment tool will provide recipients with additional guidance on cost allowability.

Enterprise Risk Management

Effective oversight and support of grant awards that enables grantees to effectively manage their award portfolios are critical to accomplishing the agency's mission. NSF continues to leverage its strong control environment and ERM governance structure to identify opportunities that will enhance monitoring and

[27] The name Directorate for Education and Human Resources (EHR) was changed to Directorate for STEM Education (EDU) in FY 2023.

oversight. The release of the NSF 2022-2026 Strategic Plan provided an opportunity to reflect on the linkage between strategy and risk and revisit the agency's risk profile for "Overseeing Grant Awardees." The risk profile articulates how NSF is considering risks related to the effectiveness of grantee monitoring. This year, the agency has updated the profile to capture both the approach to mitigating threats to effective monitoring and pursuing opportunities to enhance the agency's interactions with grantees. The profile is a tool that spurs productive dialogue on current and proposed risk responses and enhances coordination across the agency's organizational units. For example, through collaboration on the risk profile updates, the ERM Risk Captains identified the opportunity to collaborate on a roadshow for grantees on lessons learned from a recent OIG review that could improve effectiveness in the management of fellowship funding.

Managing Transformational Change

NSF will continue to emphasize data analytics and evidenced-based decision making in the monitoring of its grant portfolio. As part of its ERM program, NSF launched a quarterly series of Program Integrity & Data Science Touchpoints. These collaborative discussions between BFA and research directorates will provide a forum to discuss emerging risks and demonstrate analytic tools to monitor these risks.

As the challenge is written prospectively on the potential increased risks due to a change in portfolio composition of small and mid-size awardees, NSF continues to monitor these changes through its normal award monitoring processes and procedures, with planned enhancements to monitor portfolio composition through analytics. To further enhance this, NSF is creating an integrated and collaborative effort around supporting the new types of awardee institutions anticipated under programs for the Directorate for Technology, Innovation and Partnerships (see response to Management Challenge 8, below), as well as for individuals underrepresented in STEM and underserved institutions. NSF's new Agency Priority Goal to, "improve representation in the scientific enterprise" by making changes that will lead to an increase in proposal submissions from applicants and communities that are underrepresented and underserved offers a strong mechanism for managing this transformational change. NSF is pursuing this emphasis even under existing resources and is also exploring other authorities to reach these groups underrepresented in STEM. NSF is also analyzing the CHIPS and Science Act of 2022 and its potential impacts to portfolio composition and grant oversight, which will continue into FY 2023.[28]

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

- Completed triennial PIIA risk assessment, including a quantitative and qualitative risk assessment over the entire NSF grant portfolio. Assessment results indicated a low risk of improper payments.
- Established oversight controls over Coronavirus Aid, Relief, and Economic Security (CARES) Act and American Rescue Plan supplemental funding.
- Assembled the Project Reporting Improvement Team (PRIT) to implement actions to improve compliance on the timely submission of grant project reports across the agency.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Developed monitoring to observe changes and trends in portfolio composition related to small and mid-sized grantees.

[28] The CHIPS and Science Act, Public Law 117-167 was enacted August 8, 2022 and authorizes various new programs and activities at NSF. https://www.congress.gov/bill/117th-congress/house-bill/4346/text

- Implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs along with additional fact sheets on various topics.
- Established quarterly Program Integrity & Data Science Touchpoints to discuss emerging risks and demonstrate analytic tools to monitor these risks.
- Continued to implement enhancements to improve the timely submission of grant project reports.
- Completed 24 site visits and 103 desk reviews under NSF's advanced award monitoring and oversight program. An additional 22 desk reviews are planned for submission by September 30, 2022.
- The NSF OIG's independent PIIA performance audit report supported NSF's conclusion in its FY 2021 risk assessment that its grant and cooperative agreement programs have low risk of making improper payments above the statutory threshold.
- Completed exploratory payment testing of the GRFP program to assess the control environment and risk of improper payments.

NSF's Ongoing Actions

NSF management will continue to execute the following monitoring activities in consideration of NSF's strategic and operational objectives, which expand upon the previously completed agency actions described above.

- Execute annual advanced monitoring site visits and desk reviews.
- Proactively monitor portfolio composition and potential increases of small and mid-size grantees.
- Refine enterprise risk profiles around the NSF grants portfolio to account for future environment changes.
- Develop additional grantee self-assessment and monitoring tools for publication to further educate the research community on sound oversight.
- Execute annual PIIA compliance activities to measure changes to NSF's current baseline low risk of improper payments and conduct annual baseline payments testing.

MANAGEMENT CHALLENGE 4: Managing the Intergovernmental Personnel Act Program

NSF Leads: Wonzie Gardner, Chief Human Capital Officer, and Office Head, Office of Information and Resource Management; and Joanne Tornow, Assistant Director, Directorate for Biological Sciences

Summary of OIG Identified Challenge

NSF provides the opportunity for scientists, engineers, and educators to rotate into the agency as temporary Program Directors, advisors, and leaders. Rotators bring fresh perspectives from across the country and across all fields of science and engineering supported by NSF, helping influence new directions for research in science, engineering, and education, including emerging interdisciplinary areas. Many of these rotators remain involved in their professional research and development activities while working at NSF through participation in the independent research/development (IR/D) program, which is overseen by the NSF IR/D Council. Risks associated with rotators include conflicts of interest, frequent turnover, and salaries not subject to federal pay and benefits limits.

Over the past several years, NSF has taken steps to address these risks. NSF has implemented a cost share policy requiring that institutions provide a minimum 10 percent cost share for every full-time Intergovernmental Personnel Act (IPA) agreement. Additionally, NSF facilitated a focus group for IPAs who onboarded during the pandemic to help identify unique challenges associated with onboarding in a remote-work environment. NSF has also continued to strengthen its policies around the IR/D program, potential conflicts of interest, performance management and managing turnover.

NSF's current focus is the vetting and hiring processes related to the IPA program. The goal is to further reduce the risks inherent to the IPA program and strengthen NSF's control environment while maintaining diligent oversight and monitoring of the continuing IPA challenges.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

NSF takes a proactive approach in the management of the IPA program to appropriately consider and mitigate inherent risks associated with its execution. The IPA Steering Committee is charged with ensuring NSF is best utilizing the IPA hiring authority. It advises the agency's senior leadership on matters that directly concern policy on the use of the IPA program, and on common approaches to budgeting and implementation of the program. It also regularly reports on its oversight and stewardship of the IPA program, including costs associated with the program, to the NSF Director and Chief Operating Officer, the Office of Management and Budget (OMB), and Congress, pursuant to the American Innovation and Competitiveness Act (AICA).

Monitoring Program Challenge Progression

NSF continues to monitor the use of IPA assignments on an ongoing basis, providing a data-driven summary to NSF senior leadership via an annual review of metrics related to participation, demographic characteristics, annual costs, and cost share value. Analyses of these data have demonstrated positive trends in increasing demographic diversity and reductions in annual costs. In FY 2021, NSF saved $2 million in costs by using the IPA program to fill key scientific positions, in comparison to the average comparable

Federal rate. It is with such talent that NSF is better positioned to promote the progress of science. NSF's scientific community and the American taxpayer all benefit from a regular influx of scientists and engineers with exceptional expertise and experience.

NSF has taken steps to ensure the IPA program fully supports the mission of the agency and the nation's interests. For example, NSF has addressed the management challenges identified by the OIG as well as other agency-identified risks and challenges by integrating program and executive level IPAs into the USAPerformance system to enhance its ability to monitor supervisory oversight of IPA performance. NSF is also engaging in continuous improvement of its management of the IPA program and participation in the IR/D program. Indeed, NSF believes that the steps taken to date have reduced the inherent risk substantially, such that the residual risk is acceptable to the agency.

Managing Transformational Change

Based on the preemptive measures discussed above and continuous management improvements of the IPA program, NSF feels it is prepared to effectively manage transformational change and support the agency's expected growth and overall human capital strategy.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

NSF has completed many actions over the last several years regarding the oversight and monitoring of the IPA program. Many policies and practices have been put into place that have successfully mitigated the identified risks related to the IPA program. NSF will continue to maintain the excellent management practices that have been acknowledged by the OIG.

Some of the major actions NSF has taken to address this challenge in prior years include:

- Resolved and closed the recommendations from the OIG report, "NSF Controls to Mitigate IPA Conflicts of Interest."[29] NSF effectively minimized the inherent risk of IPA conflicts of interest while working at NSF (as most IPAs come from institutions receiving NSF grants).
- Established a Steering Committee for Policy and Oversight of the IPA Program (IPA Steering Committee) to serve as the primary body for considering policy on NSF's use of IPAs, and to oversee common approaches to budgeting and implementation of the IPA program.
- After a successful pilot period, NSF implemented the required cost share as policy, requiring that institutions provide a minimum of 10 percent cost share for every full-time IPA agreement. The total amount of cost share by institutions increased by over $1 million due to the implementation of this policy, and 90 percent of IPA agreements include cost sharing. The cost share mechanism continues to maximize taxpayer value.

Demonstrated Progress Through Agency Actions Taken in FY 2022

NSF has identified the need to better vet incoming IPAs via the recent OIG audit on the agency's internal processes. To address concerns and risks identified, NSF has established an IPA Candidate Vetting Working Group. The purpose of the group is to make recommendations to the NSF Chief Operating Officer regarding the NSF approach to vetting candidates for IPA positions at NSF.

[29] Report available at https://www.oversight.gov/sites/default/files/oig-reports/17-2-008_COI.pdf

- NSF's Office of Information and Resource Management proactively improved the process for vetting IPA candidates for Assistant Director positions, which was used for two Assistant Director searches in FY 2022.
- The IPA Candidate Vetting Working Group has partnered with NSF stakeholders to address issues such as (1) potential threats to national or economic security by IPA candidates with foreign affiliations or sources of funding; (2) potential risks due to other conflicts of interest and commitments; (3) confirmation of eligibility, salary, and employment history; (4) timeliness of vetting relative to employment offers and start of assignment; and (5) responsibility and overall timeline for various aspects of vetting and assessment.

NSF's Ongoing Actions

NSF management developed the following anticipated milestones and responses to the findings in the FY 2022 OIG Management Challenge Report in consideration of NSF's strategic and operational objectives, the risks inherent to achieving these objectives, and the key actions NSF has already taken in response to those risks.

The IPA Steering Committee will continue to use ERM concepts, applying them to the committee's risk environment to monitor metrics related to participation, demographic characteristics, annual costs, and cost share value.

The IR/D Council will continue to develop and monitor internal controls related to the IR/D Program, to include clear communication on participation and NSF policies on the use of IR/D.

The NSF IPA Candidate Vetting Working Group will partner with NSF stakeholders to address the below issues:

- Potential threats to national or economic security by IPA candidates with foreign affiliations or sources of funding,
- Potential risks due to other conflicts of interest and commitment,
- Timeliness of vetting relative to employment offers and start of assignment, to include identifying the responsibilities and authorities of different organizations within NSF and how and when they interact during the process, and
- NSF will release a Corrective Action Plan related to OIG's audit on the agency's IPA vetting process in FY 2023.

MANAGEMENT CHALLENGE 5: Overseeing Major Multi-User Research Facilities

NSF Leads: Linnea Avallone, Chief Officer for Research Facilities and Janis Coughlin-Piester, Chief Financial Officer and Office Head, Budget, Finance, and Award Management

Summary of OIG Identified Challenge

As part of its mission, NSF funds award recipients to manage the development, design, construction, operation, and divestment of major multi-user research facilities (major facilities), which are state-of-the art infrastructures that support research and education and include telescopes, ships, detectors, and distributed observatories. The major facilities portfolio is complex and has certain inherent risks including meeting emergent scientific objectives, protecting the safety of life and property, potential construction delays, and unanticipated additional costs. The OIG previously reported on the risk of inadvertent misuse of funds and improper use of budget contingency, but the COVID-19 pandemic presented additional, unique challenges across the portfolio. Following the flexibilities granted by the Office of Management and Budget (OMB) in response to the pandemic, NSF took action to address the associated cost impacts by developing internal and external guidance for major facility programs and award recipients. NSF has continued to monitor this unforeseen event, implement mitigation strategies, and assess any remaining financial impacts as the pandemic becomes better understood and managed.

Since 2015, NSF has implemented enhanced controls and strengthened agency governance to fully address OIG recommendations, the recommendations of the 2015 National Academy of Public Administration report, the requirements of the *American Innovation and Competitiveness Act of 2017* (AICA), and FY 2018 and FY 2019 Government Accountability Office (GAO) reports. As a result, oversight of NSF's major facilities portfolio has continued to evolve and improve each year, making it a model program within NSF.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

NSF understands the importance of its role in overseeing award recipients' on-going management of major facilities. The agency also recognizes the importance of assessing prospective recipients' capabilities for managing major facilities prior to award. Over the past several years, NSF has strengthened its oversight policies and procedures. This includes a bi-annual Major Facilities Portfolio Risk Assessment to determine the necessary reviews and audits to be conducted by the Office of Budget, Finance, and Award Management (BFA). In close cooperation with NSF program offices, BFA's Large Facilities Office (LFO) and Division of Acquisition and Cooperative Support conduct these reviews to safeguard NSF's significant, long-term investments in supporting the scientific endeavor.

NSF leadership continues to show its commitment to major facilities oversight through appointment of the Chief Officer for Research Facilities (CORF) and periodic use of the Office of the Director's Watch List. The governance structure currently in place, which includes the Accountable Directorate Representatives, Facilities Governance Board, Facilities Readiness Panel, and the Director's Review Board, continues to help ensure consistent implementation of NSF's enhanced controls related to major facilities oversight. Furthermore, NSF is ensuring adequate human capacity among the Major Facility oversight staff through

implementation of the Program Management Improvement Accountability Act (PMIAA) on the major facility/acquisition portfolio, and by establishing guidance on the necessary core competencies for recipient staff managing major facilities.

Since 2017, NSF has been through five GAO reviews related to its oversight of projects funded from the Major Research Equipment and Facilities Construction (MREFC) account. The June 2018 report (GAO-18-370)[30] recommended that NSF revise its policies for estimating and reviewing the costs and schedules of major facility projects to better incorporate the best practices in GAO's guides. The March 2019 report (GAO-19-227)[31] recommended that NSF conduct a workforce gap analysis for project management competencies, ensure recipients provide lessons learned and best practices to NSF, and establish criteria for recipient project management competencies to be incorporated into NSF's review process. The April 2020 report (GAO-20-268)[32], the June 2021 report (GAO-21-417)[33], and the July 2022 report (GAO-22-105550)[34] had no new recommendations. NSF has corrective action plans (CAPs) in place as described below, and five of the six GAO recommendations from 2018 and 2019 are considered fully implemented.

The COVID-19 pandemic presented unique challenges for major facilities, including protecting the safety of personnel and property, construction delays, and other unanticipated additional costs related to this unforeseen event. The greatest risks were loss of scientific capability, the inadvertent misuse of funds when re-budgeting (Operations Stage awards) and the proper use of budget contingency (Construction Stage awards). Following the flexibilities granted through OMB Guidance under the pandemic, NSF took action to address these risks by developing internal and external guidance for major facility programs and recipients. These efforts included the following: (1) developing and updating a set of frequently asked questions (FAQs) specific to major facility recipients as a complement to NSF's implementation of OMB Guidance; (2) issuing guidance jointly from the CORF and LFO to NSF program officers in response to the COVID-19 pandemic to ensure recipients segregate and track related cost increases; and (3) providing guidance for addressing re-baselining of construction projects, incorporation of impacts into earned value management, and the application of management reserve to reduce the need for de-scoping. NSF followed its current policies and controls with only minor clarifications. No additional controls were deemed necessary.

NSF has evaluated this management challenge under ERM considering the activities already completed and those planned for FY 2022. NSF has determined that the residual risk impact for fraud, waste and abuse (Risk 1) is "low" and the likelihood is "very low," and that the residual risk impact for scientific performance (Risk 2) is "moderate" and the likelihood is "very low." Risk 2 impact and likelihood assume sufficient additional funding is made available when needed to sustain on-going activities. Additional funding needs for both Operations Stage and Construction Stage awards were addressed by reprogramming of funds, modification of budget requests to Congress, and application of American Rescue Plan funds as described below. NSF's controls related to major facility oversight adequately considered and balanced risk, resources, benefit to the science community, and stewardship of federal funds.

[30] GAO-18-370 is available at https://www.gao.gov/products/gao-18-370.
[31] GAO-19-227 is available at https://www.gao.gov/products/gao-19-227.
[32] GAO-20-268 is available at https://www.gao.gov/products/gao-20-268.
[33] GAO-21-417 is available at https://www.gao.gov/products/gao-21-417.
[34] GAO-22-105550 is available at https://www.gao.gov/products/gao-22-105550

Regarding removal criteria described in OIG Bulletin 18-02, Attachment 2,[35] NSF believes it has demonstrated senior-level leadership commitment through the appointment of the CORF, has CAPs in place that implement solutions that are tied to root causes, and has established appropriate performance measures to monitor construction progress. Capacity is demonstrated through rigorous reporting and accountability, and workforce capacity will continue to be enhanced as NSF completes implementation of PMIAA for the major facilities portfolio. In addition, NSF has implemented planned corrective actions, demonstrated progress, and monitored on-going activities as described below.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

Since 2015, NSF has implemented enhanced controls and strengthened agency governance to fully address the recommendations of the 2015 National Academy of Public Administration report; the requirements of the AICA; the FY 2018 and FY 2019 GAO reports; and numerous OIG report recommendations. Examples of recent (FYs 2020 and 2021) agency actions include the following:

- Revised Major Facility Terms and Conditions to require recipients to participate in NSF's Major Facilities Knowledge Management Program, which identifies good practices aimed at improving agency oversight and recipient management of major facilities projects, as part of the CAP for GAO-19-227.
- Required recipients of Construction Stage awards to develop Segregation of Funding Plans.
- Continued use of the Office of the Director's Watch List under cognizance of the CORF with inclusion based on credible threats of cost or schedule overruns, performance issues, or constituting a new, high-risk, large-scale endeavor for the agency.
- Re-programmed funds appropriated in the MREFC account for use as management reserve to cover documented costs incurred due to COVID-19.
- Implemented corrective actions in response to all OIG recommendations under OIG Report *Audit of NSF's Oversight of Subrecipient Monitoring* (18-2-005),[36] which included updating various NSF policies and procedures related to subrecipient risk assessments.
- Continued to monitor allocation of funds between awards as part of required cost incurred audits using Segregation of Funding Plans as reference.
- Completed the major facilities portfolio workforce gap analysis and began development of a Course Curriculum Tool tied specifically to the major facility oversight competency model as part of PMIAA implementation and the GAO-19-227 CAP.
- Finalized revisions to the 2021 *Major Facilities Guide* (MFG) and the re-titled 2022 *Research Infrastructure Guide* (RIG),[37] including:

[35] OIG Bulletin 18-02, "Management Challenges," dated August 15, 2018, describes OIG's process for identifying and reporting the most significant management challenges facing NSF and the National Science Board (NSB). This document also describes OIG's criteria for removing prior reported management challenges.

[36] OIG Report 18-2-005 is available at https://www.oversight.gov/report/nsf/audit-nsf%E2%80%99s-oversight-subrecipient-monitoring

[37] The *Major Facilities Guide* was renamed to the *Research Infrastructure Guide* to be more inclusive of the expanding portfolio of Mid-Scale Research Infrastructure.

    - More detailed guidance on Segregation of Funding Plans which was provided to the OIG for consideration in closing recommendations in OIG Report 19-2-006,[38] *Audit of NSF's Controls to Prevent Misallocation of Major Facility Expenses.*
    - Development of new sections on Key Personnel and Recipient Core Competencies.
    - Development of Section 4.3, *Schedule Development, Estimating, and Analysis* (GAO-19-227)
- Revised and published the *Business Systems Review (BSR) Guide* to better align with the Uniform Guidance and address implementation of segregation of funding plans and the allocation of expenses during the Construction and Operations Stages (if identified as a risk).
- Revised and published *Obligation and Allocation of Management Reserve* Standard Operating Guidance (SOG) (NSF-LFO-FY19-02-00) to clarify the relationship to the National Science Board's delegation of award authority and to eliminate the $10 million applicability limit for use on construction projects impacted by the COVID-19 pandemic.
- In response to the OIG audit report *Monitoring of Government-Owned Equipment Purchased on NSF Award*s (20-2-007), implemented a new SOG on *NSF Oversight and Monitoring of Property in the Custody of Recipients* (NSF-BFA-IRM-FY20-01, Rev 0), transferred title of property to recipients as appropriate, conducted a vehicle allocation methodology, and updated optimal fleet profiles for NSF-titled vehicles.
- Authorized additional management reserve for projects in the Construction Stage, either using the Director's delegated authority or requesting authorization from the National Science Board, as appropriate, to account for continuing impacts of the COVID-19 pandemic and other unforeseen events (e.g., Hurricane *Ida*) and enhanced federal requirements for data security.
- Allocated FY 2021 funds from the American Rescue Plan to cover realized and anticipated COVID-caused cost increases for projects in the Construction Stage, as well as for operations of the Academic Research Fleet.
- Until April 2022, produced a regular report on COVID-19 impacts on major facilities in both the Operations and Construction Stages,[39] which kept leadership aware of the current state of COVID-19 impacts and where NSF action or enhanced oversight might be necessary.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Finalize the *Major Facilities Oversight Reviews* SOG and provide to the OIG and GAO for consideration in closing a remaining recommendation in OIG Report 19-2-006, *Audit of NSF's Controls to Prevent Misallocation of Major Facility Expenses* and a recommendation on recipient project management expertise from GAO-19-227 [FY 2022, Q3].
- Addressed pending OIG recommendation on NSF's divestment of major facilities by utilizing NSF's 2022 Strategic Review process to develop revised definitions and other recommendations related to policies, procedures, and practices. Revised internal standard operating guidance related to competition, renewal, and divestment [FY 2022, Q4].

[38] OIG Report 19-2-006 is available at https://oig.nsf.gov/reports/audit/audit-nsfs-controls-prevent-misallocation-major-facility-expenses.

[39] The regular COVID-19 impacts report was produced weekly by the CORF, working closely with the ADRs, from early March 2020 through mid-June 2020, then biweekly through the beginning of March 2021, and now is produced once per month.

NSF's Ongoing Actions

NSF management established the following milestones in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- Complete development and implementation of the PMIAA Course Curriculum Tool for the major facilities oversight workforce as part of PMIAA implementation and the GAO-19-227 CAP. Monitor progress through periodic self-assessment surveys or other means.
- Continue to evaluate title to property (federally-owned versus recipient-titled) and develop property transition plans, as necessary.

MANAGEMENT CHALLENGE 6: Mitigating Threats Posed by Foreign Government Talent Recruitment Programs

NSF Lead: Rebecca Keiser, Chief of Research Security Strategy and Policy

Summary of OIG Identified Challenge

Safeguarding the U.S. research enterprise from threats of inappropriate foreign influence is of critical importance to NSF and other agencies that fund research, especially as the research community continues to face challenges from foreign talent recruitment programs. According to the Office of Science and Technology Policy, a foreign government sponsored talent program is an effort directly or indirectly organized, managed, or funded by a foreign government to recruit science and technology professionals in targeted fields. While some countries sponsor such programs for legitimate purposes, some programs encourage or direct unethical and criminal behaviors. Contracts for participation in some programs include language that creates conflicts of commitment and/or conflicts of interest for researchers, such as requirements to attribute U.S.-funded work to a foreign institution; recruit or train other talent recruitment plan members, circumventing merit-based processes; and to replicate or transfer U.S.-funded work in another country.

NSF has taken action to mitigate threats posed by such programs. NSF should continue to assess and refine its controls in this area and should work to ensure that it has sufficient staff and resources to address this challenge.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

To maintain a vibrant science and engineering community for the benefit of the nation and maintain the integrity of international scientific collaborations, NSF seeks to safeguard the U.S. research enterprise from threats of inappropriate foreign influence. Participation in this community relies on individuals to uphold core principles such as openness, transparency, reciprocity, collaboration, and integrity. However, open scientific exchange and research face a challenge from some foreign governments through the use of talent recruitment programs. Some of these programs deliberately disregard these core principles and incentivize participants to misappropriate U.S.-funded scientific research prior to its open publication. These programs target scientists, engineers, and educators of all nationalities working or educated in the United States.

Over the past four years, NSF has taken action to mitigate threats posed by talent recruitment programs by working to strengthen disclosure requirements and processes; developing guidelines for strengthening research security; creating a research security strategy position; expanding research security training; and educating the research community.

NSF focuses on the following risks to its funded research from foreign government interference:

- Conflicts of interest that need to be recognized and mitigated by the U.S. employers of the research community,
- Undisclosed research duplication and researcher commitments to research entities outside their U.S. employer,
- Compromises to the merit review system, and

- Unauthorized use of pre-publication data and information.

NSF serves as co-chair of the National Science and Technology Council (NSTC) Subcommittee on Research Security, working closely with the rest of the U.S. government to develop policy that enhances the security and integrity of America's science and technology research enterprise. The Subcommittee on Research Security brought together science agencies and law enforcement to develop the recommendations that served as the foundation for National Security Presidential Memorandum 33 (NSPM-33).[40] The *Recommended Practices for Strengthening the Security and Integrity of America's Science and Technology Research Enterprise*, and the associated fact sheet were released by the White House in January 2021 to direct a national response to safeguard the security and integrity of federally-funded research and development (R&D) in the United States.[41]

In January 2022, the NSTC Subcommittee on Research Security subsequently published the NSPM-33 Implementation Guidance to provide further direction to federal departments and agencies on issues regarding disclosure of conflicts of interest, digital persistent identifiers, consequences for violation, information sharing, and research security programs.[42] The Subcommittee on Research Security is in the final stages of developing common disclosure formats that will soon be released for public comment.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

NSF has completed many actions in prior fiscal years to help mitigate threats posed by foreign government talent recruitment programs and ensure the integrity of federally-funded research. Below are a few of the major actions NSF has taken to address this challenge in prior years.

To provide organizational leadership and oversight, NSF created and filled the first-in-government position of the Chief of Research Security Strategy and Policy (CRSSP) in 2020. The CRSSP provides the NSF Director with policy advice on all aspects of research security strategy while concurrently leading efforts alongside relevant NSF offices to develop and implement strategies that improve research security and the agency's coordination with the White House and other federal agencies.

In March 2020, NSF released mandatory training for all NSF personnel on science and security. The training includes modules on the importance of international collaborations, undue foreign government interference, NSF's policies on disclosure, and NSF's policies on staff participation in foreign government talent recruitment programs. In August 2021, NSF released a second phase of training aimed at staff that directly communicate with proposer and awardee organizations as well as principal investigators on new

[40] The National Security Presidential Memorandum 33 (NSPM-33) may be accessed at https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-united-states-government-supported-research-development-national-security-policy/

[41] Recommended Practices for Strengthening the Security and Integrity of America's Science and Technology Research Enterprise may be accessed at https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/NSTC-Research-Security-Best-Practices-Jan2021.pdf. The associated fact sheet is available at https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/NSC-OSTP-NSPM33-Fact-Sheet-Jan2021.pdf.

[42] Guidance for Implementing National Security Presidential Memorandum 33 (NSPM-33) may be accessed at https://www.whitehouse.gov/wp-content/uploads/2022/01/010422-NSPM-33-Implementation-Guidance.pdf.

requirements in the proposal process related to the submission of "Current and Pending Support" and the "Biographical Sketch" by senior personnel.

As part of its revision to the Proposal & Award Policies & Procedures Guide (PAPPG), NSF announced that use of an NSF-approved format will be required to be used by senior personnel in preparation of both the biographical sketch and current and pending support sections of the proposal.[43] In addition, a new table entitled, *NSF Pre-award and Post-award Disclosures Relating to the Biographical Sketch and Current and Pending Support,* has been developed, disseminated, and updated in April 2022 to assist users in completion of these sections of the proposal.[44]

In FY 2021, NSF greatly increased its collaboration with the OIG and the Federal Bureau of Investigation to exchange information and take action to address offenses, where appropriate. NSF worked collaboratively with the OIG, where appropriate, to address threats posed by foreign government talent recruitment programs. In 2021, consistent with our OIG Cooperation Directive, NSF continued to support the OIG's investigations, including those involving allegations related to foreign talent programs. Following referrals by the OIG, NSF has recouped, or prevented the loss of, millions of taxpayer dollars through actions on awards given to institutions of higher education and small businesses through NSF award suspension, government-wide suspension, and NSF award termination.

Demonstrated Progress Through Agency Actions Taken in FY 2022

Pursuant to NSPM-33, the NSPM-33 Implementation Guidance, and the recommendations of JASON, NSF took multiple actions in FY 2022, which are summarized here:

Developing Policy Across the Enterprise

- NSTC Subcommittee: NSF continues to serve as a co-chair on the NSTC Subcommittee on Research Security, closely working with the White House and other federal science funding agencies, intelligence, and law enforcement communities to coordinate policy and practices, and conduct outreach to institutions of higher education and other research organizations. The NSTC Subcommittee on Research Security is currently working to provide further guidance to the federal enterprise and research community on standardized disclosure formats, digital persistent identifiers, and standardized research security program standards. In addition, the Subcommittee is hosting listening sessions to connect with members of the Asian American, Native Hawaiian, and Pacific Islander communities on issues related to research security and integrity.

  Malign Foreign Talent Programs Working Group: The NSF working group, chaired by the CRSSP, was developed to make recommendations to the NSF Director regarding strategy and implementation of a prohibition of involvement in foreign government talent recruitment programs for those supported by an NSF project, for NSF reviewers, and for those working at NSF-funded large facilities. Following enactment of the CHIPS and Science Act of 2022, NSF is coordinating with the White House

[43] NSF's Proposal & Award Policies & Procedures Guide (PAPPG) may be accessed at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf22001&org=NSF. Additional information on the biographical sketch is available at https://www.nsf.gov/bfa/dias/policy/biosketch.jsp and on the current and pending support is available at https://www.nsf.gov/bfa/dias/policy/cps.jsp.

[44] The updated NSF Pre-award and Post-award Disclosures Relating to the Biographical Sketch and Current and Pending Support table can be accessed at https://www.nsf.gov/bfa/dias/policy/disclosures_table/april2022.pdf.

Office of Science and Technology Policy (OSTP) as OSTP is responsible for coordination of a malign foreign talent plan prohibition.

- Intergovernmental Personnel Act (IPA)-Vetting Working Group: The IPA-vetting Working Group was developed to make recommendations to the Chief Operating Officer regarding (1) potential threats to national or economic security by IPA candidates with foreign affiliations or sources of funding; (2) potential risks due to other conflicts of interest and commitments; (3) confirmation of eligibility, salary, and employment history; (4) timeliness of vetting relative to employment offers and start of assignment; and (5) responsibility and overall timeline for various aspects of vetting and assessment. Recommendations are expected to be delivered to the COO in FY 2023.
- Revision of Terms and Conditions: NSF is undergoing a process to revise the terms and conditions with a requirement on principal investigator certifications for inclusion in the 2023 PAPPG.
- JASON study on "Research on Research Security": NSF is working with the JASON Advisory Group to begin a study that will advise on the constitution of a program on "Research on Research Security."
- Security Clearances Working Group: The NSF working group was formed to make recommendations to the CRSSP regarding establishing a more consistent approach to managing clearances agency-wide. The working group, which met over two phases, worked to develop high-level principles and strategies for determining which positions require security clearances for NSF personnel (Phase 1), and a final set of implementation recommendations (Phase 2). The CRSSP later made recommendations to the Director and COO for integration into NSF's policies and practices.

Pursuing a Systems of Record Notice (SORN) to Use Data Analytics Tool

- SORN-77: NSF published a notice on a new system of records, NSF-77 Data Analytics Application Suite, that will aggregate, link, and analyze information reported by individuals and organizations participating in NSF-supported activities along with published information related to the research enterprise.[45]

Continuing Outreach and Education

- Research Security Training for the External Community and Solicitation: NSF published a solicitation, a joint effort with four other federal agencies (the National Institutes of Health, the Department of Energy, the Department of Defense, and the Federal Bureau of Investigation), to develop online training modules designed to promote the understanding of research security threats as they relate to activities of researchers and other key personnel whose work is supported by federally-funded research awards at awardee organizations.[46] The training will include aspects of talent programs and is also intended to fulfill the training portion of the research security program condition in NSPM-33, which directs federal funding agencies to strengthen protections of U.S. government-supported research and development against foreign government interference and exploitation.
- Outreach to the Academic Community: To increase awareness of the risks and compliance with NSF's policies and procedures, NSF's CRSSP participated in numerous meetings and conferences with the research community, including but not limited to meetings with the Association of American Medical Colleges, the Association of International Education Administrators, the Association of Public and Land Grant Universities, the American Physical Society, the American Physiological Society,

[45] NSF-77 Data Analytics Application Suite can be accessed at https://www.federalregister.gov/documents/2021/11/09/2021-24487/privacy-act-of-1974-system-of-records.

[46] The joint solicitation on Research Security Training for the United States (U.S.) Research Community (NSF 22-576) can be accessed at https://www.nsf.gov/pubs/2022/nsf22576/nsf22576.htm#pgm.

AUTM, the Council on Governmental Relations, the National Academies of Sciences, Engineering, and Medicine, as well as to institutions of higher education such as Bucknell University, Duke University, the University of Arizona, the University of Pennsylvania, the University of Tennessee-Knoxville, and the University of Texas.

NSF's Ongoing Actions

NSF will continue to work diligently to address the risks of foreign government interference in NSF-funded research so that our research community can continue to contribute to the U.S. economy and U.S. security. NSF management developed the following anticipated milestones in consideration of NSF's strategic and operational objectives, and previous actions are described above. Ongoing and future actions include:

- NSTC Subcommittee: NSF will continue to serve as co-chair on the NSTC Subcommittee on Research Security and work closely with the White House, other federal science funding agencies, and intelligence and law enforcement communities to coordinate policy, develop practices, and engage with the research community.
- Malign Foreign Talent Program Working Group: The NSF Malign Foreign Talent Program Working Group will revise policy and implementation options based on the CHIPS and Science Act of 2022.
- 2023 PAPPG: Additional language in the 2023 PAPPG is in development to conform with the NSPM-33 Implementation Guidance, including language on standardized disclosure formats and consequences for violation.
- JASON study "Research on Research Security": The Office of the CRSSP will work to carry out an initial implementation of JASON's study on the constitution of a program on "Research on Research Security."
- Research Security Risk Assessment Center[47]: The Office of the CRSSP will begin concept development on a Research Security Risk Assessment Center and other duties assigned to the Office of the CRSSP as outlined in the CHIPS and Science Act of 2022.
- Research Security Training for the Research Community: The Office of the CRSSP will work together with awardees under cooperative agreements to develop training for the research community in research security. The training requirement is also included in the CHIPS and Science Act of 2022.
- NSF Engines Program: The NSF Engines program under the new Directorate for Technology, Innovation and Partnerships (TIP) is considering new approaches to research security. Specifically, TIP may engage lead awardee organizations in periodic reviews of their research security approaches, both to verify accountability for the large and complex NSF Engines awards, and for the tangential benefit of other awards to those lead awardee organizations.

[47] "The Research Security Risk Assessment Center" is expected to incorporate the requirements that the CHIPS and Science Act of 2022 assigns to a Research Security and Integrity Information Sharing Analysis Organization. https://www.congress.gov/bill/117th-congress/house-bill/4346/text

MANAGEMENT CHALLENGE 7: Mitigating Threats Posed by the Risk of Cyberattacks

NSF Lead: Dorothy Aronson, Chief Information Officer

Summary of OIG Identified Challenge

The prevention, detection, assessment, and remediation of cybersecurity incidents is a top priority of the Administration and essential to national and economic security. Recent world incidents, such as those impacting SolarWinds and Microsoft Exchange, demonstrate the significant risk to federal information when systems are breached. In these and other incidents, foreign governments exploited vulnerabilities in commercial software programs used by federal agencies and gained privileged access to federal systems, allowing them to extract data and personally identifiable information. Although these incidents did not directly affect NSF, they highlight the need for increasingly effective measures to ensure the availability, integrity, and confidentiality of data used to achieve NSF's mission.

Executive Order 14028 "Improving the Nation's Cybersecurity"[48] directs agencies to focus on implementing or expanding key baseline security measures, including universal logging, multi-factor authentication, reliable asset inventories, and ubiquitous use of encryption; and to adopt a zero-trust architecture (ZTA). Zero-trust assumes there is no implicit trust granted to assets or user accounts based solely on their physical or network location or based on asset ownership, and thus shifts to an authentication model where every stage of a digital interaction is validated.

Although OIG has found that NSF has an effective information security program under current FISMA standards, the agency could enhance cybersecurity by implementing zero trust measures.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

NSF's Information Technology (IT) Security Program is committed to ensuring that NSF infrastructure and assets are appropriately protected while maintaining an open and collaborative environment for scientific research and discovery. The agency established a strong and comprehensive risk-based IT Security Program consistent with government-wide guidance and industry best practices. NSF maintains a sophisticated and robust capability to quickly detect and respond to incidents, including state-of-the-art network and security protections as well as advanced threat and breach protections that provide industry-leading threat visibility and detection against attacks.

NSF recognizes the importance and necessity of moving to a modern data-centric model of cybersecurity as government networks evolve and adopt more resilient architectures. The concept of ZTA provides the framework for implementing controls and providing scalability as NSF extends mission critical applications into diverse cloud environments. NSF's ZTA plan and approach describes plans to address the five pillars of

[48] Executive Order 14028, "Improving the Nation's Cybersecurity" is available at https://www.whitehouse.gov/briefing-room/presidential-actions/2021/05/12/executive-order-on-improving-the-nations-cybersecurity/

the Department of Homeland Security's Zero Trust Maturity Model: identity, device, network/environment, application workload, and data.

NSF is employing a multi-pronged approach to the implementation of the ZTA model. NSF understands that implementing a mature ZTA is a long-term effort that will require coordinated efforts across many pillars of cybersecurity. NSF developed a high-level roadmap towards zero trust adoption to move our security program forward with a defense-in-depth strategy. NSF's zero trust approach focuses on a security model that informs risk-based decisions and integrates the principles across the entire IT environment.

NSF's Completed Actions to Address the Challenge

NSF has implemented many actions in support of ZTA principles. NSF leverages the Department of Homeland Security's Continuous Diagnostics and Monitoring program for asset inventory and information sharing; fully deploys endpoint detection and response capabilities; maintains a vulnerability disclosure policy; and implements techniques where components are replaced rather than changed in the NSF Amazon Web Services (AWS) cloud environment.

In years prior to FY 2022 NSF completed encryption of data at rest, and initiated encryption of data in transit.

Demonstrated Progress Through Agency Actions Taken in FY 2022

Implementation of encryption of data in transit continues in FY 2022. In addition, NSF made significant progress in the following areas in FY 2022:

- Enterprise identity management and multifactor authentication: NSF implemented Login.gov for Research.gov as an option for external customers to facilitate the implementation of multi-factor authentication for external users. NSF will be continuing to expand multifactor authentication, e.g., PIV access, for internal applications and is in the early stages of assessing the effort, time and resources required.
- Software security testing: NSF conducts comprehensive and rigorous software testing, including automated security testing throughout the system authorization process. Further manual security testing is planned to strengthen automated testing to provide adequate software security assurance.
- Secure internet accessible system: NSF has identified an initial plan for making a system internet accessible and is in the process of modifying a system to be accessible over the public internet and evaluating the accessibility for others.
- Auditing encrypted data in NSF's AWS cloud environment: NSF incorporates independently managed AWS storage service encryption and decryption services in AWS and configures encryption for data at rest. NSF will continue to encrypt data at rest where the data storage solution contains sensitive data.
- Supply chain risk management anti-counterfeit training: NSF developed and delivered counterfeit detection awareness training for employees and contractors who test software and hardware, have IT security roles, or conduct acquisitions or purchases. The counterfeit awareness training applies to employees and contractors who have IT security roles or conduct acquisitions or purchases.

NSF is incorporating ZTA approaches into all agency modernization strategies. NSF made significant strides in moving IT systems and services to the cloud to modernize legacy technology, improve capacity and uptime, enable more standardization of services, and leverage the security benefits of cloud-based infrastructure. As NSF continues to move agency systems and services to the cloud, the agency will use the

principles of ZTA in cloud planning and deployment efforts. NSF's continuing work will further strengthen data protection, access controls, and application boundaries in alignment with ZTA principles.

NSF's Ongoing Actions

NSF's near-term zero trust efforts are focused on establishing new capabilities to reduce risk and protect sensitive agency data from compromise. NSF's IT infrastructure, applications, security, and development teams are using this approach to describe how NSF plans to isolate applications and environments based on the zero trust principles.

In line with Office of Management and Budget (OMB)'s guidance *Moving the U.S. Government Toward Zero Trust Cybersecurity Principles*,[49] NSF has developed an initial plan to achieve zero trust security goals by the end of FY 2024. As this plan develops, NSF will continue to refine the long-term ZTA migration plan in alignment with guidance from OMB. NSF understands implementing a mature Zero Trust Architecture is a long-term effort requiring coordinated efforts across and within the agency.

In addition to the actions NSF has already taken as described above, NSF management identified the following priority milestones in support of a zero-trust architecture to meet the outcomes outlined in Executive Order 14028 to improve cybersecurity:

Cloud migration
NSF has been migrating enterprise applications to the cloud for the past several years. During migration, NSF makes improvements in process and design that align to ZTA principles, such as network environment isolation, automation for component build, and secure application deployment. NSF's cloud deployments use AWS Organization Units to create multiple accounts. Each account services the needs for a specific environment with minimal connectivity between the accounts. NSF cloud migration activities are ongoing.

Identifying critical software used by NSF
Executive Order 14028 recognizes the importance of software security, particularly critical software security, to the federal government. The National Institute of Standards and Technology (NIST) defines EO-critical software as any software that has, or has direct software dependencies, upon one or more components, e.g., designed to control access to data or operational technology. NSF identified critical software in the IT environment focusing on standalone, on-premises software that has security-critical functions or poses similar significant potential for harm if compromised. NSF's security measures ensure proper access control, inventory, backup, and configuration of software, including critical software, to ensure system integrity and availability. NSF will continue to monitor critical software in its environment.

Ensuring storage and retention of logging data complies with requirements
Audit logging is a central component in the evaluation and analysis of events that affect system security. NSF's IT Security team, in coordination with Information System Owners and other stakeholders, ensures the integrity of NSF information systems by identifying critical logging data in different production environments. NSF retains all audit records for agency required timeframes online using its Security

[49] OMB Memo M-22-09, Moving the U.S. Government Toward Zero Trust Cybersecurity Principles, is available at https://www.whitehouse.gov/wp-content/uploads/2022/01/M-22-09.pdf

Information and Event Management solution. Audit records may be archived to a secure location. NSF will continue to monitor, store, log required critical data across the various production environments.

Supply chain risk management authenticity/anti-counterfeit training
NSF will continue to provide supply chain risk management anti-counterfeit training to employees and contractors as required.

Expand access to phishing-resistant multi-factor authentication on public-facing systems
NSF will continue to work with Login.gov to understand how their timeline for implementing phishing-resistant multi-factor authentication will impact NSF's plan for this task.

Review and revise password policies across the agency
NSF is drafting new password policies for enterprise-facing and public-facing systems and evaluating technologies to support the change. For example, NSF is evaluating capabilities to check passwords against known-breached data and dictionary words, and enterprise password manager tools. NSF plans to implement a password review tool and update the password policy by January 2023.

Secure Access Service Edge (SASE) Deployment
NSF intends to deploy Secure Access Service Edge (SASE) solutions as an architectural approach that will converge networking and security services into a cloud service. NSF is evaluating several enterprise SASE solutions and performing proof-of-concept deployments with select vendors. After evaluating the success of the proof-of-concept deployments, a vendor will be chosen to proceed with a pilot deployment with the goal of rolling out SASE enterprise-wide once policies and configurations have been tuned. NSF anticipates proceeding with deployment in FY 2023.

NSF's high-level roadmap towards zero trust adoption and continued migration to the cloud will serve to optimize security. NSF will continue to refine its long-term ZTA migration plan in alignment with the Department of Homeland Security's zero trust maturity model and guidance from the Office of Management and Budget and NIST.

MANAGEMENT CHALLENGE 8: Managing Transformational Change

NSF Lead: Karen Marrongelle, Chief Operating Officer

Summary of OIG Identified Challenge

NSF may be facing transformational change due to pending legislation, establishment of a new directorate with a cross-disciplinary focus, and the shift to a hybrid workforce. These changes will require NSF to sustain existing programs while developing and implementing new ones, and with existing staff working at maximum capacity. Ensuring NSF continues to provide resources and opportunities to strengthen and advance diversity, equity, inclusion, and accessibility is paramount as NSF faces possible large-scale growth and the transition to a hybrid workforce model.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

Fiscal year 2022 was one of notable change for NSF. In Spring 2022, the agency announced the establishment of the Directorate for Technology, Innovation and Partnerships (TIP), the first new directorate at the agency in 30 years; received its largest appropriations increase in over a decade; and began transitioning staff back to working in the NSF headquarters building after two years of operating under a maximum telework posture. At the same time, the need for NSF to carry out its mission to, "promote the progress of science; to advance the national health, prosperity and welfare; to secure the national defense..." has never been more important. NSF-funded research addresses some of society's most pressing issues including developing solutions to address climate change, investing in the emerging industries that will strengthen our economy, and increasing equity for underserved communities through development of a more representative science and engineering workforce.

NSF has established processes to identify, anticipate, and manage the risk to accomplishment of these organizational changes so the agency may continue to carry out its mission. NSF has a strong history of financial controls, including 24 consecutive years of a clean audit opinion, as well as robust pre- and post-award monitoring to ensure awardees adhere to financial and other reporting guidelines. NSF's Enterprise Risk Management (ERM) process has also matured in recent years, leveraging tools such as data analytics to identify risk areas, risk profiles to articulate a level of risk and the appropriate response, and regular communications to share information and best practices.

In addition to strengthening existing processes, NSF recognizes it must develop new capacity and centralize certain functions to ensure smooth transitions across growth and change. One of these shifts is from knowledge being housed within a program or a specific individual to a paradigm of rapid access to knowledge across directorates and offices. In FY 2022, NSF established an executive-level senior advisor in the Office of Integrative Activities within the Office of the Director with the purpose of establishing a Knowledge Management Framework at NSF to position the agency to be more strategic and agile in delivering the mission. NSF has committed dedicated resources and innovative workforce planning processes to ensure it will recruit and retain the staffing required to capitalize on opportunities presented by our changing environment. In addition, the agency has centralized its space management to facilitate a holistic reassessment of space needs under a hybrid working environment.

Change Management Actions

Managing transformational change is a challenge with a scope that spans the entire agency, as well as both program and business operations. For this reason, there was no singular action plan to address this challenge. Rather, NSF incorporated its existing risk management tools into the broader approach it used to prepare for and manage through changes in FY 2022. In each instance, NSF assembled leaders and subject matter experts from across the organization to define objectives, identify the data needed to assess risks, and outline various options. By engaging all the relevant parties in the process, NSF ensured it achieved its ERM objective to manage strategic and reputational threats and opportunities, and its internal control objective to manage operational, reporting, and compliance risks.

The following narrative discusses how prominent examples of change in FY 2022 – establishment of TIP and transition to a hybrid workforce – employed principles of effective change management based on a model that describes the various components of successful change, including defining success, leadership, project management, and change management.[50] Other examples of managing transformational change throughout NSF are described in the progress reports for OIG's Management Challenges regarding Overseeing Grants in a Changing Environment, Managing the Intergovernmental Personnel Act Program, and Improving Diversity in Science and Engineering Education and Employment, which also speaks to actions NSF has taken to advance diversity, equity, inclusion, and accessibility in its own workforce.

Establishing the Directorate for Technology, Innovation and Partnerships (TIP)

The TIP directorate is a cross-cutting platform that spurs innovation across all science and engineering fields to rapidly address societal challenges and bring new technologies to market and society, while investing in nurturing the diverse talent needed for the future. Effective change management was critical to ensuring that the new directorate's programmatic, technological, and human capital processes were integrated into the NSF structure, while also delivering on new and innovative ways of engaging within and externally to the organization.

Definition of Success: The mission of the TIP directorate is to harness the nation's vast and diverse talent pool to advance critical and emerging technologies, address pressing societal and economic challenges, and accelerate the translation of research results from lab to market and society.

Leadership/Sponsorship: Given the importance of TIP's mission, NSF ensured executive support and management oversight for all phases of the establishment of the TIP directorate. In addition, the NSF Director, senior advisors to TIP, and the Office of Legislative and Public Affairs (OLPA) leadership developed a strategic alliance with the Congressional four corners and the White House to advance a national focus on U.S. competitiveness to bolster TIP's scientific impact.

[50] The Prosci Change Triangle Model outlines four critical aspects for successful change: 1) **Success** – the definition of success for a change, which includes the reason for the change, project objectives, and organizational benefit, 2) **Leadership/Sponsorship** – the direction and guidance for a project, including who is accountable for defining why a change is happening, how it aligns with the direction of the organization, and why it is a priority, 3) **Project Management** – the discipline that addresses the technical side of a change, by designing, developing and delivering the solution that solves a problem or addresses an opportunity, within the constraints of time, cost and scope, and 4) **Change Management** – the discipline that addresses the people side of the change, enabling people to engage, adopt and use the solution. More information available at https://www.prosci.com/methodology/pct-model?hsLang=en-us

Project Management: The TIP implementation and launch were thoughtfully executed through a close collaboration between the Office of Budget, Finance, and Award Management (BFA) and the Office of Information and Resource Management (OIRM), in conjunction with TIP advisors in the Office of the Director and senior NSF officials within OLPA, the Office of the Director, the Office of General Counsel, and AFGE Local 3403. Project plans outlined milestones across eight areas: organization, staffing, contracts, communications, outreach, programmatic, space, and budget. Office points of contact engaged in vital communication at regular checkpoints to review the TIP implementation timeline and establish priorities, chart progress, and provide opportunities for synergy and integration.

Change Management: The unique business objectives and operations of the TIP directorate required innovation and flexibility. As an example, TIP will leverage novel solicitation and award instruments, such as the use of Broad Agency Announcements, to encourage participation from diverse types of entities including industry, non-profits, governments, academia, and communities of practice. The intended outcomes of these awards are also a departure from many traditional NSF awards—formation of regional partnerships to address and solve societal and economic challenges while advancing technology innovations. Acclimating the NSF workforce to new ways of doing business, and cultivating relationships with new types of potential awardees, requires intentional and frequent communications and trust-building.

Transitioning NSF to a Hybrid Workforce

In 2018, NSF contemplated changes to its workforce to adapt to the agency's evolving needs and mission as part of the Renewing NSF initiative. One such change was to "assess the workforce's desire to and feasibility of a geographically dispersed physical presence," as an opportunity to increase the attractiveness of NSF as an employer and increase rotator opportunities by eliminating the need to relocate to the Washington, D.C. metro area. The work to consider the feasibility of a hybrid workforce was accelerated by the COVID-19 pandemic and transition to maximum telework in the spring of 2020, as well as the need to plan to transition at least some of the workforce back to the NSF headquarters building when it was safe to do so.

Definition of Success: NSF's plan for transitioning to a hybrid workforce and re-entry to NSF headquarters in spring 2022 articulated the following desired future outcomes: preserving the organizational culture; enhancing the employee experience and development; strengthening recruitment, retention, and diversity of NSF talent; maintaining and increasing collaboration across the agency; refining and maintaining customer service delivery; and leveraging flexible work arrangements to achieve mission requirements.

Leadership/Sponsorship: From the start of the pandemic, NSF leadership assured staff that the number-one priority was their safety and welfare and backed that promise by executing maximum telework and scheduling flexibilities. As the agency anticipated returning to work in the building, NSF leadership – including the Director and Chief Operating Officer – continued to play a prominent role in providing frequent status updates and addressing staff concerns. NSF is now in an optimal position to proceed to a hybrid work environment due to the credibility of NSF management and the trust earned from NSF staff.

Project Management: NSF is set-up for success in managing the change to a hybrid environment due to proactive planning, engagement with NSF staff, and superior technological infrastructure. The data collected and lessons learned during the pandemic have strengthened the applicability of a hybrid workforce environment at NSF.

Change Management: Communication has been of utmost importance during the pandemic and throughout the transition to hybrid work. The Office of the Director, the Chief Human Capital Officer and

OIRM leadership held numerous town halls and forums to inform staff of the latest situation and the current policies and tools that were in place to ensure staff were comfortable and engaged. NSF has consistently received feedback from its staff during the pandemic through human resources "pulse surveys" to assess staff's concerns and needs. The feedback has been used to expand workplace flexibilities and supervisor tools, which will also be utilized in the hybrid environment. OIRM has provided tools to staff and supervisors to assist with managing change including courses and seminars to improve skills specific to the hybrid environment and supervisor listening sessions to understand challenges associated with moving to a hybrid workforce.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

Agency-wide initiatives

- NSF increased its workforce's ability to communicate and manage through change by promoting learning opportunities on change management to staff and leadership beginning in FY 2021.
- Establishment of an ERM governance structure, including a community of practice to share ideas and information on enterprise-level risks, and development of tools such as risk profiles to help to engrain risk management processes more fully into the NSF culture.

Establishing TIP

- NSF established a workgroup of points of contact throughout OIRM, BFA, and the Office of the Director to coordinate on TIP implementation and roll-out.

Transitioning NSF to a Hybrid Workforce

- NSF incorporated infrastructure needed to conduct hybrid work in its 2017 headquarters relocation, including integrated video conferencing in every conference room, wireless presentation capability, and large video monitors. Hundreds of hybrid meetings were conducted from the conference rooms prior to the pandemic. In addition, the agency accelerated the rollout of Zoom for Government and increased the adoption of Microsoft Teams early in the pandemic to facilitate ease of virtual meetings, webinars, chat, and document collaboration.
- In March 2021, NSF assembled a Hybrid Panel Task Force to evaluate and analyze hybrid panel and meeting operations. The Task Force recommended deploying a state-of-the-art technical panel and meetings collaboration environment.
- NSF established a Remote Work Tiger Team in April 2021 based on an assessment showing strong support for implementing a hybrid workforce model. The purpose of the Tiger Team was to engage staff perspectives and promulgate recommendations for policy, guidance, logistics, and change management required to support implementing a hybrid workforce model. The results of the Tiger Team report have been used to assist in the development of new policies related to remote and hybrid work.

Demonstrated Progress Through Agency Actions Taken in FY 2022

Establishment of the TIP Directorate

TIP was formally announced by the NSF Director and successfully rolled out on March 16, 2022. Establishment of the TIP Directorate involved both integrating operations into existing processes as well as establishing novel approaches to achieve intended program outcomes.

- TIP built on the existing culture of innovation and the extensive portfolio of existing NSF programs that foster public and private partnerships to advance technological innovation, such as the Small Business Innovation Research and Innovation Corps programs. For the recently-launched NSF Regional Innovation Engines (NSF Engines) and Pathways to enable Open-Source Ecosystems (POSE)

programs, TIP established cross-NSF working groups involving representatives from all directorates to help implement the programs.
- NSF's operationally-focused offices—BFA and OIRM—facilitated TIP integration into existing business processes by gathering status information through standardized templates, allowing for management of interdependencies, communication of task completion, and adjustments for delays or roadblocks.
- In general, NSF followed standard IT implementation processes such as documenting and refining business requirements, performing quality assurance and user acceptance testing, and monitoring development using ERM concepts. NSF followed its standard IT playbook for executing a reorganization and was able to establish new best practices given the additional rigor of creating a new directorate. For example, TIP was the first new directorate established under the current NSF business applications and financial system (iTRAK).

TIP engaged in extensive outreach and communication with both internal and external stakeholders to ensure the needed input and buy-in to successfully implement the new directorate's programs and operations.
- For example, NSF leadership conducted outreach to an extensive set of stakeholders in advance of the rollout, including industry, venture capital firms, federal agencies, professional organizations, and colleges and universities. This included listening sessions with 259 participants from 143 different organizations representing minority-serving institutions, two-year colleges, and primarily undergraduate institutions with the objectives of gathering insight from participants about how they can benefit from TIP initiatives, how their experiences and perspectives can be incorporated into the designs of new TIP programs, and to address the questions, concerns, and challenges related to engaging with TIP.
- TIP leadership presented TIP's mission, vision and strategic goals to all directorate leadership teams and advisory committees, including discussion of investment touch points for partnership investments and the establishment of cross-directorate working groups for TIP programs.
- Weekly and ad-hoc meetings of points of contact from BFA, OIRM, and the Office of the Director fostered information sharing and provided motivation and comradery among BFA and OIRM points of contacts and their staff. This close collaboration allowed for efficient issue identification and resolution and helped to secure buy-in from senior management and internal stakeholders.

Transition to a Hybrid Workforce

NSF's planning for transition to a hybrid workforce reflected a robust change-management process that engaged all levels of the workforce. Each phase details specific steps, considerations, and communications requirements to prepare the NSF facility, systems, and support functions for re-entry. Detailed timelines and project plans have been developed to execute, track, and review progress throughout the re-entry process. In general, the transition to a hybrid workforce involved strategies and actions in three key areas: people, place, and technology.

<u>People:</u>
- OIRM issued two pulse surveys in FY 2022 to seek input and feedback from staff to make policy decisions. NSF was able to validate that the workforce felt supported and heard, allowing NSF management to make real time decisions accordingly.
- An NSF-wide Hybrid Vision Work Group drafted an employee engagement action plan that recommended expanding employee networks, promoting shared values, and amplifying the employee voice. Action plans will be developed both at the NSF level and within the directorates and offices with the goals to attract, hire, and retain a talented and diverse workforce.

- NSF conducted a survey of panelist experiences in virtual versus in-person panels to inform future panel operations.
- NSF communicated plans for employee re-entry and transition to a hybrid workforce in many forums and provided numerous resources to address employee concerns. NSF launched a FutureWorks email alias and intranet site to include a transition plan, a fact sheet on assessing positions for remote work eligibility, a variety of tips, guides, and effective practices for hybrid work, and frequently asked questions. Many of these topics were presented at employee and supervisor town halls and addressed during office hours.
- NSF initiated a process to categorize each NSF position as either telework or remote work eligible based on the position's job duties and the effectiveness of performing the job in a fully virtual environment. Results of this assessment, as well as a revised telework and remote work policy, were disseminated in the fourth quarter of FY 2022.

Place:

- OIRM's Division of Administrative Services developed a strategic plan focused on leveraging existing expertise and new building capabilities to enable NSF staff to do their best work. As part of this process, OIRM undertook a large-scale effort to consider each of 100 service areas through the lens of hybrid work. Examples of implemented hybrid operations include moving to an "on-call" or "appointment only" model for onsite services and transitioning certain help desks from on-site to fully remote support.
- NSF centralized space management functions in OIRM to better understand the need and availability of existing workstations because the shift to a hybrid workforce will require a holistic reassessment of space needs.
- In preparation for re-entry and future hybrid work, NSF developed a hoteling center demonstration that staff can use to familiarize themselves with hoteling options and provide feedback.

Technology:

- NSF prepared staff for successful hybrid engagements through extensive testing and updating of conference room equipment, distribution of tips sheets for hybrid meetings and conference room technology, and by conducting an analysis of available technologies to better support hybrid meetings. Specific recommendations included procurement of new camera systems that support either voice tracking or presence tracking in the conference rooms.
- NSF established a Hybrid Work Working Group that will review and recommend current and emerging technologies for NSF's hybrid work environment for the future. Examples include ready access to standard equipment such as laptops and mobile devices, and cutting edge technology such as virtual reality headsets and conference rooms that facilitate hybrid collaboration using advanced audio-visual and immersive techniques.

NSF's Ongoing Actions

NSF management developed the following anticipated milestones in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- NSF will take steps to improve knowledge management by completing an inventory of all agency policies and making them easily accessible by all staff.
- NSF will continue to mature its ERM process as new programs and risks are identified, including updating its risk profiles to reflect the current operating environment.

- NSF will continue to offer courses on change management and hybrid skills, including supervisor listening sessions to understand the challenges as they navigate moving to a hybrid workforce.
- Based on experience gained during TIP establishment, OIRM is in the process of updating, confirming, and validating the process for realignments and reorganizations, including specific duties, roles, and responsibilities of each organization to ensure that all parties are made aware of potential changes, and are able evaluate the proposed changes prior to the effective date.
- NSF will continue to evaluate and implement options for innovative financial instruments, such as the Broad Agency Announcement to accelerate use-inspired research, foster new pathways to rapidly translate discoveries to market and society, and fully engage the nation's diverse talent pool in shaping, conducting, piloting, and scaling research efforts.
- OIRM will continue to monitor and develop technologies to improve the agency's hybrid work capabilities.
- As NSF continues to evaluate space utilization and future needs, OIRM will continue analysis and review of space requirements, including recommendations on design, blocking and stacking plans and the possible creation of new workspaces throughout NSF headquarters.

PAYMENT INTEGRITY INFORMATION ACT REPORTING

The Improper Payments Information Act of 2002 (IPIA; Pub. L. 107-300), as amended by the Improper Payments Elimination and Recovery Act of 2010 (IPERA; Pub. L. 111-204), the Improper Payments Elimination and Recovery Improvement Act of 2012 (IPERIA; Pub. L. 112-248), and the Payment Integrity Information Act of 2019 (PIIA; Pub. L. 116-117) require agencies to annually report information on improper payments to the President and Congress. NSF does not have any high-priority programs as defined by A-123 Appendix C (programs with estimates of improper payments resulting in monetary loss that exceeds $100 million annually). More detailed information on NSF's payment integrity program can be found at https://paymentaccuracy.gov/.

Actions Taken to Address Auditor Recovery Recommendations

Using OMB Circular A-123, Appendix C, Part V.B.2 guidance, NSF determined that it would not be cost effective to conduct recapture audits of its single grants program and other activities (contracts, charge cards, and payments to employees). OMB agreed with NSF's analysis. As such, NSF does not conduct payment recapture audits.

NSF has leveraged the results of the work performed under PIIA, audits, grant monitoring programs, and internal control reviews. All activities consistently demonstrated that there is not a significant risk of unallowable costs or improper payments within NSF's single grant program and other mission support activities. No circumstances have changed within NSF's grant program or its mission support activities requiring NSF to reassess its payment recapture cost-effectiveness analysis.

CIVIL MONETARY PENALTY ADJUSTMENT FOR INFLATION

The Federal Civil Penalties Inflation Adjustment Act Improvements Act of 2015 (the 2015 Act; Sec. 701 of Public Law [P.L.] 114–74) further amended the Federal Civil Penalties Inflation Adjustment Act of 1990 (P.L. 104–410) to improve the effectiveness of civil monetary penalties and to maintain their deterrent effect. The 2015 Act requires agencies to (1) adjust the level of civil monetary penalties with an initial "catch-up" adjustment through an interim final rulemaking and (2) make subsequent annual adjustments for inflation. Inflation adjustments are to be based on the percent change in the Consumer Price Index for all Urban Consumers (CPI-U) for the month of October preceding the date of the adjustment, relative to the October CPI-U in the year of the previous adjustment.

The civil monetary penalties within NSF's jurisdiction are those authorized by the Antarctic Conservation Act of 1978, 16 U.S.C. 2401, et seq., and the Program Fraud Civil Remedies Act of 1986, 31 U.S.C. 3801, et seq.

The following table identifies NSF's FY 2022 inflation adjustments to civil monetary penalties.

Table 3.3 – FY 2022 Civil Monetary Penalty Adjustment for Inflation

Statutory Authority	Penalty (Name and Description)	Year Enacted	Latest Year of Adjustment (via Statute or Regulation)	Current Penalty Level ($ Amount or Range)	Location for Penalty Update Details
Antarctic Conservation Act of 1978, 16 U.S.C., 2401 *et seq.,* as amended	Antarctic Conservation Act, Knowing violations	1978	2022	$31,980	86 FR 72285 Thursday, December 21, 2021
Antarctic Conservation Act of 1978, 16 U.S.C., 2401 *et seq.,* as amended	Antarctic Conservation Act, Not knowing violations	1978	2022	$18,898	86 FR 72285 Thursday, December 21, 2021
Program Fraud Civil Remedies Act of 1986, 31 U.S.C., 3801, *et seq.*	Program Fraud violations	1986	2022	$12,537	86 FR 72285 Thursday, December 21, 2021

GRANTS PROGRAM REPORTING

OMB's Circular A-136, Financial Reporting Requirements requires agencies with Federal grants programs to submit a high-level summary of expired, but not closed, Federal grants and cooperative agreements (awards). Table 3.4, below, shows the total number of awards and balances for which closeout has not yet occurred, but for which the period of performance has elapsed by two years or more prior to September 30, 2022.

Table 3.4 – Age and Balances for Expired Awards not Closed

CATEGORY	2 – 3 Years	>3-5 years	>5 years
Number of Grants/ Cooperative Agreements With Zero Dollar Balances	363	224	96
Number of Grants/ Cooperative Agreements With Undisbursed Balances	0	0	0
Total Amount of Undisbursed Balances	$0	$0	$0

Information shown above is as of 9/30/2022.

As indicated in the table above, NSF's 683 financial assistance awards (grants, cooperative agreements, and fellowships) that are expired but not closed have zero-dollar balances in NSF's financial accounting system. The majority of these awards (98.4%) that are still not fully closed have overdue final project reports and/or project outcome reports and cannot be completely closed.

In the FY 2021 AFR appendix *Grants Program Reporting*, NSF also reported 0 awards with undisbursed funds. NSF continues to review operating policies and accounting practices to close all awards on the same schedule, thereby, ensuring the number is 0.

NSF works to close out all awards as quickly as possible. Typically, awards are financially closed 120-days after the end-date of the award and are administratively closed automatically once the awards are financially closed. To close awards more quickly, NSF now administratively closes awards nightly instead of monthly and runs the automated closeout routines daily instead of just on weekdays.

NSF has made progress in decreasing the number of overdue final project reports and/or project outcome reports by implementing policies and procedures to track and enforce the submission of required project reports. Changes to our processes are guided by recommendations from an NSF working group addressing overdue reports.

NSF reviews overdue report information for reporting eligibility to the Federal Awardee Performance and Integrity Information System (FAPIIS), as prescribed in the revised 2 CFR § 200.[1] In FY 2022, NSF determined no awards/awardees were subject to FAPIIS reporting.

[1] 2 CFR § 200, published in the Federal Register on 8/13/2020: https://www.federalregister.gov/documents/2020/08/13/2020-17468/guidance-for-grants-and-agreements

UNDISBURSED BALANCES IN EXPIRED GRANT ACCOUNTS

In FY 2022, NSF funded research and education in science and engineering through grants and cooperative agreements to 1,800 colleges, universities, and other institutions. NSF grants are funded in one of two ways: (1) the grant may be funded fully at the time of award, called a standard grant, or (2) the grant may be funded incrementally (one year at a time), called a continuing grant. In both cases, all costs on the grant must be incurred by the grantee during the term of the grant period. At NSF, grantees typically have 120 days after the grant expires to complete final drawdowns and expenditures.

The information provided here pertains to the agency's two grant making appropriation accounts: Research and Related Activities and Education and Human Resources. The data reported are based on the following definitions:

- An **expired grant** is a grant award that has reached the grant end date and is eligible for closeout. For NSF, this means grants with an expired period of performance.
- **Undisbursed balances** on expired grants are amounts that remain available for expenditure before it is closed out.

Once a grant has expired, NSF takes actions to close out the grant both administratively and financially. The financial closeout action takes place 120 days after the award expiration date when the undisbursed balances are de-obligated from the award. Administrative closeout is initiated after financial closeout is completed.

The methodology used to develop undisbursed balances on expired grant awards is consistent with the U.S. Government Accountability Office (GAO) conclusions documented in their April 2012 report, GAO-12-360, *Grants Management: Action Needed to Improve the Timeliness of Grant Closeouts by Federal Agencies,* along with discussion and clarifying information from GAO. The data reported here reflects the amount of undisbursed balances in grant accounts that have reached their end date and are eligible for closeout and is provided in accordance with OMB M-16-18, *Financial and Performance Reporting on Undisbursed Balances in Expired Grant Accounts*.

1. **In the preceding three fiscal years, the total number of expired grant accounts with undisbursed balances (on the first day for each fiscal year) and the total amount that has not been obligated to specific grant or project remaining in the accounts**
   The number of expired grants with undisbursed balances for the preceding 3 fiscal years is provided in Table 3.5. The numbers and balances reflect a point in time before expired awards are closed out during normal processes described above. For FY 2022, there were 5,127 expired grants with undisbursed balances of $123,876,877.

Table 3.5 – Status of Undisbursed Balances in Expired Grants

	FY 2022 (as of 9/30/22)	FY 2021 (as of 9/30/21)	FY 2020 (as of 9/30/20)
Number of expired grants	5,127	4,616	4,478
Undisbursed balances prior to closeout	$123,876,877	$99,486,778	$84,615,563

2. **Details on future action NSF will take to resolve undisbursed balances in expired grant accounts**
   NSF continually monitors its grant awards throughout their lifecycle following a comprehensive post-award monitoring process. NSF grants are closed based on their period of performance end date. All unliquidated (or undisbursed) award balances are de-obligated 120 days after the grant period has expired. Having small undisbursed balances at the end of the grant period is a routine occurrence, as not all grantees fully spend the funds obligated during the course of their research.

3. **The method that NSF uses to track undisbursed balances in expired grant accounts**
   NSF completes financial closeout of expired grant awards on a daily basis using a set of automated and manual activities. Eligibility for closeout for all NSF awards begins 120 days after the award expiration date. The NSF closeout process automatically de-obligates any unliquidated award balance, produces an award closeout transaction to flag the award as financially closed, and sends the financial closeout date to NSF's award management system. This initiates final administrative closeout procedures in the award management system.

   The expected award closeout date is made available to awardees and staff through the Award Cash Management Service (ACM$). ACM$ requires the submission of award level payment amounts and expenditures each time funds are requested by awardees and allows NSF to complete post-award monitoring at the individual award level throughout the lifecycle of the award.

4. **Process for identification of undisbursed balances in expired grant accounts that may be returned to the Treasury of the United States**
   When a grant is closed out, the unliquidated balances are de-obligated. The de-obligated grant balances are treated one of three ways:
   - If the source appropriation is still active, the balances are recovered by NSF and remain available for valid new obligations until the source appropriation's expiration date.
   - If the source appropriation has expired but funds have not yet been canceled, the grant balances are recovered by NSF and remain available for upward adjustments on other existing obligations within the source appropriation.
   - If the source appropriation has been canceled, the grant balances are returned to the Treasury.

   Prior to September 30 of each year, all undisbursed grant balances in canceling appropriations are de-obligated and subsequently returned to Treasury.

CLIMATE REPORTING

NSF's FY 2022 *Sustainability Report and Implementation Plan* was prepared in accordance with guidance from the Council for Environmental Quality and highlights actions to advance sustainability and climate resilient operations at NSF.

The report is at this link: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf23005.

AWARDS TO AFFILIATED INSTITUTIONS

The following table lists institutions affiliated with members of the National Science Board (NSB) in FY 2022.[1]

Affiliated Institution	Awards Obligated in FY 2022 (Dollars in thousands)
Arizona State University	$90,390
Auburn University	16,557
California Institute of Technology	78,641
Catholic University of America	1,985
Michigan State University	74,717
Southwest Research Institute	453
Stanford University	61,028
University of California, Los Angeles	77,343
University of Colorado	140,941
University of Florida	52,213
University of Massachusetts	63,001
University of Oregon	26,411
University of Tennessee	40,299
University of Texas at El Paso	26,001
University of the District of Columbia	4,860
University of Utah	52,420
University of Vermont	10,831
Washington University	27,976
TOTAL	***$ 846,067***

[1] This information is provided solely in the interest of openness and transparency. The table lists the dollar value of the awards made to institutions affiliated with NSB members during their time on the NSB in fiscal year ended September 30, 2022. NSB establishes the policies of NSF within the framework of applicable national policies set forth by the President and Congress. Federal conflict of interest rules prohibits NSB members from participating in matters where they have a conflict of interest or there is an impartiality concern without prior authorization from the designated agency Ethics Official. Individual NSF grant awards are made pursuant to a peer-review based process and most are not reviewed by the NSB. With regard to matters that are brought to the Board, NSB members are not involved in the review or approval of grant awards to their affiliated institutions. The table displaying Awards to Affiliated Institutions applicable to the previous fiscal year is available in the Appendices at https://www.nsf.gov/pubs/2022/nsf22002/pdf/nsf22002.pdf. Because of the regular turnover among NSB membership, the information in these tables is not directly comparable across years.

Awards to Assistant Director IPAs' Home Institutions by NSF Directorates

The following tables identify the awards made by directorates to the home institutions of Assistant Directors serving under the Intergovernmental Personnel Act (AD IPAs) during their time at NSF for the fiscal years ended September 30, 2022 and 2021. AD IPAs led four directorates during the fiscal year ended September 30, 2022 and five directorates during the fiscal year ended September 30, 2021. NSF executive staff formulate directorate or office scientific goals, objectives, and priorities. Federal conflict of interest rules prohibit executives, including IPA detailees who serve in AD positions, from participating in matters where they have a conflict of interest or an impartiality concern. NSF grant awards are made pursuant to a merit-review based process and are not routinely reviewed by IPAs serving in executive positions. If matters are brought to such IPAs, they do not participate in the review or approval of awards to their home institutions. The following tables are provided in the interest of openness and transparency.

Table 3.6 – FY 2022 Awards to AD IPAs' Home Institutions

(Dollars in Thousands)

Directorate	Total Dollars and Awards Made by Directorate in FY 2022	Home Institution of IPA Assistant Director	Total Dollars and Awards to Home Institution by Directorate in FY 2022	Total Dollars and Awards to Home Institution by NSF in FY 2022
Computer & Information Science & Engineering	$1,039,029 (2,117 awards)	Princeton University	$10,099 (37 awards)	$57,590 (129 awards)
Engineering	$970,237 (3,260 awards)	Emory University	$424 (3 awards)	$8,387 (41 awards)
Social, Behavioral, & Economic Sciences	$253,555 (1,150 awards)	University of Michigan	$55 (2 awards)	$4,101 (23 awards)
Education & Human Resources	$1,432,621 (3,126 awards)	Ohio State University	$2,726 (5 awards)	$13,115 (26 awards)
Total	$3,695,442 (9,653 awards)		$13,304 (47 awards)	$83,193 (219 awards)

Table 3.7 – FY 2021 Awards to AD IPAs' Home Institutions

(Dollars in Thousands)

Directorate	Total Dollars and Awards Made by Directorate in FY 2021[1]	Home Institution of IPA Assistant Director	Total Dollars and Awards to Home Institution by Directorate in FY 2021	Total Dollars and Awards to Home Institution by NSF in FY 2021
Computer & Information Science & Engineering	$1,064,516 (3,188 awards)	Princeton University	$12,689 (33 awards)	$70,187 (149 awards)
Engineering	$1,068,240 (3,670 awards)	University of Michigan	$4,761 (30 awards)	$93,971 (285 awards)
		Emory University	$715 (4 awards)	$13,681 (38 awards)
Geosciences	$1,573,387 (2,861 awards)	Pennsylvania State University	$2,083 (17 awards)	$28,858 (95 awards)
Social, Behavioral, & Economic Sciences	$259,359 (1,240 awards)	University of Michigan	$14,122 (26 awards)	$93,971 (285 awards)
Education & Human Resources	$1,115,229 (1,906 awards)	Portland State University	$1,546 (5 awards)	$4,268 (20 awards)
Total	$5,080,731 (12,865 awards)		$35,916 (115 awards)	$210,965[2] (587 awards)

[1] Some NSF awards are split funded, meaning an award is funded by two or more directorates. For a split-funded award in this column: the award is counted for each directorate; the award funding is only the split-funded amount.

[2] Two IPAs from the University of Michigan served as ADs during FY 2021. Award dollars and count have been reduced by $93,971 thousand and 285 awards, respectively, in this total box to avoid double counting.

NSF SENIOR MANAGEMENT AND NATIONAL SCIENCE BOARD

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(as of September 30, 2022)

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(during FY 2022)

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Office of Inspector General

Allison C. Lerner, *Inspector General*

[1] Members of the National Science Board whose terms have recently expired, temporarily serving as consultants to the Board.
[2] Resigned November 9, 2021

PATENTS AND INVENTIONS RESULTING FROM NSF SUPPORT

The following information about inventions is being reported in compliance with Section 3(f) of the National Science Foundation Act of 1950, as amended [42 U.S.C. 1862(f)]. There were 1,388 NSF invention disclosures reported to NSF either directly or through the National Institutes of Health's iEdison database during FY 2022. Rights to these inventions were allocated in accordance with Chapter 18 of Title 35 of the United States Code, commonly called the "Bayh-Dole Act."

ACRONYMS

ACM$	NSF Award Cash Management Service
AFR	Agency Financial Report
AOAM	Agency Operations and Award Management
APR	Annual Performance Report
ARP Act	American Rescue Plan Act of 2021
ASC	Antarctic Support Contractor
BFA	Office of Budget, Finance and Award Management
CAP	Cross-Agency Priority or Corrective Action Plan
CFO	Chief Financial Officer
COVID	Coronavirus Disease
DEIA	Diversity, Equity, Inclusion, and Accessibility
EAC	Evaluation and Assessment Capability
EHR	Directorate for Education and Human Resources
EHT	Event Horizon Telescope
ERM	Enterprise Risk Management
FBWT	Fund Balance with Treasury
FECA	Federal Employees' Compensation Act
FFMIA	Federal Financial Management Improvement Act of 1996
FFRDC	Federally Funded Research and Development Center
FISMA	Federal Information Security Modernization Act
FMFIA	Federal Managers' Financial Integrity Act of 1982
FTE	Full-time Equivalents
FY	Fiscal Year
GAAP	Generally Accepted Accounting Principles
GAO	Government Accountability Office
GPRA	Government Performance and Results Modernization Act of 2010
GPS	Global Position System
GRANTED	Growing Research Access for national Transformative Equity and Diversity
GRFP	Graduate Research Fellowship Program
GSA	General Services Administration
H-1B	H-1B Nonimmigrant Petitioner Account
IAA	Interagency Agreement
IG	Inspector General
INCLUDES	Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science
IPA	Intergovernmental Personnel Act
IR/D	Independent Research/Development
IT	Information Technology
iTRAK	NSF's financial management system
MREFC	Major Research Equipment and Facilities Construction
MSI	Minority Serving Institution
NCSES	National Center for Science and Engineering Statistics
NSB	National Science Board
NSF	National Science Foundation
OIG	Office of Inspector General

OMB	Office of Management and Budget
OPM	Office of Personnel Management
OPP	Office of Polar Programs
PAPPG	Proposal and Award Policies and Procedures Guide
PP&E	General Property, Plant, and Equipment
R&D	Research and Development
R&RA	Research and Related Activities
SAM	System for Award Management
SBIR	Small Business Innovation Research
SBR	Statement of Budgetary Resources
SFFAS	Statement of Federal Financial Accounting Standards
STEM	Science, Technology, Engineering, and Mathematics
STTR	Small Business Technology Transfer
TIP	Directorate for Technology, Innovation and Partnerships
UEI	Unique Entity Identifier
USAP	U.S. Antarctic Program
USSGL	United States Standard General Ledger
ZTA	Zero-trust Architecture