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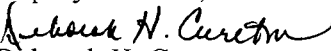


OFFICE OF
INSPECTOR GENERAL

MEMORANDUM

DATE: September 30, 2008

TO: Kathie L. Olsen
Deputy Director, National Science Foundation

FROM: 
Deborah H. Cureton
Associate Inspector General for Audit

SUBJECT: *Audit of Large Facility Operations Agreements: Performance Measurement and Evaluation, OIG Report Number 08-2-005*

Attached please find the final report of our audit of NSF's inclusion of performance measurement and evaluation components in large facility operation agreements. We have included NSF's response, in full, as an appendix to the final report.

OMB Circular A-50 requires NSF to prepare a time-phased corrective action plan to address the report recommendations. Please furnish our office with a copy of this corrective action plan by December 1, 2008.

I appreciate the courtesies and assistance provided by so many NSF staff during the audit. If you have any questions, please contact Karen Scott or me at (703) 292-7100.

Attachment

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**Audit of Large Facility Operations Agreements:
Performance Measurement and Evaluation**

September 30, 2008
OIG 08-2-005



National Science Foundation
Office of Inspector General

Executive Summary

Background

The National Science Foundation (NSF) funds large facilities that allow scientists, educators, and students to access and work at the frontiers of knowledge. These large facilities lead to scientific discovery, learning, and innovation by providing scientists with the advanced instrumentation needed to conduct state-of-the-art research. With funding of more than \$1 billion annually, large facilities are a significant investment for NSF.

Each of NSF's large facilities goes through a multi-stage life cycle consisting of planning, construction, operations and maintenance, and renewal or termination. While construction costs for these facilities can reach into the hundreds of millions, the more significant impact to NSF's budget is from facilities that are in operations.

To operate and maintain these large facilities, NSF typically awards five-year cooperative agreements to universities or non-profit organizations. Under these agreements, the awardee is responsible for the day-to-day operations of the facility, while NSF has the responsibility to monitor and oversee the awardee's programmatic and financial performance.

Purpose

We are conducting a series of audits focused on NSF cooperative agreements for currently operating large facilities. These audits will determine whether NSF's cooperative agreements are sufficient to ensure: 1) identification and accomplishment of programmatic goals; 2) fiscal accountability; 3) stewardship of NSF assets; and 4) compliance with laws and regulations. This is the first of these audits.

Results in Brief

In general, the terms and conditions included in NSF's cooperative agreements for the management and operation of its large facilities need to be strengthened for NSF to fully ensure its facilities accomplish their programmatic goals and objectives. Only two of the six large facility cooperative agreements reviewed include terms and conditions addressing all four of the primary components of a robust program evaluation and measurement system. These primary components include program goals, qualitative and quantitative performance measures and targets against these goals, reporting requirements, and evaluation and feedback.

With over \$1 billion annually going to NSF's large facilities, it is important that NSF have a process to ensure *all* large facility agreements contain each of the performance components. Currently, NSF has no overarching policies in place to ensure that the

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agreements for large facilities contain terms and conditions to address performance evaluation and measurement. Instead, the success that some of the facilities have achieved has been primarily due to the hard work and dedication of program officers who identified the need for performance evaluation systems and, through a process of trial and error, incorporated performance evaluation terms and conditions into the cooperative agreements over time. Therefore, we believe the absence of an agency-wide policy contributed to the inconsistency among agreements in addressing all of the critical elements of sound and effective cooperative agreements.

Without all the components for performance evaluation and measurement, NSF and external reviewers that may be called upon to evaluate the success of a facility may not be able to fully assess the performance of the awardees, and as a result, NSF can not be assured that the facilities it funds are operating as effectively and efficiently as possible or are achieving their intended goals.

NSF already has an established organization responsible for developing policies related to NSF's large facilities and for managing and overseeing these investments. This Large Facility Office, within the Office of the Chief Financial Officer, should provide the oversight needed to ensure all large facility agreements contain performance measurement systems and improve the learning curve for new program officers. If the Large Facility Office were to develop formal NSF policies regarding performance measurement and evaluation for large facilities, it would allow all responsible NSF staff to more easily construct agreements for the operation of large facilities that include programmatic performance and evaluation components.

Recommendations To ensure all current and future large facility operation agreements include clear and agreed-upon goals, performance measures and targets, reporting requirements, and methods for evaluation and feedback we recommend the NSF Deputy Director

- (1) Provide authority and resources to fully utilize the Large Facility Office to oversee **all** phases of the large facility life cycle;
- (2) Direct the Large Facility Office to develop and incorporate into NSF's Proposal and Award Manual, an overarching policy and implementing procedures that require, either directly in the award notice or by reference through other documents, all current and future facility agreements to include, at a

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minimum, the four performance evaluation and measurement components: 1) clear and agreed-upon goals and objectives; 2) performance measures and, where appropriate, performance targets; 3) periodic reporting; and 4) evaluation and feedback to assess progress;

- (3) Direct the Large Facility Office to provide training on performance evaluation and measurement systems for NSF staff; and
- (4) Direct the Large Facility Office to develop a mechanism for knowledge transfer among program officers with responsibility for currently operating large facilities.

Agency Response and OIG Comments

NSF generally agreed with our findings and agreed with all of our recommendations.

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Introduction

Large Facilities at NSF

Created by the Congress in 1950, the National Science Foundation (NSF) is an independent Federal agency whose mission is “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense...” In accomplishing this mission, NSF funds approximately 20 percent of all Federally supported basic research conducted at America’s colleges and universities, primarily through grants and cooperative agreements. The majority of these awards go to individual or small groups of investigators for research projects with an average duration of three years. NSF also funds other endeavors, such as large facilities, that allow scientists, educators, and students to access and work at the frontiers of knowledge. These large facilities lead to scientific discovery, learning, and innovation by providing scientists with the advanced instrumentation needed to conduct state-of-the-art research. With funding of more than \$1 billion annually, large facilities are a significant investment for NSF.

Each of NSF’s large facilities goes through a multi-stage life cycle consisting of planning, construction, operations and maintenance, and renewal or termination. Each phase of the lifecycle has its own unique characteristics that in turn create new and different management and operational challenges for both the facility and NSF, which provides oversight of these projects. At the time we initiated this audit, NSF was overseeing 4 large facilities in the planning phases, 6 under construction, and 16 in the operations phase.

While construction costs for these facilities can reach into the hundreds of millions, the more significant impact to NSF’s budget is from facilities that are in operations. In fiscal year 2006, NSF spent over \$1 billion, almost 18 percent of its \$5.6 billion budget,¹ to operate its large facilities. In contrast, during the same period, NSF spent \$233.8 million, or 4 percent of its budget for facility construction. The operations phase includes:

the day-to-day work required to: support and conduct research and education activities; ensure that the facility is operating efficiently and cost-effectively; and provide small- and intermediate-scale technical enhancements when needed to

¹ This \$1 billion supports the 16 large facilities that are in operations, some smaller physics and materials research facilities, and the initial support for operations and maintenance funding for projects still in construction. A small portion of this figure also supports the phase out of the Ocean Drilling Program and the concept and development for some of the major research equipment and facility construction projects.

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maintain state-of-the-art research capabilities.²

To operate and maintain these large facilities, NSF typically awards five-year cooperative agreements to universities or non-profit organizations. Under these agreements, the awardee is responsible for the day-to-day operations of the facility, while NSF has the responsibility to monitor and oversee the awardee's programmatic and financial performance.

Composition of a Cooperative Agreement

At NSF, a cooperative agreement is much more than a single document. According to the NSF's Proposal and Award Policy and Procedures Guide, the "[c]omposition of an NSF award includes:

- a. the award notice, including any special conditions applicable to the award and any numbered amendments thereto;
- b. the budget, which indicates the amounts, by categories of expense, on which NSF has based its support;
- c. the proposal referenced in the award notice;
- d. the applicable NSF conditions referenced in the award notice; and
- e. any NSF program announcement, program solicitation or other documents or special requirements incorporated by reference in the award notice."

For large facility awards in operation, the cooperative agreement is typically composed of the award notice including any special conditions applicable to the award and any numbered amendments, the award budget, the proposal referenced in the award notice, the applicable NSF conditions referenced in the award notice, and any NSF program announcement, program solicitation or other documents or special requirements incorporated by reference in the award notice. For example, some of the large facility agreements incorporate annual program plans, proposals, guidelines, and other references in the award notice and consequently, these become part of the cooperative agreement.

Objectives, Scope and Methodology

Due to the sizable investment by NSF in the operations phase of its large facilities, we are conducting a series of audits focused on NSF's cooperative agreements for currently operating large facilities. These audits will determine whether NSF's cooperative agreements are

² *Large Facilities Manual*, National Science Foundation, at 26 (May 2007).

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sufficient to ensure: 1) identification and accomplishment of programmatic goals; 2) fiscal accountability; 3) stewardship of NSF assets; and 4) compliance with laws and regulations. We will issue separate audit reports addressing each of these objectives. Our audits will be limited to assessing the adequacy of the terms and conditions of the agreements themselves and will not evaluate either the awardee's implementation of those terms and conditions or NSF's oversight and management of the cooperative agreements.

To accomplish these objectives we chose cooperative agreements for 6 of the 16 large facilities currently in the operations phase. The following facilities will constitute our sample for each audit:³

- Academic Research Fleet (ARF);⁴
- Cornell Electron Storage Ring (CESR);
- Gemini Observatories (Gemini);
- George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES);
- National Center for Atmospheric Research (NCAR); and
- National Optical Astronomy Observatory/National Solar Observatory (NOAO).

We selected these facilities in order to include as broadly as possible the varying characteristics of NSF's large facility portfolio. For example, the sample includes Federally Funded Research and Development Centers (FFRDCs)⁵ and non-FFRDCs; newly operating and longstanding facilities; those that conduct in-house research and those that do not; facilities that receive additional funding from other government agencies or international partners and those that rely solely on NSF as the funding source; and facilities overseen by different NSF scientific directorates.

This first audit focuses on whether NSF has included sufficient terms and conditions in its large facility cooperative agreements to ensure

³ See Appendix B for descriptions of each of the six facilities contained in our sample.

⁴ While referred to as the Academic Research Fleet in NSF's budget, this facility is also referred to as the University-National Oceanographic Laboratory System (UNOLS). In addition, the ARF agreements consist of one cooperative agreement for the UNOLS Office and 23 separate cooperative agreements for each of the 23 ships currently in operation. We reviewed the UNOLS office agreement and all 23 ship agreements.

⁵ See Federal Acquisition Regulation Part 35 for more information on Federally Funded Research and Development Centers.

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awardee accomplishment of the facilities' programmatic goals.⁶ To establish a framework for assessing these terms and conditions, we reviewed relevant scholarship that identified the primary components of a performance evaluation and measurement system. This scholarship included NSF's own studies of large facilities, prior audits addressing NSF's large facility projects, and other external studies.

For each of the sample facilities, we identified and reviewed the performance evaluation and measurement terms and conditions reflected in the cooperative agreements. We also discussed, with both the responsible program officers and grant officers, the terms and conditions of each of the six large facilities as they relate to our audit objective.

We conducted this performance audit between July 2006 and July 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective.

⁶ We use the term "programmatic goals" in a broad sense to indicate all goals that the awardee is intended to accomplish in the operation of the facility, such as basic operations, administration, technical enhancements, education and outreach, and maintenance. This includes more than the end scientific goals, for which the facility was first created.

Requirements for Performance Evaluation and Measurement Are Important for All Large Facility Agreements

Performance Evaluation and Measurement Are Important

Increasingly, there has been a push for Federal agencies to demonstrate the quality and results of their programs. The Government Performance and Results Act (GPRA), enacted in 1993, requires the measurement and reporting of program results to determine if the programs are effective and achieving their strategic and annual goals. Additionally, in 2002, the Office of Management and Budget (OMB) developed the Program Assessment Rating Tool (PART) to assess and improve program performance so that the Federal government can achieve better results. Most recently, in November 2007, an Executive Order issued by the President requires Federal agencies to set measurable goals to improve operations and establish a means to measure their progress towards these goals.

Additionally, there has been greater emphasis within the Federal government to apply program evaluation and measurement concepts to assistance awards such as grants and cooperative agreements. Many Federal agencies use program performance evaluation and measurement as a tool for ensuring that the desired results of its awards are achieved. Large facility awards can benefit from the application of program measurement concepts on a consistent basis.

As the competition for budget resources intensifies, high-level decisionmakers, such as the Congress and agency heads, need to know which programs are achieving their goals and objectives to make informed decisions about where to allocate scarce resources.⁷ NSF is similarly faced with making tough funding decisions among competing priorities. Proposed facilities are competing for scarce resources not only with other new facilities, but also with existing facilities and traditional single-investigator research. One of NSF's management challenges is to create a portfolio management plan that takes into account these competing priorities and the research needs of the entire scientific community. One of the ways in which NSF can meet this challenge is through the use of a robust system to evaluate and measure the accomplishments of its facility programs.

Measuring the results of a particular grant or large facility can provide evidence of its successful performance against goals and objectives. Program managers can use performance evaluation and measurement information to defend their programs against budgetary challenges and

⁷ *Guide to Opportunities for Improving Grant Accountability*, Domestic Working Group at 36 (Oct. 2005).

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make decisions on resource allocation.⁸ In addition, performance evaluation and measurement will help organizations understand how decision-making processes or practices led to success or failure and help identify needed improvements.⁹ Performance measurement also allows for the early detection of problems and the implementation of midcourse corrections.

NSF can likewise benefit by including a robust performance evaluation and measurement system in its large facility cooperative agreements. With such a system in place, program officers and external reviewers can more easily determine the success of NSF's facilities. As explained by one NSF site-visit team, if a facility does not collect critical measures, the opportunity to evaluate the work underway is lost. In turn, NSF may not be able to adequately determine funding priorities or determine whether to recompute the operations of the facility in the future. In addition, if NSF can't determine whether to recompute a facility, NSF may continue to fund an awardee that is not operating in an effective or efficient manner and this could eventually impact the science being conducted at the facility.

Four Key Components of Performance Evaluation and Measurement

Relevant scholarship¹⁰ on measuring program performance within the Federal government has identified four key components of an effective program evaluation and measurement system: 1) clear and agreed-upon goals and objectives; 2) performance measures and, where appropriate, performance targets; 3) periodic reporting; and 4) evaluation and feedback to assess progress.

Clear and Agreed-Upon Goals

The first component of a robust performance evaluation and measurement system is a set of clearly defined goals and objectives that have been agreed to in writing by both NSF and the awardee.

The *Guide to Opportunities for Improving Grant Accountability* developed by the Domestic Working Group states, "before the grant process even begins, goals ... must be established to provide a guide." But these goals must be well defined so that they are clearly understood by all parties. As expressed in the *National Academies Report: Key Performance Indicators for Federal Facilities Portfolios*, effective

⁸ *Id.*

⁹ *Key Performance Indicators for Federal Facilities Portfolios*, National Academies (2005).

¹⁰ See Appendix C for a full list and description of this scholarship material.

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performance evaluation and measurement systems include “clearly defined, actionable, and measurable goals.”

OMB’s *Performance Measurement Challenges and Strategies* identifies two types of goals. Strategic goals are statements of purpose or mission. An example of a strategic goal for a weather program might be “protecting life and property, and promoting commerce and the quality of life, through accurate forecasts.” The second type of goal flows from the strategic goals and is called a performance goal. OMB defines performance goals as “target levels of performance expressed as a measurable objective, against which actual achievement can be compared.” Performance goals can be used to evidence progress towards accomplishment of strategic goals. For example, a performance goal for a weather program might be “increasing the accuracy of local weather forecasts over the next year.”

In addition to being clearly defined, the goals for each of NSF’s large facilities must be agreed upon between NSF and the awardee. NSF awards its large facilities through cooperative agreements. The basic understanding of such an agreement is that the two parties work in partnership to achieve a common purpose. Consequently, agreement on facility goals, both strategic and performance, is essential to the success of the facility and provides the direction for both management and oversight of the facility. According to the *Guide to Opportunities for Improving Grant Accountability*, “lack of agreement among grantees and Federal parties regarding grant purposes and performance measures, results in a lack of focused planning to achieve common goals.”

Further, it is important to document these goals in the facility cooperative agreements. As stated in NSF’s *Award Administration Guide*, “the grantee should monitor the performance of the project to assure adherence to performance goals, time schedules or other requirements as appropriate to the project or the terms of the grant.” Further, as stated in NSF’s *Proposal and Award Manual*, NSF’s role focuses partly on “monitoring the work performed by the prime awardee to ensure that it is consistent with the primary objectives of the program as reflected in the award.” By placing the facility’s goals in the agreement, the awardee has clear knowledge of the expectations and award requirements upon which to measure its performance.

Requirements for Performance Evaluation and Measurement Are Important for All Large Facility Agreements

Performance Measures and Targets

The next step in creating a robust performance evaluation and measurement system is to develop performance measures and targets where appropriate, as tools for determining whether a facility is progressing successfully towards its stated goals and objectives. According to the *Guide to Opportunities for Improving Grant Accountability*, “measuring the results of a program can provide evidence of its successful performance against goals and objectives.”

OMB’s *Performance Measurement Challenges and Strategies* defines performance measures as “indicators or metrics that are used to gauge program performance.” Performance measures can be outcome or output focused, as well as qualitative or quantitative. Outcome measures assess the results of a program against its intended purpose while output measures are tabulations or calculations of an activity that can be expressed in either a qualitative or quantitative manner.¹¹ For example, an outcome measure might be whether the weather program has achieved its goal of protecting life and property, while one output measure might be average advance warning time for tornadoes. A target for the tornado warning time might be an average of 20 minutes by a certain date.

Progress against stated goals might also be measured through the conduct of a qualitative study or review of a program. For example, one way that NSF evaluates the performance of its awardees is through awardee site visits. However, performance measures encompass more than a statement that NSF will conduct a periodic review of the facility. Performance measures and targets give definition to such a review. Consequently, a balance of output and outcome, or quantitative and qualitative measures and targets can provide an organization with a full view of the success of a facility. For example, output or quantitative measures and targets can better inform an overall outcome or qualitative assessment.

While the use of this exact model may not be optimum for NSF's large facilities, the Department of Energy (DOE) Office of Science includes performance measures and targets in its contracts for the management of its laboratories, which, like some of NSF's large facilities, are considered FFRDCs and are managed by outside entities such as research universities. According to DOE, this performance-based management approach has “placed a greater emphasis on mission performance, best business practices, cost management, and improved contractor

¹¹ Government Performance and Results Act, Public Law 103-62 (2003).

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accountability.” DOE defines a performance measure as a “quantitative or qualitative method for characterizing performance to **assist the reviewer** in assessing achievement of the corresponding performance objective (i.e., what you would measure)” (emphasis added). DOE’s measurement process includes outcome and output performance measures and targets for both management and operation goals and science and technology goals. For example, management and operation evaluation may include such measures as the number of safety incidents or the percent of external audit findings that were not previously identified through self assessment, while science and technology measures may include the number of publications in journals, significant awards, and invited talks.

Just as with goals, it is important for NSF to include performance measures and targets in its cooperative agreements for large facilities. *The Guide to Opportunities for Improving Grant Accountability* states that Federal agencies “need to establish measures for new grant programs quickly, ideally before awards are made, to incorporate measurement requirements into the grant award.” Further, according to NSF’s Facilities Subcommittee of the Business Operations Advisory Committee, “**all** cooperative agreements that fund operations should incorporate appropriate metrics for success” (emphasis added). As expressed in a recent NSF Total Business Systems Review¹² of a large facility, implementing performance metrics allows NSF to monitor awardee performance and is a means of continuously improving operating performance, accountability, and efficiency.

For NSF for example, large facility measures could include such output or quantitative measures as 1) the number of scientists and students trained or using a facility, 2) the number of students going on to graduate school after being involved with a program at the facility, 3) the number of facility-related publication citations per year, 4) usage rates at the facility, 5) delivery of major instruments on time and budget, 6) number of facility users reporting satisfactory or better experience, or 7) the percentage of annual tasks completed. After determining which measures are appropriate for the given facility, NSF, in conjunction with the awardee, can then develop appropriate targets for these measures. Subsequently, the results of these measures can be used by NSF reviewers during awardee site visits and other outcome or qualitative

¹² NSF’s Total Business System Reviews (TBSR) are advanced monitoring functions that NSF uses to assess the efficiency and effectiveness of its Large Facility awardees’ business systems.

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reviews to assess overall success.

Periodic Reporting

The third necessary component for a strong performance evaluation and measurement system is a mechanism for reporting on performance information. In its report, *Internal Control – Integrated Framework*, the Committee of Sponsoring Organizations explains that performance information is needed to run an organization, and to move toward achievement of the organization’s objectives. Reporting of this information provides management a way to assess the entity’s performance relative to established objectives.

Performance information reporting is applicable to NSF’s large facilities. Reporting requirements complement the performance management system best when they are incorporated into the cooperative agreement. NSF does recognize the importance of reporting for its large facilities. As stated by NSF in its *Large Facility Manual*:

reviews and reporting are an important part of the process that allows the [program officer] to monitor performance and compliance with project goals...The [program officer] should clearly define the reporting requirements that are the responsibility of the awardee in the Cooperative Agreement.

Information reported to NSF can be used in making management decisions regarding large facilities, such as determining whether to re-compete a facility’s management agreement. As further explained in NSF’s guidance on large facility Project Execution Plans:¹³


since the policy of NSF is to re-compete operational agreements for large facilities on a five-year basis (or sooner, if indicated by the performance of the Awardee in managing the facility), these awards should be structured in a way that **provides the information to NSF** to make this assessment. Thus, the cooperative agreement may contain specific conditions that facilitate this determination... (Emphasis added.)

Further, placing reporting requirements in the cooperative agreement can

¹³ This information is taken from NSF’s *Draft Guidelines for Development of Project Execution Plans for Large Facilities*, the purpose of which is to provide assistance to the Program Officer, Grants and Agreements Officer, and others involved in overseeing a large facility project in assessing the project management plans of an awardee.

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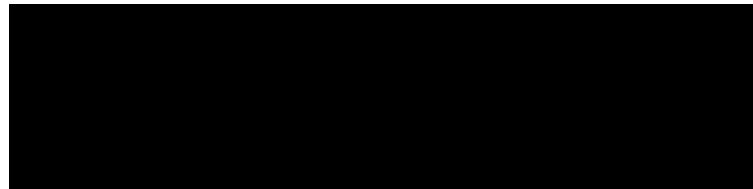
minimize future problems. The Facilities Subcommittee of NSF's Advisory Committee for Business and Operations raised a



Evaluation and Feedback

The final component of a robust performance management system is a method for evaluating progress towards meeting goals and providing feedback on that progress. As stated in the *National Academies Report: Key Performance Indicators for Federal Facilities Portfolios*, “[p]erformance measures are of limited value unless they are used in conjunction with formal and continuous feedback, or evaluation, processes.” In addition to this report, the *Guide to Opportunities for Improving Grant Accountability* states, “once grants are awarded, performance needs to be monitored. Following grant completion, the goals and measures established at the beginning of the process need to be evaluated against actual results and adjustments made as needed for future grants.”

Independent evaluation has long been a necessary component of NSF-funded research. According to the *Report by the Facilities Subcommittee of the NSF Advisory Committee for Business and Operations*:



The evaluation process also needs to provide feedback so that the facility's management can correct any potential problems. The *Guide to Opportunities for Improving Grant Accountability* states that through the evaluation of performance, awardees can address potential problems early in the grant period and keep on course toward goals. In addition, evaluations can help “identify reasons for success or failure and recommend changes that can help a program achieve its goals and objectives.” According to the *National Academies Report: Key Performance Indicators for Federal Facilities Portfolios*, key components of an effective performance measurement system include “feedback systems to support continuous improvement of an organization's processes, practices, and results.”

Requirements for Performance Evaluation and Measurement Are Important for All Large Facility Agreements

Improvements Needed to NSF's Cooperative Agreements

All six of the facilities in our sample included at least one component of an effective program evaluation and measurement system. However, only two contained all four elements.¹⁴

| | Gemini | NOAO | NCAR | ARF | NEES | CESR |
|-------------------------------------------|--------|------|------|-----|------|------|
| Clear and Agreed-Upon Goals | Yes | Yes | Yes | No | No | No |
| Balanced Performance Measures and Targets | Yes | Yes | No | Yes | No | No |
| Reporting Requirements | Yes | Yes | Yes | Yes | Yes | No |
| Evaluation and Feedback | Yes | Yes | Yes | Yes | Yes | Yes |

All of the cooperative agreements contained in our sample provide for a monitoring system that includes evaluation and feedback. In addition to a general statement of NSF's responsibility for facility monitoring and oversight, all the agreements inform the awardee that both NSF and external experts will review the performance of the facility on a periodic basis to help determine the success of the facility.

The Gemini and NOAO agreements both contain all four components of a robust performance evaluation and measurement system. These agreements provide for clear and agreed-upon goals and also address a process for updating these goals when necessary. These agreements require long-term as well as annual program plans, approved by NSF program officers that define and give substance to strategic goals by detailing major program goals and emphases, including new thrusts and changes envisioned for the upcoming years. These agreements also require balanced performance measures and targets through a combination of qualitative and quantitative, and outcome and output measures. The Gemini and NOAO cooperative agreements also require the awardee to report to NSF on tasks completed under its annual program plans, GPRA measures and targets, and quantitative and qualitative performance information. However, while these agreements met all of our basic performance evaluation components, they could still be improved by requiring the awardees to report on more of the key performance measures and targets for which they are already collecting

¹⁴ See Appendix D for more detailed information on how each facility's agreement addressed the four components.

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performance data and by clearly defining what constitutes poor performance that would necessitate corrective action on the part of the awardee.

Like the Gemini and NOAO agreements, the NCAR agreement includes clear and agreed-upon goals, reporting requirements, and a method for evaluation and feedback. However, the NCAR agreement does not provide for balanced performance measures and targets. The NCAR agreement contains primarily qualitative and outcome oriented measures. NCAR's strategic plan, which has been incorporated into the cooperative agreement by reference, contains numerous measures for how it plans to meet its strategic goals such as the following measure related to education:

Student and teachers will have new opportunities to benefit from and participate in the science and engineering taking place at a major national research center.

The plan continues by providing additional detail on the many facets of this measure. For example, the plan states:

NCAR will work with university colleagues and other interested stakeholders to propagate atmospheric science-related curricula, science centers, and museum exhibits worldwide, with an initial focus on climate affairs.

However, the NCAR cooperative agreement does not balance these qualitative and outcome measures with quantitative or output measures. In many cases, a simple change could provide more information for potential reviewers to evaluate whether NCAR is fully successful in meeting its overall goals. For example, the above measure may have provided more meaning if it defined either target amounts of curricula, science centers, and museum exhibits or a target increase over current levels.

The ARF agreements also meet three of the four requirements for an effective performance measurement system, but are missing clear and agree-upon goals. While the ship operations' context statements¹⁵

¹⁵ The context statement is part of the program officer's review analysis of each ship proposal.

¹⁶ Due in part to the lack of clearly defined metrics, NSF intends to phase out the NEESinc cooperative agreement over a two-year period.

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contain detailed goals for ships in operation, these goals were not incorporated into the cooperative agreements. However, according to the NSF grants officer responsible for ARF, NSF is open to placing these goals into the cooperative agreements in the future.

The NEES agreement only contains two of the four components necessary for an effective performance measurement system. First, while NEES has been attempting to improve the clarity of its goals, further improvements are still needed. While the original cooperative agreement contained some goals, two expert review teams have noted problems with the clarity of those goals. A 2005 NSF review team composed of management and financial professionals noted that NEES “did not have clear, consistent, and focused goals.” As a result, the awardee created a “task group on success” and issued revised long-term strategic goals. Most recently, a July 2007 review team stated that NEES still needed to better convey what the facility wants to achieve. In particular, the site visit report stated that NEES lacked “corresponding objectives to demonstrate the relevancy, measurability, or successful achievement of each of [its] goals.” In addition, while the NEES agreement does require user surveys, qualitative and quantitative performance information, and NSF GPRA measures, NSF relies heavily on the awardee to create most of the balanced performance measures and targets for the facility. Although the cooperative agreement requires the awardee to create performance metrics, it does not specify by when the awardee should complete and submit all of its metrics to NSF. Over three and a half years into the award, the awardee has still not finalized many of its measures and targets nor have they been incorporated into the cooperative agreement. Further, while the scope of our audit did not include an assessment of the quality of the measures the awardee has created, a July 2007 site visit team stated, “[t]he recently defined performance metrics are process oriented and are monitoring progress rather than performance.”¹⁶ Further, while NEES has started to submit annual work plans to NSF, the NEES agreement does not explicitly require such plans be submitted to NSF for each year and thus incorporated into the cooperative agreement.

The final agreement we reviewed contains just one of the four components needed for an effective performance measurement system. CESR is a mature facility that NSF is phasing out of its portfolio. For that reason, the goals of the facility have changed. However, the cooperative agreement has not kept pace with those changes and been updated with these new goals. If the CESR agreement had incorporated

Requirements for Performance Evaluation and Measurement Are Important for All Large Facility Agreements

annual or long-term program plans by reference into the cooperative agreement, CESR could have had a vehicle for defining and updating its goals. In addition to needing updated and clearly-defined goals, the CESR agreement is mostly silent on the creation of performance measures and targets. This agreement does not incorporate the NSF GPRA measures, nor does it require user surveys, annual program plans, or in-depth quantitative or qualitative information. Finally, the CESR agreement only requires the awardee to report basic information to NSF. Because the CESR agreement does not include performance measures and targets, the awardee may not collect meaningful information or report this to NSF.

More Policy and Support Needed

Limited Success Occurred through Trial and Error

While the agreements we reviewed contain some of the elements needed for effective accountability and assessment, NSF lacks an overall policy requiring its facility agreements to include provisions for identifying, tracking, and reporting performance goals and accomplishments of the facility. In addition, NSF provides little or no means for responsible program officers to share information, experiences, and best practices for assessing facility success. We believe such an overarching policy on performance management in agreements for facilities and formal mechanisms to transfer and share best practices would lead to more comprehensive and consistent facility agreements.

Without an overall policy for including performance-related terms and conditions in its cooperative agreements, NSF's performance requirements in the current agreements are the result of a process of trial and error. One program officer stated that if the cooperative agreement was at all successful, it was through hard work, and he had the "bumps and bruises" to show for it. For example, several of the award agreements we reviewed incorporated performance evaluation after an external review or study noted the lack of performance measures at the facility. NOAO strengthened its performance measurement after the National Research Council of the Astronomy and Astrophysics Survey Committee released a report in 2001 entitled "*Astronomy and Astrophysics in the New Millennium*," which recommended that "NSF should set criteria...by which NOAO's success can be evaluated." Similarly, NCAR has continuously improved its performance measurement systems in response to NSF program officers' requests and to recommendations from NSF panel reviews. For example, a December 2002, panel report recommended that NCAR "develop a robust set of metrics (beyond citation analyses) that characterize the quality, effectiveness and efficiency of both science programs and service functions." In response, NCAR developed a more comprehensive set of metrics. As program officers must currently rely on prior experience to learn how to strengthen future agreements, program officers could be more efficient and more assured that their cooperative agreements are complete if they had NSF-wide guidance and resources.

Additionally, NSF provides little means for program officers to transfer knowledge among other program officers by sharing lessons they have learned in overseeing their facilities. As expressed by one program officer, she would have incorporated performance measures such as annual program plans and certain performance information in the

More Policy and Support Needed

original operation agreement if someone had shared these ideas with her. Program officers stated that it would be helpful to have examples of performance metrics or templates of operation agreements. Others recommended that the program officers meet on a regular basis as a group to discuss their facilities and what they have learned. Similarly, NSF's Facilities Subcommittee of the NSF Advisory Committee for Business and Operations believed that the collective experience across NSF on performance metrics may help program managers for large facilities better plan for data collection in a timely and organized manner. Additionally, many of NSF's facilities are managed by a single program officer. As those individuals leave NSF, through retirements or otherwise, their knowledge on large facility management is lost without a system for capturing and sharing it with others.

Role for Large Facilities Office

NSF currently has an office dedicated to the oversight of large facility projects that should have the responsibility for the development of policy regarding performance evaluation and measurement for large facilities. However, this office does not appear to be providing this level of guidance to the program officers of facilities that are already in the operations phase. By overlooking the operations phase, NSF is missing a key opportunity to be involved in the total life-cycle of all facilities.

In 2003, NSF created the Large Facility Office within its Office of Budget, Finance, and Award Administration to provide oversight for NSF's large facility projects. As noted in the Office of Inspector General's 2004 report, *Survey of Large Facility Projects Management and Oversight Division*, it was intended that this office would have sufficient institutional authority and resources to independently focus on the planning, managing, and performance of NSF's sizable investment in large facility projects in **all** phases of their life cycle.

Since its creation, however, this office has concentrated most of its limited resources developing policy for and monitoring facilities that are anticipated or are under construction. According to many of the facility program officers, the Large Facility Office is not supporting facilities that are already in operation.

In addition, the Large Facility Office does not seem to have the authority to effectuate an overarching performance measurement policy currently lacking for NSF facilities. As noted in our 2004 survey, the Large Facility Office faced obstacles in implementing a viable large facility management and oversight program because of a lack of

More Policy and Support Needed

institutional authority and staff resources. This problem still seems to exist as a 2006 report by the Business Operations Advisory Committee stated,



By not providing the Large Facility Office the resources and authority necessary to fully focus on **all** phases of the large facility life cycle, NSF is unable to provide holistic and universal guidance and policy to its program officers with responsibility over operational facilities. As a result, program officers have been left to find their own way. As we have seen, NSF's program officers are dedicated and have worked hard to try to provide robust agreements for the facilities they oversee. However, with the proper support, NSF could have been much more efficient and effective in developing cooperative agreements with robust performance evaluation and measure systems for its operating facilities.

Conclusion and Recommendations

Conclusion

With NSF investing substantial amounts of funds into the operations of its 16 large facilities, it is essential that the agreements for these facilities contain robust terms and conditions to ensure the facilities operate efficiently and accomplish their intended award goals. As such, the agreements must provide for strong performance evaluation and measurement requirements. These requirements should include clear and agreed-upon goals, performance measures and targets, reporting requirements, and methods for evaluation and feedback. While most of the agreements we reviewed require some form of these performance measurement components, NSF needs to ensure these components become institutional requirements of all of its large facility agreements. As such, NSF should establish a cooperative agreement policy that provides for these components to be incorporated in every agreement. Also, NSF needs to establish mechanisms to allow for knowledge transfer among program officers. By sharing ideas such as annual program plans, reporting requirements, trend data, other measures, and targets, NSF can help ensure all large facility operation agreements contain the performance information both NSF and external reviewers need to assess the performance of the facility. By providing more guidance, NSF would also be closer to meeting its own stewardship goal stated in the *NSF FY06-FY11 Strategic Plan* of enhancing its processes for management and oversight of large facilities.

NSF established its Large Facility Office to ensure effective management and oversight of its large facilities. This includes ensuring that cooperative agreements include strong performance evaluation and measurement requirements. In its Large Facility Office, NSF has some of the resources needed, such as access to other NSF offices, to help ensure that cooperative agreements for operating large facilities include strong performance evaluation and measurement requirements. However, this office is involved primarily with the planning and construction of new facilities rather than the operations of existing facilities. Additionally, the Large Facility Office does not appear to have the authority necessary to influence the drafting and oversight of the cooperative agreements.

Recommendations

To ensure all current and future large facility operation agreements include clear and agreed-upon goals, performance measures and targets, reporting requirements, and methods for evaluation and feedback, we recommend the NSF Deputy Director:

Conclusion and Recommendations

- 1) Fully utilize the Large Facility Office by providing it with the institutional authority and resources to effectively create mandatory policies and oversee **all** phases of the large facility life cycle.¹⁷
- 2) Direct the Large Facility Office to develop and incorporate into NSF's Proposal and Award Manual, an overarching policy and implementing procedures that require, either directly in the award notice or by reference through other documents, all current and future facility agreements to include, at a minimum, the four performance evaluation and measurement components: 1) clear and agreed-upon goals and objectives; 2) performance measures and, where appropriate, performance targets; 3) periodic reporting; and 4) evaluation and feedback to assess progress.
- 3) Direct the Large Facility Office to provide training to program officers and other appropriate NSF staff on the development of cooperative agreements for large facilities in the operations phase, including the incorporation of performance evaluation and measurement components.
- 4) Direct the Large Facility Office to develop a process for ensuring knowledge transfer and the sharing of management concepts and best practices for large facility performance management systems and periodic assessment among large facility program officers such as periodic round-table meetings and/or an electronic discussion board.

Agency Response and OIG Comments

NSF generally agreed with our findings and agreed to all four of our recommendations. Appendix A contains the agency's response in full.

¹⁷ As a template to evaluate the authority and resource-level of the Large Facility Office, NSF should consider using the newly-issued *Guidelines for Assessing the Acquisition Function* developed by the Office of Federal Procurement Policy, which provides a means for assessing, among other things, organization alignment and leadership. While this guidance was developed for an agency's acquisition function, there are strong similarities to an office with responsibility for the oversight of large capital projects, like NSF's Large Facility Office. NSF can use this template to assess various aspects of this office such as the appropriate organizational placement and whether its roles and responsibilities are clearly defined. For example, according to the guidance, an agency should beware of a disconnect "between where the ... function is placed in the organization's hierarchy and its actual role in achieving the component's mission or supporting operations." In addition, an agency should beware of a situation where "management does not have adequate resources and support to implement common processes and approaches."

Agency's Response

NATIONAL SCIENCE FOUNDATION

4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

DATE: September 25, 2008

TO: Deborah H. Cureton
Associate Inspector General for Audit

FROM: Thomas N. Cooley *Marty Rubenstein for*
Director and Chief Financial Officer
Office of Budget, Finance, and Award Management

SUBJECT: NSF Response to *Audit of Large Facility Operations Agreements:
Performance Measurement*

Attached is the NSF Response to the Inspector General's *Audit of Large Facility Operations Agreements: Performance Measurement*.

Also, attached is additional information about the oversight activities, including goal setting mechanisms, qualitative and quantitative performance measurement methods, reporting requirements, and assessment and feedback mechanisms employed by each of the six projects included in the OIG audit. This information may prove useful to you in finalizing your report.

I appreciate the work done by the OIG staff in developing this audit and report. The findings and recommendations provide valuable input to NSF for our ongoing efforts to improve the practices and process we use in managing these large facilities.

Please contact me at 703 292 8001 if you have any questions or wish to discuss further.

cc: Dr. Olsen
Dr. Boesz
Karen Scott

Agency's Response

Cureton, Deborah H.

From: Olsen, Kathie L.
Sent: Tuesday, September 30, 2008 7:29 PM
To: Cureton, Deborah H.
Cc: Lightbourne, James H.
Subject: RE: Audit of Large Facility Operations Agreements:Performance Measurement and Evaluation

Thank you for the email. I have read the material forwarded to you on behalf of Tom Cooley and concur with his comments.
Kathie

From: Cureton, Deborah H.
Sent: Tuesday, September 30, 2008 9:19 AM
To: Olsen, Kathie L.
Cc: Lightbourne, James H.
Subject: Audit of Large Facility Operations Agreements:Performance Measurement and Evaluation

Kathie,

We recently received comments on our draft audit report of NSF's large facility operations cooperative agreements which we appreciate. But the transmittal memo accompanying the comments was signed by Marty Rubenstein on behalf of Tom Cooley. Since the draft report was issued to you in your capacity as Deputy Director, I wanted to be sure before we finalize and issue this report that the comments we received also represent your and NSF's official views. If you could please confirm that, we would appreciate it.

Thanks.
Debbie

Agency's Response

NSF Response to OIG DRAFT Audit of Cooperative Agreements for Large Facilities

INTRODUCTION AND SUMMARY:

NSF has reviewed the DRAFT OIG Audit of Cooperative Agreements for Large Facilities. The OIG Audit Report makes four recommendations. These are listed below, accompanied by NSF's individual responses to each of the recommendations.

Recommendation 1: Fully utilize the Large Facility Office by providing it with the institutional authority and resources to effectively create mandatory policies and oversee **all** *[emphasis OIG's]* phases of the large facility life cycle.

NSF Response: NSF agrees that the Large Facility Office should provide independent oversight of all phases of an MREFC project. To accomplish that goal will require collaboration with many functions across NSF, including, for example, the Program Offices, finance, budget, and grants, contracts and cooperative agreement specialists. Obtaining the resources necessary for these efforts and other budgetary considerations remains a high priority for the Agency.

Recommendation 2: Direct the Large Facility Office to develop and incorporate into NSF's Proposal and Award Manual, an overarching policy and implementing procedures that require, either directly in the award notice or by reference through other documents, all current and future facility agreements to include, at a minimum, the four performance evaluation and measurement components: 1) clear and agreed-upon goals and objectives; 2) performance measures and, where appropriate, performance targets; 3) periodic reporting; and 4) evaluation and feedback to assess progress.

NSF Response: NSF agrees with this recommendation.

Recommendation 3: Direct the Large Facility Office to provide training to program officers and other appropriate NSF staff on the development of cooperative agreements for large facilities in the operations phase, including the incorporation of performance evaluation and measurement components.

NSF Response: NSF agrees with this recommendation.

Recommendation 4: Direct the Large Facility Office to develop a process for ensuring knowledge transfer and the sharing of management concepts and best practices for large facility performance management systems and periodic assessment among large facility program officers such as periodic round-table meetings and/or an electronic discussion board.

NSF Response: NSF agrees with this recommendation.

Descriptions of Sample Facilities

Gemini Observatories

Designed to provide access to the entire sky, the Gemini Observatory, managed by the Association of Universities for Research in Astronomy, consists of twin 8-meter optical/infrared telescopes located on two of the best sites on our planet for observing the universe: Mauna Kea, Hawaii and Cerro Pachon, Chile. Both of the Gemini telescopes have been designed to take advantage of the latest technology and thermal controls to excel in a wide variety of optical and infrared capabilities. One example of this is the unique Gemini coating chamber that uses "sputtering" technology to apply protected silver coatings on the Gemini mirrors in order to provide unprecedented infrared performance.¹⁸

"Gemini's aggressive instrument program keeps the observatory at the cutting edge of astronomical research. By incorporating technologies such as laser guide stars, Multi-Conjugate Adaptive Optics and multi-object spectroscopy, astronomers in the Gemini partnership have access to the latest tools for exploring the universe."¹⁹

Gemini was built and is operated by a partnership of 7 countries including the United States, United Kingdom, Canada, Chile, Australia, Brazil and Argentina. Any astronomer in a partner country can apply for time on Gemini, which is allocated in accordance with the amount of financial support provided by each partner.²⁰

We chose to review Gemini because it is one of the few NSF operating facilities receiving international funding. Its telescopes are also located both inside and outside of United States, and NSF holds title to some of the buildings for Gemini. In addition, Gemini is a fairly new facility, having started operations in 2000 and 2001.

National Optical Astronomy Observatory

The National Optical Astronomy Observatory (NOAO), managed by the Association of Universities for Research in Astronomy, is a Federally Funded Research and Development Center the purpose of which is "to provide the best ground-based astronomical telescopes to [American] astronomers, to promote public understanding and support of science, and to help advance all aspects of [United States] astronomy. As a national facility, NOAO telescopes are open to all

¹⁸ See <http://www.gemini.edu/about>.

¹⁹ Id.

²⁰ Id.

Descriptions of Sample Facilities

astronomers regardless of institutional affiliation.”²¹

We chose to review NOAO for several reasons including that it is a Federally Funded Research and Development Center, NSF holds title to some of NOAO’s buildings, and its numerous facilities are located inside and outside the United States. In addition, other Federal agencies provide funding for NOAO. Finally, NOAO conducts both internal research using staff scientists, and has telescopes which are also open to external users.

National Center for Atmospheric Research

The National Center for Atmospheric Research (NCAR), managed by the University Corporation for Atmospheric Research, provides the university science and teaching community with the tools, facilities, and support required to perform innovative atmospheric research. Through NCAR, scientists gain access to high-performance computational and observational facilities, such as supercomputers, aircraft and radar - resources researchers need to improve human understanding of atmospheric and Earth system processes. NCAR and university scientists work together on research topics in atmospheric chemistry, climate, cloud physics and storms, weather hazards to aviation, and interactions between the sun and Earth. In all of these areas, scientists are looking closely at the role of humans in both creating climate change and responding to severe weather occurrences.²²

We chose to review NCAR not only because it is a Federally Funded Research and Development Center (FFRDC),²³ but also because it is the only FFRDC funded through NSF’s Geosciences Directorate. In addition, NCAR receives funds from other Federal agencies, and NSF holds title to some of NCAR’s buildings and land. Finally, NCAR conducts in-house research using salaried employees and is also open to external users.

²¹ <http://www.noao.edu/outreach/aboutnoao.html>.

²² <http://www.ncar.ucar.edu/>.

²³ See Federal Acquisition Regulation Part 35 for more information on Federally Funded Research and Development Centers.

Descriptions of Sample Facilities

Academic Research Fleet The Academic Research Fleet (ARF) is an “organization of 61 academic institutions and National Laboratories involved in oceanographic research.” One of its primary functions is to ensure the efficient scheduling of scientific cruises aboard its 23 research vessels located at different operating institutions in the ARF organization.²⁴

We selected ARF for review because NSF’s oversight for ARF is unlike the structure NSF uses for its other large facilities. NSF has separate management agreements for each of its 23 ships and one cooperative agreement for the University-National Oceanographic Laboratory System office, which provides administrative services for ARF ships and activities. In addition, NSF holds title to some of the ships, and these research vessels travel both in U.S. and foreign waters. Finally, ARF receives funding for ship operations from other Federal agencies.

George E. Brown, Jr. Network for Earthquake Engineering Simulation “The National Science Foundation created the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) to improve our understanding of earthquakes and their effects. NEES is a shared national network of 15 experimental facilities, collaborative tools, a centralized data repository, and earthquake simulation software, all linked by the ultra-high-speed Internet2 connections of NEESgrid. Together, these resources provide the means for collaboration and discovery in the form of more advanced research based on experimentation and computational simulations of the ways buildings, bridges, utility systems, coastal regions, and geomaterials perform during seismic events.”²⁵

“NEES [is intended to] revolutionize earthquake engineering research and education. NEES research will enable engineers to develop better and more cost-effective ways of mitigating earthquake damage through the innovative use of improved designs, materials, construction techniques, and monitoring tools. This research can also help prevent infrastructure damage from other natural disasters and from terrorism. Preparing for and protecting against these threats makes American communities more resilient and enhances their ability to meet the challenges posed by future disasters.”²⁶

²⁴ <http://www.unols.org/info/unols.html>.

²⁵ http://www.nees.org/About_NEES/ (visited 10/03/2006).

²⁶ Id.

Descriptions of Sample Facilities

We selected NEES for review because it is one of only two facilities in NSF's Engineering Directorate. It also is one of the newer NSF facilities, with operations starting in 2004, and is one of the few NSF facilities for which NSF has conducted a Total Business System Review.²⁷

Cornell Electron Storage Ring

The Cornell Electron Storage Ring (CESR) is a high-luminosity 6+6 GeV electron-positron collider operated by the CESR group at the Wilson Synchrotron Laboratory at Cornell University. CESR has a circumference of 768 meters and is located 12 meters below ground on the Cornell University campus. It is capable of producing collisions between electrons and their anti-particles, positrons, with center-of-mass energies between 9 and 12 GeV. When an electron and positron collide and annihilate, the flash of energy results in the creation of new matter, sometimes exotic and unfamiliar.²⁸ These studies shed light on questions like: how did the universe evolve? What is the nature of space and time? What, really, is mass?²⁹

“At the end of the last decade, a new program began at CESR where the physics focus shifted from the bottom quark to the lighter charm quark and the energy of CESR was lowered accordingly. The CESR-c/CLEO-c program is scheduled to end in 2008, but two proposals are under development that will utilize CESR for work on future facilities.”³⁰

We chose to review CESR because of how its characteristics fit into NSF's overall large facility portfolio. CESR is an older large facility in a single location within the United States; NSF does not own CESR's land or buildings; and the facility is used for both internal research and external/user research.

²⁷ NSF's Total Business System Reviews (TBSR) are advanced monitoring functions that NSF uses to assess the efficiency and effectiveness of its Large Facility awardees' business systems.

²⁸ See <http://www.lns.cornell.edu/Research/AP/CESR/WebHome.html>.

²⁹ See <http://www.lns.cornell.edu/>

³⁰ <http://www.lns.cornell.edu/Research/AP/CESR/WebHome.html>.

Performance Measurement Scholarship

Guide to Opportunities for Improving Grant Accountability, 2005

The Domestic Working Group, chaired by the Comptroller General of the United States, consists of 19 Federal, State, and local audit organizations. The purpose of the working group is “to identify current and emerging challenges of mutual interest and to explore opportunities for greater collaboration within the intergovernmental audit community.” The working group identified grant accountability as a concern, and requested the Inspector General of the U.S. Environmental Protection Agency to lead a project to address this concern. As a result, in October 2005, the working group issued the *Guide to Opportunities for Improving Grant Accountability*. The stated purpose of this guide is to “provide government executives at the Federal, State and local levels with ideas for better managing grants.” The Guide identifies opportunities for improvement in five key areas: internal controls, performance measures, the pre-award process, managing performance, and assessing and using results.

Committee of Sponsoring Organizations: Internal Control – Integrated Framework, 1992

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) is a voluntary private sector organization dedicated to improving the quality of financial reporting through business ethics, effective internal controls, and corporate governance. COSO was originally formed in 1985 to sponsor the National Commission on Fraudulent Financial Reporting, an independent private sector initiative that studied the causal factors that can lead to fraudulent financial reporting and developed recommendations for public companies and their independent auditors, for the SEC and other regulators, and for educational institutions. COSO has established a common definition of internal controls, standards, and criteria against which companies and organizations can assess their control systems.

Key Performance Indicators for Federal Facilities Portfolios, 2005

In September 2002, the Federal Facilities Council of the National Research Council³¹ authorized a study to “identify key performance indicators that could be used by senior-level Federal managers to determine a full range of outcomes of investments in portfolios of research facilities and to improve facilities asset management.” “This study lays out a framework for developing and evaluating trends in facilities portfolio conditions, investments, and costs and identifies a set of key indicators that can be used to track performance over time.”

³¹ The National Research Council is part of the National Academies, which also comprise the National Academy of Sciences, National Academy of Engineering and Institute of Medicine. They are private, nonprofit institutions that provide science, technology and health policy advice under a congressional charter. The Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of further knowledge and advising the Federal government.

Performance Measurement Scholarship

*Performance
Measurement
Challenges and
Strategies, 2003*

In 2003, the Office of Management and Budget (OMB), along with the Council for Excellence in Government (a nonprofit organization), held a workshop on performance management. As a result, the OMB published a document entitled *Performance Measurement Challenges and Strategies* to complement its already existing guidance for the Performance Assessment Rating Tool, which is tool used to assess government-program performance. Many of the challenges identified in this document relate to assistance awards. The challenges and suggested strategies address programs that: 1) have outcomes that are extremely difficult to measure (such as research and development programs); 2) are among many contributors to a desired outcome (such as many grant programs); 3) have results that will not be achieved for many years (such as research and development programs); 4) relate to deterrence or prevention of specific behaviors; 5) have multiple purposes and funding that can be used for a range of activities; and 6) are administrative or process oriented.

*Results-Oriented
Assistance: A
USAID
Sourcebook, 2002*

This sourcebook, most recently updated in 2002, is available to assist in the design, award, and administration of results-oriented grants and cooperative agreements to implement foreign assistance activities. Results-oriented awards are those that seek to measure performance in terms of the desired outcomes of the programs. The sourcebook is intended to help USAID staff and Development Partners improve their ability to manage for results through partnership relationships.

*Department of
Energy
Performance
Appraisal Process,
2006*

The United States Department of Energy (DOE) funds several laboratories, which like some of NSF's large facilities are considered Federally Funded Research and Development Centers and are managed by outside entities such as research universities under contract with DOE. To provide an overall methodology and framework for laboratory performance evaluation and incentives, DOE has instituted policies for laboratory contractor performance and evaluation. The performance evaluation and measurement process is incorporated into the laboratories' contracts with DOE. This measurement process includes performance measures and targets for both management and operation goals and objectives and science and technology goals and objectives. Management and operation evaluation include measures such as the percent of external audits findings that were not previously identified through self assessment or the number of safety incidents, while science and technology measures include number of publication in journals, significant awards, and invited talks.

Performance Measurement Scholarship

*Report by the
Facilities
Subcommittee of
the NSF Advisory
Committee for
Business and
Operations, 2006*

NSF's Advisory Committee³² for Business and Operations provides advice to the Director of the Office of Budget, Finance and Award Management concerning issues related to the oversight, integrity, development, and enhancement for improved performance of NSF's business operations. This advisory committee also provides specialized guidance through its Facilities subcommittee. This subcommittee examines the business practices NSF applies to planning and executing major research facility projects. In 2006, in response to a charge given by NSF's Chief Financial Officer, the Facilities subcommittee examined the steps NSF could take to improve its assessment processes that ascertain the state of facility performance. Joined by a group of NSF-selected facilities operations participants with experience in the operations issues of large scientific facilities, this subcommittee conducted the study and presented its report to the full Advisory Committee for Business and Operations.

³² This committee is established under the Federal Advisory Committee Act (5 USC App.) and is comprised of professionals from the scientific research administration, education management, and business communities.

Detailed Information on Each Cooperative Agreement

Gemini Observatories

Clear and Agreed-Upon Goals: The *award notice* for Gemini clearly states the goals to be achieved in the operations phase of the facility. For example, two of the goals stated in the award notice are “providing facilities, services and support to individual scientific investigators and research institutions, both foreign and domestic” and “engaging in educational and training programs as may be appropriate to assist Gemini users and further education in these and closely related fields.” In addition, the *award notice* requires long-term as well as annual program plans, approved by the NSF program officer, that define and give substance to these facility goals.

Performance Measures and Targets: Gemini’s *proposal* lists a wealth of performance measures and targets the awardee will collect such as statistics by country, demand for each Gemini instrument and observing mode, oversubscription rates and histories, and the time required to slew a telescope, reconfigure it, acquire the target, carry out the observing sequence, perform calibrations, and assess data quality. Gemini’s *proposal* also identifies a target of cost per paper or citation and requires the comparison of this cost to other ground-based or space observatories. It also requires the facility to send questionnaires to users. The *award notice* also requires Gemini to collect Government Performance and Results Act (GPRA) measures and targets, annual program plans, and quantitative performance measures. These measures include a list of observing programs, with their investigators, site visitors, observers, and hours devoted to each and non-scientific visitor statistics.

Reporting to NSF: Gemini’s *award notice* requires the awardee to report to NSF on tasks completed under its annual program plan, GPRA measures and targets, and specific quantitative and qualitative performance information. However, while the Gemini agreement does meet all of our basic performance evaluation components, it could still be improved by requiring the awardee to report on all of the performance measures and targets for which NSF requires the awardee to collect performance data.

Evaluation and Feedback: The *award notice* addresses NSF’s responsibilities for evaluation and feedback. It explains that NSF will, “in cooperation with the Gemini partners, conduct an in-depth review of the management of the Observatory by [Association of Universities for Research in Astronomy] midway through the duration of this Cooperative Agreement.” In addition, the *award notice* references OMB Circular A-110 which provides a process through which NSF can impose

Detailed Information on Each Cooperative Agreement

additional requirements on awardees with a history of poor performance. The Gemini *proposal* also requires the awardee to maintain several committees which provide input on the operations of the facility. The agreement also includes a termination clause that allows NSF to terminate the award in whole or in part in certain situations, including if the awardee has failed to comply with terms and conditions of the award. The *award notice* further explains that NSF will “require updates to the Management Plan in response to management issues that may arise. These updates should reflect remedies or remedial action necessary to address these concerns. The Awardee shall submit such revisions to the NSF Program Officer for review.” However, nowhere does the agreement clearly specify what constitutes poor performance that would necessitate corrective action on the part of the awardee.

National Optical Astronomy Observatory

Clear and Agreed-Upon Goals: The *award notice* for the National Optical Astronomy Observatory (NOAO) states the goals to be achieved in the operations phase of the facility. For example, two of the goals stated in the award notice are to “provide forefront observing capabilities and observing support to individual scientific investigators and research institutions on the basis of merit” and “provide education and training programs which strengthen astronomy education at all levels.” In addition, the *award notice* requires long-term as well as annual program plans, approved by the NSF program officer, that define and give substance to these facility goals.

Performance Measures and Targets: NOAO’s *proposal*, which is incorporated into the award notice by reference, lists a wealth of performance measures and targets NOAO will collect. These include such quantitative performance measures as the number of teachers and students reached during the year, annual visitor totals, actual vs. budgeted costs, workshop participation rates, and delivery of major system instrumentation on time and budget. It also includes such targets as the number of scientific citations per \$100 million invested as compared to an equivalent observatory. The *proposal* also explains NOAO will require every user to complete a satisfaction survey. In addition to the proposal, the *award notice* requires performance measures such as a summary of visitor use of facilities including demographic information about visitors, numbers of students, and a summary of telescope subscription statistics. The *award notice* further requires NOAO to collect Government Performance and Results Act (GPRA) performance measures and targets and Annual Program Plans, which help measure the success of the facility by comparing actual accomplishments during the

Detailed Information on Each Cooperative Agreement

year to the awardee-created goals or milestones in the previous year's plan.

Reporting to NSF: NOAO's *award notice* further requires the awardee to report to NSF on tasks completed under its annual program plan, GPRA measures and targets, and specific quantitative and qualitative performance information. However, while the NOAO agreement does meet all of our basic performance evaluation components, it could still be improved by requiring the awardee to report on all of the performance measures and targets for which NSF requires the awardee to collect performance data.

Evaluation and Feedback: The *award notice* also addresses evaluation and feedback. It explains the facility will, “[c]onduct an in-depth review of the management of NOAO and [National Solar Observatory] by [Association of Universities for Research in Astronomy] within approximately three (3) years from the effective date of this award.” It also sets up “an external oversight committee which will regularly report to NSF their evaluation and recommendations regarding the overall effectiveness of NOAO...” In addition, the *award notice* references OMB Circular A-110 which provides a process through which NSF can impose additional requirements on awardees with a history of poor performance. The *award notice* also references NSF's *Grant General Conditions*, which includes a termination clause that allows NSF to terminate an award in whole or in part in certain situations, including if the awardee has failed to comply with terms and conditions of the award. However, nowhere does the agreement clearly specify what constitutes poor performance that would necessitate corrective action on the part of the awardee, nor does it explain what types of intermediate levels of corrective action NSF can require of the awardee short of suspension or termination of award funds and operations. Finally, NOAO's *proposal* also creates user committees that provide useful feedback to the facility on its performance.

National Center
for
Atmospheric
Research

Clear and Agreed-Upon Goals: The *proposal* for the National Center for Atmospheric Research (NCAR) lists six overarching priorities of the facility. In addition, the *cooperative support agreement* requires long-term as well as annual program plans, approved by the NSF program officer, that define and give substance to these facility goals. NCAR's *strategic plan* includes several more goals for both NCAR's scientific and education programs. For example, two of the goals stated in the strategic plan are to “provide robust, accessible, and innovative

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information services and tools” and “provide world-class ground, airborne, and space-borne observational facilities and services.” Finally, NCAR’s primary cooperative support agreement, issued pursuant to the *award notice*, contains additional goals provided as “awardee responsibilities.”

Performance Measures and Targets: NCAR’s strategic plan, incorporated as part of its *proposal*, lists a wealth of performance measures and targets NCAR will collect. These include primarily qualitative performance measures such as: providing access to tools and services that will enhance the scientific community’s ability to perform cutting-edge, innovative research; producing more sophisticated analyses and predictions of Earth system variability and change, and of the impacts of change on ecosystems and human society; and providing students and teachers new opportunities to benefit from and participate in the science and engineering taking place at a major national research center. These measures also include sub-measures or activities that effectuate these more broad qualitative measures. However, there are very few quantitative or output-oriented measures and targets. One such measure is related to the HIAPER aircraft and states the aircraft will be available for at least 400 hours of research operations per year through a community-based allocation process. Several of the measures, though, could easily become quantitative or output in nature. For example, many of the education and outreach related measures could be re-cast as quantitative measures. One such measure is that “the broader geosciences community and university atmospheric sciences community will enjoy more opportunities to visit and work with NCAR.” This measure could have been defined in terms of the number of visiting scientists and collaborators and then NCAR could have calculated the increase. By recasting these types of measures in quantitative terms, NCAR and NSF can use the data to provide a much more effective picture of NCAR’s success in this area.

Reporting to NSF: In addition to the basic reporting requirements contained in NCAR’s *award notice*, the primary cooperative support agreement, issued pursuant to the award notice, requires a detailed Annual Scientific Report that describes the scientific and facilities programs conducted by NCAR staff, NCAR visitors and community participants in the preceding fiscal year. This report is also to “promote understanding of the nature and scope of the programs, significance of accomplishments, participation in NCAR programs by scientists from other institutions, participation of NCAR staff in community projects,

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and a listing of the scientific output and capacity of the Center.”

Evaluation and Feedback: The *award notice* also addresses evaluation and feedback. It explains NSF will “conduct a review of the science and facility programs of NCAR, and the management of NCAR at a mutually agreed time. Specific guidelines for the review will be agreed upon by NSF, NCAR and [the managing organization].” In addition, the *award notice* references *the Cooperative Agreement Financial and Administrative Terms and Conditions* which reference OMB Circular A-110. A-110 provides a process through which NSF can impose additional requirements on awardees with a history of poor performance. The *Cooperative Agreement Financial and Administrative Terms and Conditions* also includes a termination clause that allows NSF to terminate an award in whole or in part in certain situations, including if the awardee has failed to comply with terms and conditions of the award. However, nowhere does the agreement clearly specify what constitutes poor performance that would necessitate corrective action on the part of the awardee, nor does it explain what types of intermediate level of corrective actions NSF can require of the awardee short of suspension or termination of award funds and operations.

Academic Research Fleet

Clear and Agreed-Upon Goals: Each of the Academic Research Fleet (ARF) *award notices* clearly list some, but not all of its goals to be achieved in the operations phase of the facility. For example, one of its goals is “maintaining the Vessel and all of its equipment in accordance with good marine practice.” However, the ARF program officer provided a list of clear goals, which were not explicitly included in the cooperative agreements. Rather, these goals were part of a context statement, which are not incorporated into the agreements. For example, one of these critical goals was “[f]iscal responsibility to achieve budgetary goals without impacting science goals and safety.” The NSF Grants Officer in charge of ARF stated NSF’s Division of Grants and Agreements was open in the future to incorporating these goals into the cooperative agreement.

Performance Measures and Targets: The ARF *award notice*, through incorporation of *NSF Guidelines 04-52*, requires the awardee to collect many performance measures and provide annual estimates for these measures, which they use as targets. These include information on the scientific utilization of the ships for the past two years, estimated current year, and proposed next year. This includes information on the number of cruises, operating days, days at sea, maintenance days, and days out of

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service. In addition, the agreements require detailed cost information broken out by categories such as salary, food, fuel, and insurance for the past two years, current year, and estimates for the next year. The *award notice* also requires scientists and ship captains to fill out post-cruise assessments. These surveys ask questions such as to what extent science objectives of the cruise were met and how well the research vessel and its installed equipment contributed to achieving the scientific objectives.

Reporting to NSF: ARF ship agreements require the awardees to report the annual quantitative and qualitative performance information described in the above paragraph to NSF, and the University-National Oceanographic Laboratory System support office agreement requires the awardee to send the results of user surveys to NSF.

Evaluation and Feedback: The *award notice*, through incorporation of NSF *Guidelines 04-52*, addresses NSF's responsibilities for evaluation and feedback. It explains "agreements are evaluated annually by the cognizant Program Director and every five years through an external merit review process." In addition, the *award notice* references the NSF *Cooperative Agreement Financial and Administrative Terms and Conditions*, which references OMB Circular A-110. A-110 provides a process through which NSF can impose additional requirements on awardees with a history of poor performance. The NSF *Cooperative Agreement Financial and Administrative Terms and Conditions* also include a termination clause that allows NSF to terminate an award in whole or in part in certain situations, including if the awardee has failed to comply with terms and conditions of the award. However, the ARF agreements do not clearly specify what constitutes poor performance that would necessitate corrective action on the part of the awardee and does not explain what types of intermediate level of corrective actions NSF can require of the awardee short of suspension or termination of award funds and operations.

George E.
Brown, Jr.
Network for
Earthquake
Engineering
Simulation

Clear and Agreed-Upon Goals: The Network for Earthquake Engineering Simulation (NEES) *award notice* lists some of the goals to be achieved in the operations phase of the facility. For example, one goal is for the awardee to "[p]rovide leadership and planning to ensure that NEES remains a state-of-the-art distributed research facility accessible to the earthquake engineering community." However, the facility's management is still trying to improve the clarity of some of its goals. A 2005 NSF review team noted that NEES "did not have clear, consistent, and focused goals." As a result, the awardee created a "task group on

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success” and issued revised long-term strategic goals. Most recently, a July 2007 review team stated that NEES still needed to better convey what the facility wants to achieve. In particular, the site visit report stated that NEES lacked “corresponding objectives to demonstrate the relevancy, measurability, or successful achievement of each of [its] goals.” NSF now intends to phase out the NEESinc cooperative agreement over a two-year period.

Performance Measures and Targets: The NEES *award notice* requires the awardee to develop performance measures and targets. However, the cooperative agreement does not specify by when the awardee should complete and submit its metrics to NSF. As of June 2007, the awardee was still in the process of creating some of its performance measures and targets. The *award notice* also requires user surveys, qualitative and quantitative performance information, and NSF GPRA measures. In addition, NEES and NSF have also started to use annual work plans to assess facility activities but NSF has not explicitly included annual work plans in NEES’ cooperative agreement.

Reporting to NSF: NSF has strengthened the NEES reporting requirements through an *amendment* to its cooperative agreement that requires the awardee to report to NSF on its self-determined performance metrics. It also requires the awardee to submit additional performance information, including equipment site usage data, maintenance outages, downtime, and purchases.

Evaluation and Feedback: Finally, the *award notice* addresses NSF’s responsibilities for evaluation and feedback. It explains that a comprehensive program evaluation review will be conducted in year four of the award. In addition, the *award notice* references *Cooperative Agreement Financial and Administrative Terms and Conditions* (CAFATC) which references OMB Circular A-110. A-110 provides a process through which NSF can impose additional requirements on awardees with a history of poor performance. The CAFATC also includes a termination clause that allows NSF to terminate an award in whole or in part in certain situations, including if the awardee has failed to comply with terms and conditions of the award. However, the agreement does not clearly specify what constitutes poor performance that would necessitate corrective action on the part of the awardee and does not explain what types of intermediate level of corrective actions NSF can require of the awardee short of suspension or termination of award funds and operations.

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Cornell Electron Storage Ring

Clear and Agreed-Upon Goals: The Cornell Electron Storage Ring (CESR) *award notice* lists some of the goals the CESR awardee is to achieve in the operations phase of the facility. For example, two goals are “[t]o operate the CESR accelerator with the highest efficiency consistent with available technology” and to “[p]rovide support for external users of the CESR facility and collaborators.” However, CESR’s goals have changed over time as the facility has matured but the cooperative agreement has not kept pace and been updated with these new goals. In addition, CESR’s agreement does not require annual or long term program plans, which can be useful in defining goals and providing a mechanism for updating them.

Performance Measures and Targets: CESR’s agreement is mostly silent on the creation of performance measures and targets. This agreement does not incorporate the NSF GPRA measures, nor does it require user surveys, annual program plans, or in-depth quantitative or qualitative information.

Reporting to NSF: The CESR agreement only requires the awardee to report basic project reporting information such as NSF requires for majority of its awardees. Because the CESR agreement does not include performance measures and targets, the awardee may not collect meaningful information or report this to NSF.

Evaluation and Feedback: The *award notice* does address NSF’s responsibilities for evaluation and feedback. It explains “a comprehensive review will be held midway through the third year by NSF staff, with possible assistance from an external panel of experts.” In addition, the *award notice* references *the Grant General Conditions* which reference OMB Circular A-110. A-110 provides a process through which NSF can impose additional requirements on awardees with a history of poor performance. The *Grant General Conditions* also include a termination clause that allows NSF to terminate an award in whole or in part in certain situations, including if the awardee has failed to comply with terms and conditions of the award. However, the agreement does not clearly specify what constitutes poor performance that would necessitate corrective action on the part of the awardee and does not explain what types of intermediate level of corrective actions NSF can require of the awardee short of suspension or termination of award funds and operations.