National Science Foundation • Office of Inspector General

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MEMORANDUM

DATE: December 21, 2016

TO: Dr. France Cordova
Director, National Science Foundation

FROM: Mark Bell
Assistant Inspector General
Office of Audits

SUBJECT: NSF OIG Report No. 17-3-002, *Review of NSF's Oversight of its Relocation: Part 3 Baseline Schedule*

Summary

This memorandum presents our concerns with the National Science Foundation's (NSF) baseline schedule for preparing to move to its new headquarters in Alexandria, Virginia. The lease for the new building begins on or about September 1, 2017. The leases on the buildings NSF currently occupies in Arlington, Virginia, expire at the end of December 2017, and rent will likely increase if NSF has to extend the leases.

NSF did not include all key information in its May 2016 relocation baseline schedule, such as the order in which certain tasks contained in the schedule must occur and the resources needed to complete the activities included in the schedule. These omissions could undermine NSF's ability to effectively use the schedule to support management oversight of the construction process by making it harder to identify and mitigate project risks.

We cannot say with certainty that the issues we have identified mean that the project will inevitably be delayed. What they do indicate, however, is that the baseline schedule — which plays a critical role in NSF's ability to identify and manage project risk — is less robust than it would be if the matters we identified were addressed. Given the very short timeframe in which NSF and contractors must complete construction of the new building, move staff, and vacate its existing buildings, the quality of this schedule is crucial. Therefore, we are providing our findings and recommendations in the hope that swift action will strengthen this valuable tool and thus reduce the risk of future project delays.

This report concludes with our recommendation for NSF to take action to strengthen its relocation baseline schedule.

Background

NSF has 4 months (between September and December 2017) to complete its move to the new building before its current leases expire. During this time, NSF needs to relocate about 2,250 people, move furniture and IT equipment, and decommission its current buildings. Prior to NSF's physical move, NSF must also ensure that the new building is operational, with workstation furniture installed and functional IT systems and conference rooms so employees can perform their work.

> **Baseline Schedule**
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> A baseline schedule is the basis for managing the program scope, the time period for accomplishing it, and the required resources. Program performance is measured, monitored, and reported against the baseline schedule.

NSF established the baseline relocation schedule as of May 2016 to manage and monitor activities that NSF and several contractors must complete before the relocation. The baseline relocation schedule contains more than 3,200 activities. These activities include the construction contractor's activities to finish the building's interior as well as both NSF's and another contractor's activities to ensure the building is operational prior to the move. Though the baseline schedule includes activities of contractors and NSF, NSF is responsible for the schedule. To meet its deadline and avoid additional costs, it is critical for NSF to have a complete and accurate baseline schedule against which it can track and monitor its progress.

We used the Government Accountability Office (GAO) *Schedule Assessment Guide* to determine what information NSF should include in its baseline schedule. A baseline schedule is the basis for comparing estimates with actual results — the plan for accomplishing the project. As work is completed, the project schedule is updated to reflect actual progress. Then, performance is measured by comparing the project schedule to the baseline schedule.

GAO recommends that agencies complete schedules 3 to 6 months after signing a contract or before significant activities start. Once an agency establishes the baseline schedule, it must regularly update its status to reflect progress, identify delays, and determine the impact of delays on remaining activities. GAO recommends that, as a project gets closer to completion, management should require the contractor to provide weekly or bi-weekly updates on the project. Frequent updates allow the project manager to monitor progress and make decisions regarding risk mitigation, resource allocations, and the impact of downstream work from schedule variances in as timely a fashion as possible. Attachment 1 describes other best practices contained in GAO's guide.

Key Issues

NSF did not include all critical information in its baseline schedule, such as the order in which all activities must be completed and the resources needed to complete these activities. These omissions undermine the schedule's effectiveness by making it harder for management to identify and mitigate project risks. NSF also needs to obtain updates from the contractor more frequently to reduce the risk of delay.

Project Activity Sequence

At the time we reviewed the baseline schedule, about 18 percent of the activities it included needed additional information to improve NSF's ability to monitor progress. Specifically, the schedule did not always identify or link predecessor and successor activities.

According to GAO's *Schedule Assessment Guide*, activities that are logically related within a schedule network are referred to as predecessor and successor activities. As the names indicate, a predecessor activity must start or finish before its successor activity. The point of establishing a logical relationship between activities is to depict the sequence in which they occur. Such relationships illustrate when activities are planned to start and finish in relation to the start and finish of other activities. This logic relationship therefore models the effect of on-time, delayed, or accelerated activity on subsequent activities.

Identifying all dependencies between activities is necessary for the schedule to properly calculate dates and predict change in the future. Without the right links, activities that slip early in the schedule do not transmit delays to the activities that depend on them. When this happens, the schedule will not sufficiently portray the project as a whole, and users of the schedule will lack confidence in the dates and the critical path.[1]

Accordingly, to the extent that NSF's baseline schedule is missing these linkages, NSF may not be able to identify how delays in some activities could affect subsequent activities. As a result, NSF's program manager may not have adequate insight into linked problems or delays, which could affect his ability to take timely corrective action. The more activities that are not properly linked and the earlier they occur in the project, the greater the risk to the baseline schedule and to the reliability of the project's critical path. To illustrate the impact of this sequencing problem, in a construction schedule the logical flow of activities required to hang and install conference room monitors would first involve wiring, followed by wall construction, and concluding with monitor installation. If these activities are not logically linked in the schedule, the impact of a delay in any of these activities on the installation of the monitors would not be apparent. In addition, if monitor installation is not linked to successor activities, then the effect of a delay in this activity on downstream activities would also not be apparent.

Project Resource Needs

[1] A project's critical path is the longest continuous sequence of activities in a schedule. It defines the project's earliest completion date or minimum duration.

According to GAO, a project's schedule should reflect the resources (including labor, materials, travel, facilities, and equipment) needed to do the work, whether they will be available when needed, and any funding or timing constraints related to those resources. Including resources in a schedule is important because resource requirements directly relate to an activity's duration. Assigning resources to activities, therefore, helps ensure that the projected duration of those activities will be realistic and rational.

Although loading resources to a schedule can be difficult for complex programs, a schedule that has not been reviewed for resource issues is not reliable, as it implies an unlimited number of resources and their unlimited availability — an improbable scenario. As a result, if a baseline schedule does not identify planned resources, it cannot be used to make important management decisions, such as reallocating resources from activities with significant float[2] to critical activities that are behind schedule. Such a schedule would also severely limit management's ability to monitor crew productivity, allocate idle resources, and monitor resource-constrained activities, and level resources across activities.

To illustrate the value of loading resources, consider a construction manager who, among other activities associated with his project, has a plumbing job to complete. The manager has three plumbers who could do the job and four days in which to accomplish it. To determine whether the time allocated is sufficient to complete the plumbing job, the manager needs to know how many hours each of his plumbers can work on that job, given other tasks to which they are assigned. If the manager does not know the extent to which his plumbers are committed to other projects, his ability to determine if he can complete the project in the time available is significantly undermined.

The NSF schedule does not reflect the project's resource needs, as it does not contain information about how much labor, equipment, or materials, among other things, would be required to complete necessary activities, such as installing furniture and IT testing. In fact, the schedule shows 100% availability of all resources — an unlikely situation, as few resources are available 100% of the time. In the absence of resource-related information, it will be difficult for the project manager to predict the likelihood that activities will be completed as scheduled, and thus his ability to foresee and mitigate risk will be undermined.

Baseline Schedule Status

Status information in the schedule may not always be current because NSF receives only monthly updates from the construction contractor. With only 9 months remaining until the move from Arlington to Alexandria begins, identifying and mitigating potential delays as quickly as possible is essential. By having updates only once a month, NSF misses the chance to catch potential schedule risks or slippages at the earliest possible moment. NSF could reduce the risk of delays going undetected by working with the General Services Administration (GSA) and other applicable parties to obtain more frequent updates on construction. Weekly or bi-weekly updates, as recommended by GAO, would provide NSF management with timely, important information about the status of activities in progress, including if activities are late, and if late

[2] Float, or slack, is the amount of time a predecessor activity can slip before the delay affects the project's estimated finish date. As a general rule, activities along the project's critical path have the least float.

activities affect other linked activities, the timeline, or the critical path. The longer it takes NSF management to receive this information, the more difficult it will be for NSF to monitor the relocation, make informed decisions about how to address challenges that arise during the course of the project, and determine the impact of those decisions on remaining work.

Recommendations

We cannot say with certainty that the issues we have identified mean that the project will inevitably be delayed. What they do indicate, however, is that the baseline schedule — which plays a critical role in NSF's ability to identify and manage project risk — is less robust than it would be if the matters we note were addressed. Given the very short timeframe in which construction of the new building must be completed and NSF must move staff and vacate its existing buildings, the quality of this schedule is crucial. Therefore, we are providing the following recommendations, hoping that swift action will strengthen this valuable tool and thus reduce the risk of future project delays.

We recommend NSF senior management take appropriate action to strengthen the baseline schedule. Such actions should include:

1. Linking predecessor and successor activities and assigning resources to all activities; and
2. Work with GSA and other applicable parties to determine whether more frequent updates on the building's construction are feasible.

Objectives, Scope, and Methodology

The NSF Office of Inspector General (OIG) began an inspection of NSF's oversight of its relocation to its new headquarters in Alexandria, Virginia, in February 2014. We will continue the ongoing inspection until NSF moves to the new headquarters. Two of the objectives of our inspection are to determine (1) the effectiveness of NSF's controls for adhering to NSF-required milestones and maintaining schedule and (2) the extent to which NSF is able to identify and mitigate limitations and disruptions from the planning phase through occupancy. Under the Quality Standards for Inspection and Evaluation developed by the Council of Inspectors General on Integrity and Efficiency, we are communicating our concerns regarding NSF's relocation baseline schedule, which we based on interviews, analysis of NSF's May 26, 2016 baseline schedule, and information gathered to date.

Agency Response and OIG Comments

The NSF agreed to manage the NSF relocation in accordance with the Government Accountability Office's *Schedule Assessment Guide: Best Practices for Project Management Schedules.* However, NSF believes the cost of updating the baseline schedule, as we recommended, would outweigh the possible benefits. NSF stated it has updated its integrated project schedule with predecessor and successor activities, which serves as an alternative to the NSF OIG recommendations. As mentioned earlier in our report, a baseline schedule is the basis for comparing estimates in the baseline schedule to actual results in the project schedule. An

accurate baseline would have allowed NSF to compare the project schedule to the plan for accomplishing NSF's relocation to Alexandria.

With respect to receiving more timely updates on construction, NSF stated that the GSA lease controls the frequency of updates on the building's construction and that NSF relies on other reports and meetings to gauge the progress of construction.

During audit resolution, we will review NSF's proposed alternatives as we continue to provide oversight over NSF's relocation.

Attachments

cc: Joanne Tornow
Donna Butler
Brian MacDonald
Christina Sarris
Kaitlin McDonald
Elizabeth Argeris
Ann Bushmiller
Allison Lerner
Elizabeth Goebels
Cynthia Davis
Marie Maguire
Fae Korsmo
Michael Van Woert
John Anderson

GAO Report No. GAO-16-89G. *Schedule Assessment Guide: Best Practices for Project Schedules,* December 2015

GAO's *Schedule Assessment Guide* describes best practices for project schedules, such as maintaining a baseline schedule, sequencing activities, and assigning resources to all activities.

Maintaining Baseline Activities

Agencies should measure and monitor program performance against the baseline schedule to identify and report schedule variances that affect downstream work. A reliable baseline schedule includes resource information that can help an agency determine the cost impact if the project does not finish on time.

Sequencing Activities

Agencies must list activities in the order they are to be carried out and link predecessor activities to successor activities with logic. If an agency does not logically sequence and link activities, the schedule will not accurately reflect changes to the project's finish date, and resources may be misallocated, and activities delayed.

Assigning Resources to All Activities

All activities in the schedule should include the time to complete the activities and the resources needed, such as number of labor hours or days and equipment needed to complete an activity. Not including resources in the baseline schedule increases the risk of over-allocating resources and project delays.

NATIONAL SCIENCE FOUNDATION
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December 8, 2016

MEMORANDUM

TO: Mr. Mark Bell, Assistant Inspector General for Audits, OIG

FROM: Dr. Joanne Tornow, Office Head, OIRM

SUBJECT: Management's Response to the Official Draft of NSF OIG Report No. 17-3-002, *Review of NSF's Oversight of its Relocation: Part 3 Baseline Schedule*

We appreciate the opportunity to respond to the OIG's Official Draft Report No. 17-3-002, "*Review of NSF's Oversight of its Relocation: Part 3 Baseline Schedule.*" We share with the OIG the goal of a successful move.

At present, **NSF's relocation is on schedule**. We are committed to managing potential schedule risks involved with the relocation, and we agree that the GAO Guide, GAO-16-89G, *Schedule Assessment Guide: Best Practices for Project Management Schedules*, December 2015 ("GAO Guide"), provides important information about maintaining a high quality and reliable schedule.

Specifically, page 5 of the GAO Guide states that an integrated master schedule "should be the focal point of program management." NSF accomplishes this objective by maintaining an accurate, updated, and useful integrated project schedule to minimize the risk of delay. The OIG instead focused on the original, May 2016 baseline schedule.

NSF continues to maintain an updated integrated schedule as a project management tool, and recently acquired additional tools to assist with scheduling. Accordingly, we respond to the OIG's recommended actions with alternatives, as follows:

OIG Recommendation: We recommend NSF senior management take appropriate action to strengthen the baseline schedule. Such actions should include:

1. Linking predecessor and successor activities and assigning resources to all activities; and
2. Work with GSA and other applicable parties to determine whether more frequent updates on the building's construction are feasible.

NSF Response: NSF will continue to take appropriate action to mitigate the risk of delay in relocation by maintaining an updated, accurate, and useful project schedule. With respect to

sub-part 1 of the recommendation, we believe that the costs of backfilling a now 7-month old baseline schedule to link activities and assign resources exceed any possible benefits; backfilling an old schedule may increase risk to the schedule. With the exception of those activities that do not require predecessor or successor activities, NSF's current integrated schedule accomplishes the purpose of this sub-part, and NSF will continue to monitor and maintain its integrated project schedule. Additionally, the recently acquired software packages provide NSF with enhanced capabilities to analyze, assess, and improve the project schedule. With respect to sub-part 2, NSF notes that the GSA lease with the owner directs the frequency of updates on the building's construction. That said, NSF does not solely rely on construction schedule updates from the owner to gauge construction progress. The NSF contractor specializing in construction quality management provides weekly status reports summarizing progress. Additionally, NSF attends biweekly construction update meetings with the developer and GSA. Consistent with this recommended action, NSF has required – and will continue to require – bi-weekly updates from the contractors it manages.

NSF appreciates the OIG's efforts to provide critical feedback to the Agency and identify opportunities for improvement. If you have any questions concerning our response, please contact Brian MacDonald, Project Director, NSF Relocation Office, at 703-292-7561.