Audit of NSF's Process for Evaluating the Operations and Maintenance Cost Proposal for the Ocean Observatories Initiative

NATIONAL SCIENCE FOUNDATION
OFFICE OF INSPECTOR GENERAL

April 14, 2020
OIG 20-2-004

AT A GLANCE

Audit of NSF's Process for Evaluating the Operations and Maintenance Proposal for the Ocean Observatories Initiative
Report No. OIG 20-2-004
April 14, 2020

WHY WE DID THIS AUDIT

In September 2018, NSF awarded a $220 million, 5-year cooperative agreement to Woods Hole Oceanographic Institution (WHOI) for operating the Ocean Observatories Initiative (OOI). To stay within the annual budget of $44 million, WHOI plans to implement efficiencies to absorb inflation or reduce science support (the scientific activities included in the agreed-upon scope of work). We evaluated whether NSF has taken steps to ensure that WHOI's proposed cost containment measures are achievable within the proposed budget.

WHAT WE FOUND

NSF did not ensure WHOI's proposal to operate OOI within the proposed $220 million budget adequately addressed inflation and risks. Specifically, WHOI's initial proposal did not address its ability to absorb expected inflation into the fixed budget, and its supplementary inflation absorption plan did not provide the basis of estimate or sufficient details regarding how WHOI would achieve cost saving efficiencies. As a result, NSF could not have confidence that WHOI's proposed cost savings would compensate for expected inflation and allow WHOI to operate within budget without reducing the proposed level of science support or increasing funding. Further, at the time of our audit, NSF did not provide sufficient guidance on how to conduct risk and uncertainty analyses for operations proposals and did not require it.

As a result of our audit, NSF developed new solicitation language to increase the quality of cost estimates for all future operations awards and developed additional guidance in the *Major Facilities Guide* on the use of risk/uncertainty and sensitivity analyses for future operations proposals. For example, future cost estimates must contain escalation factors including inflation, and new proposals must include additional information on risk.

WHAT WE RECOMMEND

We recommend that NSF analyze WHOI's plans to determine if it is achieving its proposed efficiency cost savings and ensure that future major facility operations proposals include inflation factors, as well as risk and mitigation strategies.

AGENCY RESPONSE

NSF agreed with our recommendations. NSF's response is included in its entirety in Appendix A.

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

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

MEMORANDUM

DATE: April 14, 2020

TO: Teresa Grancorvitz
Office Head and Chief Financial Officer
Office of Budget, Finance and Award Management

FROM: Mark Bell [redacted]
Assistant Inspector General
Office of Audits

SUBJECT: Audit Report No. 20-2-004, *Audit of NSF's Process for Evaluating the Operations and Maintenance Cost Proposal for the Ocean Observatories Initiative*

Attached is the final report on the subject audit. We have included NSF's response to the draft report as an appendix.

This report contains three recommendations aimed at improving NSF's review and oversight of the Ocean Observatories Initiative (OOI) award and other NSF major facilities in the operations phase. NSF concurred with all of our recommendations. In accordance with Office of Management and Budget Circular A-50, *Audit Followup*, please provide a written corrective action plan to address the report recommendations. In addressing the report's recommendations, this corrective action plan should detail specific actions and associated milestone dates. Please provide the action plan within 60 calendar days.

We appreciate the courtesies and assistance NSF staff provided during the audit. If you have questions, please contact Elizabeth Kearns, Director of Audit Execution, at 703.292.7100 or oigpublicaffairs@nsf.gov.

cc:

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ABBREVIATIONS

COL	Consortium for Ocean Leadership
CPRD	Cost Proposal Review Document
GAO	U.S. Government Accountability Office
LFO	Large Facilities Office
NSB	National Science Board
OOI	Ocean Observatories Initiative
UNOLS	University-National Oceanographic Laboratory System
WHOI	Woods Hole Oceanographic Institute

Background

As part of its mission, the National Science Foundation funds the design, construction, and operation of major multi-user research facilities (major facilities), which are shared-use infrastructure such as telescopes and research ships accessible to a broad community of researchers and educators. NSF's major facilities typically have construction costs ranging from one hundred to several hundred million dollars and may operate for 20 to 40 years. NSF makes awards to external recipient entities (recipient) to undertake major facility construction, operations, and maintenance, typically through cooperative agreements, a type of Federal assistance award. As of July 2019, NSF had 23 major facilities including the Ocean Observatories Initiative (OOI), an ocean research observatory that includes seven research arrays comprising the world's largest network of ocean and seafloor sensors, as shown in Figure 1.

In 2009, the National Science Board[1] (NSB) approved funding for OOI, and NSF subsequently awarded a $769 million cooperative agreement to the Consortium for Ocean Leadership (COL) to construct and operate the ocean observatory over the next 8 years.[2] OOI began initial operations in 2010, and COL completed construction in June 2016.

NSF originally budgeted funding for OOI operations at $67.9 million in 2016 and $72.6 million in 2017. However, in 2013, NSF decided to cap OOI's budget at $55 million per year beginning in fiscal year 2016, the first year of full operations, due to a constrained budget environment. In 2015, the National Research Council[3] recommended that NSF make an "immediate" reduction in funding for OOI operations by 20 percent. In its response, dated May 11, 2015, NSF supported the recommendation, and described its long-term plan for reducing costs by 20 percent, including its intent to solicit a new cooperative agreement (to replace the existing agreement set to expire in April 2017), with a reduced annual budget of no more than $45 million

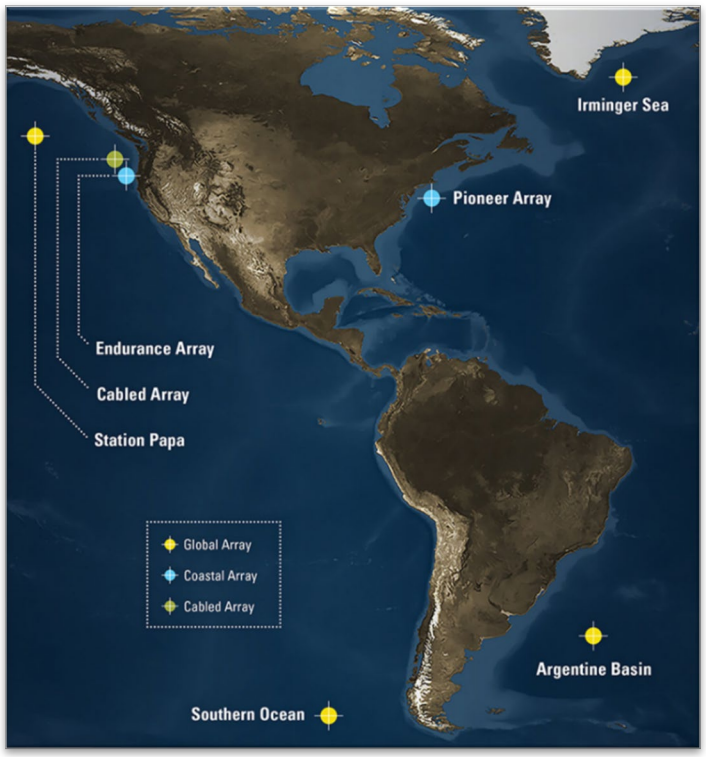


Figure 1. Location of OOI Arrays
Source: Woods Hole Oceanographic Institution

[1] The NSB establishes policies for NSF within the framework of applicable policies set forth by the President and Congress. In this capacity, the NSB identifies issues that are critical to NSF's future and approves new major programs and awards, unless it has delegated such award approval authority to the Director. The NSB also serves as an independent body of advisors to the President and Congress, providing reports every other year on the state of science and engineering in the U.S., as well as other reports as needed or by request, on specific, individual policy matters within NSF's authority.
[2] The award included $386 million for construction and $383 million for operations.
[3] At NSF's request, the National Research Council evaluated NSF's priorities for ocean science and issued recommendations in Sea Change: 2015-2025 Decadal Survey of Ocean Sciences (The National Academies Press, 2015).

per year. In November 2016, NSF issued a new solicitation for a cooperative agreement to operate OOI with a reduced annual budget of $44 million.

In September 2018, NSF awarded a cooperative agreement to Woods Hole Oceanographic Institution (WHOI) to operate OOI and approved funding of $220 million for a 5-year period. OOI operations transitioned from COL to WHOI with the new award. WHOI's award is flat funded at $44 million for each of the 5 years included in the award. To stay within the annual budgeted amount determined by NSF's Division of Ocean Sciences, WHOI plans to implement efficiencies to absorb inflation or reduce the level of science support (the scientific activities included in the agreed-upon scope of work). If WHOI cannot absorb inflation or costs increase beyond the $44 million per year, NSF also has the option to supplement OOI funds through its Research and Related Activities account.

The objective of this audit was to determine whether NSF has taken steps to ensure that WHOI's proposed cost containment measures are achievable, allowing OOI to function within the 5-year, $220 million proposed budget.

Results of Audit

NSF did not ensure WHOI's proposal to operate OOI within the proposed $220 million budget adequately addressed inflation and risks. Specifically, WHOI's initial proposal did not address its ability to absorb expected inflation into the fixed budget, and its supplementary inflation absorption plan did not provide sufficient details of the basis of estimate or how it would achieve cost saving efficiencies. As a result, NSF could not have confidence that the proposed cost savings would compensate for expected inflation and allow WHOI to operate within budget without reducing the proposed level of science support or increasing funding. Further, at the time of our audit, NSF did not provide sufficient guidance on how to conduct risk and uncertainty analyses for operations proposals and did not require it.

NSF Did Not Ensure WHOI's Proposal Adequately Addressed Inflation and Risks

The proposal WHOI submitted in April 2017 to operate and manage OOI within a $44 million annual budget for a period of 5 years did not address its ability to absorb expected inflation into the fixed budget determined by NSF's Division of Ocean Sciences. NSF's June 2015 and March 2017 *Large Facilities Manual* requires recipients to prepare proposals in accordance with the best practices included in the *GAO* [U.S. Government Accountability Office] *Cost Estimating and Assessment Guide*. According to the *Large Facilities Manual* and the *GAO Cost Estimating and Assessment Guide*, the impact of inflation should have been included in WHOI's cost estimate, and NSF should have reviewed it to make a conclusion on the quality of those estimates.

NSF contracted an independent company to perform an Independent Cost Assessment of WHOI's cost proposal. In February 2018, the contractor recommended that NSF obtain further information on WHOI's inflation estimates and management, as well as a risk and uncertainty analysis. Subsequently, on March 29, 2018, WHOI provided supplemental information, including a document titled *WHOI Management of Inflation Versus Fixed Program Budget* (inflation absorption plan) and a cost sensitivity

analysis, which described the areas of the budget that were most uncertain and may pose challenges over the 5-year award period.

Based on WHOI's inflation absorption plan, NSF concluded "[t]he estimated cost escalation and the proposed approach to off-set the costs and mitigate the risks is appropriate and reasonable, given this is a flat-funded award and the scope and budget will be continually refined through the Annual Work Plan process." However, NSF could not analyze WHOI's estimates in accordance with GAO's cost estimating guidelines because WHOI's inflation absorption plan did not provide the basis of estimate and calculations for the cost savings. WHOI's inflation absorption plan also lacked sufficient details regarding how WHOI would achieve cost saving efficiencies. Therefore, NSF could not have confidence that the proposed cost savings would be enough to cover inflation.

WHOI's Planned Efficiencies May Not Be Enough to Manage Inflation

According to its inflation absorption plan, WHOI expected inflation to increase costs by an average of [redacted] percent each year in years 2 through 5, totaling $[redacted] million during the life of the award.[4] WHOI proposed the following three categories of efficiencies in years 2 through 5 to offset expected inflation:

- Reductions in refurbishment labor costs;
- Reductions to cruise lengths with improved weather prediction; and
- Reduction in refurbishment materials costs.

However, based on our analysis of WHOI's inflation absorption plan (see Appendix C), expected cost savings from these efficiencies may not be large enough to cover anticipated inflation costs over the 5-year award period. To remain within the flat budget, WHOI also proposed [redacted]

WHOI's Cost Sensitivity Analysis Sometimes Conflicted with Its Inflation Absorption Plan

As previously described, WHOI's cost sensitivity analysis described the areas of the budget that are most uncertain and may pose challenges over the 5-year award period. For example, the analysis identified several routine annual cost increases, such as fuel and deployments lost at sea. WHOI did not specifically identify these challenges in its original budget proposal.

[redacted]

[4] WHOI expects the projected inflation rate for the next 5 years to average about [redacted] percent per year. Applying the effects of this increase alone, the program cost in Year 2 is $[redacted] million, Year 3 is $[redacted] million, Year 4 is $[redacted] million, and Year 5 is $[redacted] million.

[redacted]

NSF's Cost Proposal Review Document (CPRD), dated June 11, 2018, contains NSF's evaluation of WHOI's proposal. Although NSF attached WHOI's cost sensitivity analysis to the CPRD, it did not include agency conclusions on the analysis or its potential impact on the budget. Instead, in its evaluation in the CPRD, NSF stated, "WHOI provided … a summary discussion of its risk analysis process, all of which will be further refined during the transition phase and incorporated in the first Annual Work Plan for NSF approval." A more thorough analysis of the supplemental information would have provided more realistic expectations of the level of science support that can be maintained with $44 million in funding.

NSF Did Not Require Major Facilities Operations Proposals to Include a Risk Analysis

At the time of our audit, NSF did not require recipients to complete a risk analysis for operations awards at proposal submission because it believed the award structure allowed sufficient flexibility to handle unexpected costs during operations. For example, if risks arose the recipient could re-budget per the award terms and conditions, reduce the level of science support with NSF's approval if significant, or request additional funding from NSF. NSF specified in its WHOI CPRD that its "… current policy regarding [operations and maintenance] budgets does not require sensitivity and risk analysis to the extent required for construction awards."

Requiring proposing organizations to articulate risks — including estimated cost and likelihood, mitigation strategies, and whether to accept each risk — could allow the proposing organization and NSF to identify and better understand the likelihood of outcomes such as re-budgeting, reducing the level of science support, or requesting supplemental funding during the operations stage.

NSF Corrective Actions

As a result of our audit, NSF has begun taking steps to improve the quality of future proposals for major facility operations. For example, in December 2019, NSF revised its standard template language for major facility operation solicitations. The new template clarifies that any proposed NSF funding level is for planning purposes only and the actual funding amount will be based on the detailed cost estimate, NSF's cost analysis, and the availability of funding. The template also requires cost estimating plans to articulate escalation factors used, including inflation, and address risk.

Additionally, NSF revised its *Major Facilities Guide* (formerly the *Large Facilities Manual*) in September 2019 to include strategies for handling risks during operations awards. However, the guide does not require a risk and uncertainty analysis for operations proposals.

Recommendations

We recommend that Office Head and Chief Financial Officer, Office of Budget, Finance and Award Management, National Science Foundation:

1. Perform an analysis of WHOI's current budgetary estimates and constraints to determine if WHOI is achieving the proposed efficiency cost savings and, if necessary, determine the reductions to the level of science support that will need to occur to remain within the $44 million per year budget.

2. Ensure that inflation factors are included in future major facility operations proposals and are reviewed and evaluated.

3. NSF should develop internal and external guidance to ensure all operations proposals include an evaluation of key operational risks, their potential cost and scientific impacts, and mitigation strategies. The guidance should include instructions on determining whether to conduct a risk and uncertainty analysis or a sensitivity analysis, and how to document that analysis.

OIG Evaluation of Agency Response

NSF agreed with our recommendations. NSF's response is included in its entirety in Appendix A.

Appendix A: Agency Response

National Science Foundation

MEMORANDUM

Date: April 5, 2020

To: Mark Bell, Assistant Inspector General, Office of Audits

From: William Easterling, Assistant Director, GEO /s/

Teresa Grancorvitz, Chief Financial Officer and Head, BFA /s/

Subject: Official Draft Report, *Audit of NSF's Process for Evaluating the Operations and Maintenance Cost Proposal for the Ocean Observatories Initiative (OOI)*

The National Science Foundation (NSF) appreciates the opportunity to review and provide comments on the OIG's draft report. We also greatly appreciated the on-going dialog with your office during the audit that enabled NSF to take the early actions described below. NSF considers its stewardship over federal funds a high priority and our cost analysis process on major facilities is an important element of sound stewardship.

NSF agrees with all three of the OIG's recommendations. Regarding Recommendation 1, the Division of Ocean Sciences (OCE) and the Office of Budget, Finance and Award Management (BFA) will evaluate future annual cost submissions for OOI to determine if WHOI is achieving the proposed cost savings. The decision to reduce scientific support or supplement the award in accordance with NSF practice and policy will be determined by OCE based, in part, on the availability of funding. OOI is in the second year of operations under the new award and the Recipient (Woods Hole Oceanographic Institution) has been able to achieve scientific objectives at or below their proposed annual budget.

As noted in the OIG report regarding Recommendation 2, NSF has already developed standard solicitation language to ensure escalation factors (including inflation) are included in all future operations and maintenance proposals at submission. Additional guidance around GAO's twelve steps of a high-quality cost estimate, including both the risk/uncertainty and sensitivity analyses, have been included in the 2019 revision of the *Major Facilities Guide*. We are confident that these actions will improve the quality of major facility cost estimates submitted to NSF.

Regarding Recommendation 3, NSF believes that external guidance in the *Major Facilities Guide* and the new solicitation language is sufficient to strengthen proposal submissions, but we will reevaluate once new proposals are received. NSF will review its internal standard operating

guidance, including the new guidance on conducting major facility reviews now under development, to identify areas where NSF practices on assessing cost impacts of operational risks can be clarified. We will be preparing a Corrective Action Plan to provide your office with information showing the results of the actions already implemented by NSF as well as more details on next steps to be taken.

On behalf of the NSF staff participating in the engagement, we want to acknowledge the OIG staff for their diligence and commitment to understanding NSF's oversight processes. We look forward to receiving the final report. If you have any concerns, please contact Matthew Hawkins at mjhawkin@nsf.gov or (703)292-7407.

Appendix B: Objective, Scope, and Methodology

The objective of this performance audit was to determine whether NSF has taken steps to ensure that WHOI's proposed cost containment measures are achievable, allowing OOI to function within the 5-year, $220 million proposed budget.

To accomplish our objective, we:

- Determined NSF's requirements for evaluating WHOI's OOI proposal by analyzing NSF policies and procedures, including NSF's *Large Facilities Manual*, NSF 17-066, March 2017; NSF's *Major Facilities Guide*, Draft for Public Comment, December 2018; *NSF Proposal and Award Policies and Procedures Guide*, Version NSF 17-1, January 30, 2017; NSF Standard Operating Guidelines; and the *GAO Cost Estimating and Assessment Guide*, GAO-09-3SP, March 2009, which NSF policies reference.
- Reviewed WHOI's proposal (1743430) submitted April 17, 2017, for the Operations and Management of OOI including its supplemental documentation outlining proposed cost saving efficiencies to cover inflation throughout the award period.
- Evaluated NSF's review of WHOI's proposal by reviewing the Independent Cost Assessment (ICA) of Ocean Observatories Initiative (OOI) Project Operations, [redacted] (February 23, 2018) and the Cost Proposal Review Document: Management and Operation of Ocean Observatories Initiative (001), 2018-2023, Woods Hole Oceanographic Institute, June 11, 2018.
- Conducted interviews with the Programs Officers, Grants Officers, and officials from the Large Facilities Office.
- Reviewed open NSB meetings from 2000 to 2015 to identify NSB discussions on OOI budget decisions.
- Reviewed the August 15, 2017, February 21, 2018, and May 2, 2018 NSB Committee on Awards and Facilities meetings to determine if NSF presented information to the NSB on the risk associated with the OOI budget constraints.
- Reviewed prior reports and studies of the OOI project, including *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*, National Academy of Sciences, (2015) and NSF's response; *An Ocean Blueprint for the 21st Century*, U.S. Commission on Ocean Policy, 2004; *Ocean Observatories Initiative (OOI) Scientific Objectives and Network Design: A Closer Look*, *Construction Final Report*, Consortium for Ocean Leadership, September 2016; and *Illuminating the Hidden Planet: The Future of Seafloor Observatory Science*, National Academy Press, 2000.

To ensure that NSF applied appropriate internal controls in its review of WHOI's proposal, we compared the requirements in the Major Facilities A-123 Oversight Process, June 2017, and NSF's policies to NSF's documentation of its review. We made recommendations in the report where NSF could strengthen internal controls. We did not identify any instances of fraud, illegal acts, violations, or abuse. We did not rely on computer-processed data to complete the audit.

We conducted this performance audit between February 2019 and February 2020, 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.

Major contributors to this report include Dan Buchtel, Deputy Assistant Inspector General; Elizabeth Kearns, Director, Audit Execution; Holly Snow, Audit Manager; Jeanette Hyatt, Senior Auditor; Heather Gallagher, Senior Auditor; and Brittany Moon, Independent Report Referencer.

Appendix C: OIG Analysis of WHOI's Inflation Absorption Plan

Based on our analysis of WHOI's inflation absorption plan, expected cost savings may not cover anticipated inflation costs over the 5-year award period. As a result, the proposed level of scientific support may need to be reduced or funding for OOI may need to be increased to cover expected inflation costs.

WHOI proposed the following three categories of cost saving efficiencies in years 2 through 5 to absorb inflation and stay within the annual budget:

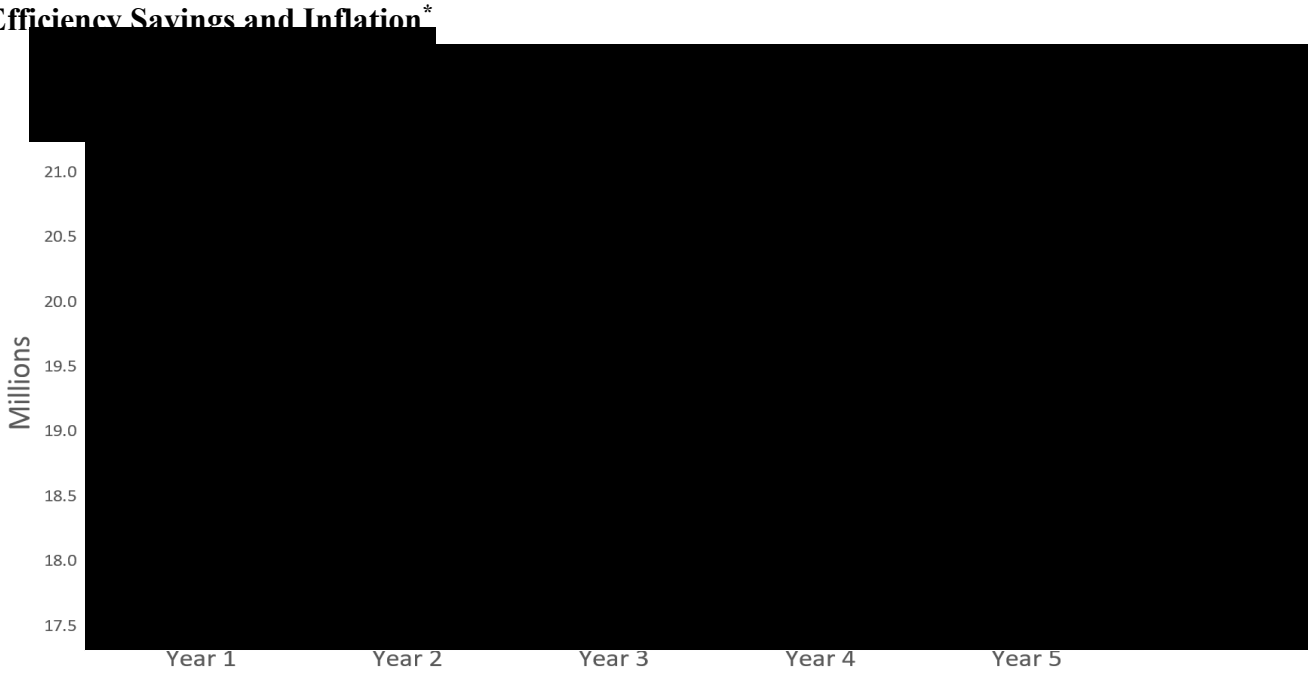
- Efficiencies and Reductions in Refurbishment Labor Costs
- Reductions to Cruise Lengths with Improved Weather Prediction
- Reduction in Refurbishment Materials Costs

Efficiencies and Reductions in Refurbishment Labor Costs

Refurbishment labor includes efforts to clean, disassemble, and replace parts and equipment, and to reassemble, integrate, and test moorings at array sites. According to the document *WHOI Management of Inflation Versus Fixed Program Budget*, WHOI estimated annual costs for refurbishment labor would decrease by [redacted]

[5] Our analysis assumes that WHOI will achieve the maximum estimated efficiency of [redacted] percent of refurbishment labor costs included in WHOI's Year 1 annual workplan, which is a savings of $[redacted] per year, or approximately $[redacted] over the remaining 4 years of the cooperative agreement.

Figure 2. WHOI's Proposed Labor Refurbishment Cost Vs. Calculated Labor Included Efficiency Savings and Inflation*



Source: NSF OIG

*The green bars depict WHOI's proposed costs for refurbishment labor over the 5-year award. The blue bars depict total costs after accounting for estimated labor efficiencies and anticipated inflation.

Reductions to Cruise Lengths with Improved Weather Prediction

To refurbish the arrays, WHOI travels by boat to the array site to deploy and recover the arrays (turn cruises) one to four times each year. The cruise lengths range from approximately 19 to 42 days for a total of 174 days per year. Poor weather can increase the length of the turn cruises or require additional cruises if sea conditions prevent WHOI from deploying or recovering the 5-ton surface moorings. WHOI continuously gathers weather data to attempt to predict weather patterns to determine the ideal travel times.

WHOI estimated it could save percent of yearly cruise costs by gathering weather data to predict future weather patterns and plan shorter turn cruises. Based on WHOI's annual operation plan for year 1, total cruise costs are just over $ million or an average of $ per day. If WHOI achieves savings of percent, this would equate to approximately fewer days of travel and a total savings of approximately $ per year.[6]

However, WHOI's inflation absorption plan did not provide the basis of its estimate and calculations for the cost savings and did not include sufficient details regarding how WHOI would achieve the efficiencies. For example, WHOI plans to use several research ships from the Academic Research Fleet

[6] Our analysis assumes that WHOI will achieve the maximum estimated efficiency of percent of cruise costs included in WHOI's annual workplan, which is a savings of approximately $ per year, or $ over the 5-year cooperative agreement.

to conduct turn cruises. [redacted]

Reduction in Refurbishment Materials Costs

WHOI's initial annual operation plan includes approximately $[redacted] million per year in refurbishment materials costs, or $[redacted] million over the 5-year cooperative agreement. WHOI uses these materials to prepare the arrays for deployment. [redacted] WHOI plans to achieve significant savings by [redacted]

[redacted]

Table 1. Required Refurbishment Materials Cost Savings

Year	Percent Cost Reduction to Cover Inflation	Savings Amount to Cover Inflation
1*	**0**	**$0**
2	[redacted]	
3		
4		
5		
Total		

Source: NSF
*There is no inflation in year 1. We assume efficiency cost savings will not begin until year 2.

[redacted]

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