MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

$200,760,000
+$760,000 / 0.4%

Major Research Equipment and Facilities Construction Funding

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change over FY 2014 Estimate Amount	Percent
Major Research Equipment and Facilities Construction	$196.49	$200.00	$200.76	$0.76	0.4%

The Major Research Equipment and Facilities Construction (MREFC) account supports the acquisition, construction, and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Initial planning and design, and post-construction operations and maintenance of the facilities are funded through the Research and Related Activities (R&RA) account. No new starts are proposed for FY 2015.

MREFC Account Funding, by Project

(Dollars in Millions)

	FY 2013 Actual	FY2014 Estimate	FY 2015 Request	FY 2016 Estimate	FY 2017 Estimate	FY 2018 Estimate	FY 2019 Estimate	FY 2020 Estimate
AdvLIGO	$15.18	$14.92	-	-	-	-	-	-
ALMA	0.51	-	-	-	-	-	-	-
DKIST[1]	25.00	36.88	25.12	20.00	20.00	20.00	16.13	-
LSST	-	27.50	79.64	99.67	67.12	55.80	47.89	45.75
NEON	90.80	93.20	96.00	80.64	-	-	-	-
OOI[1]	65.00	27.50	-	-	-	-	-	-
MREFC Total	$ 196.49	$ 200.00	$ 200.76	$ 200.31	$ 87.12	$ 75.80	$ 64.02	$ 45.75

Totals may not add due to rounding,

[1] DKIST, the Daniel K. Inouye Solar Telescope, is the new name for the Advanced Technology Solar Telescope (ATST). DKIST received $146.0 million and OOI received $105.93 million in ARRA funds in FY 2009.

Modern and effective research infrastructure is critical to maintaining U.S. leadership in science and engineering (S&E). The future success of entire fields of research depends upon access to new generations of powerful research tools. Increasingly, these tools are large and complex, and have a significant information technology component.

To be considered for MREFC funding, NSF requires that a project represent an exceptional opportunity to enable research and education. The project should be transformative in nature, with the potential to shift the paradigm in scientific understanding. The projects included in this budget request meet these criteria based on NSF and National Science Board (NSB) review.

In FY 2015, NSF requests funding to continue construction of three projects: the Daniel K. Inouye Solar Telescope (DKIST), the National Ecological Observatory Network (NEON), and the Large Synoptic Survey Telescope (LSST). The Advanced Laser Interferometer Gravitational Wave Observatory (AdvLIGO) and the Ocean Observatories Initiative (OOI) received their final construction funding in FY 2014, so no additional funding is requested for FY 2015. NSF is not requesting funds to begin any

new projects in FY 2015. For more detailed information on these projects, please refer to the following individual narratives.

Since it was established in FY 2009, projects funded through the MREFC account have been subject to NSF's "no cost overrun" policy. The policy encompasses NSF processes and procedures that promote the development of realistic, robust, and reliable cost estimates for major projects, so that project budgets are sufficient to accomplish the scientific objectives of each particular project.

The current policy requires that (1) the total cost estimate for each project at the preliminary design stage include adequate contingency to cover foreseeable risks, and (2) any total project cost increases not covered by contingency be accommodated by reductions in scope, provided that the actual enacted funding levels have been consistent with the established project profiles. In FY 2014, NSF moved to improve its procedures by requiring an independent cost assessment for MREFC construction projects.

NSF agency-wide procedures are designed to ensure that cost and contingency tracking and management processes are robust and that the project management oversight has sufficient authority to meet this objective. If total costs for a project are revised during construction for reasons other than inadequate funding, NSF will identify mechanisms for offsetting any cost increases in accordance with the no overrun policy. In addition, all of the projects funded through the MREFC account undergo major cost and schedule reviews as required by NSF guidelines.

Appropriations Language

For necessary expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets pursuant to the National Science Foundation Act of 1950 (42 U.S.C. 1861 et seq.), including authorized travel, ~~$200,000,000~~*$200,760,000,* to remain available until expended.

Major Research Equipment and Facilities Construction
FY 2015 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Carryover/ Recoveries	Permanently Reduced	Adjustments to Prior Year Accounts	Unobligated Balance End-of-Year	Total Resources	Transfers	Obligations Incurred/Est.
FY 2013 Appropriation	$196.17	$0.69	-$12.47	$0.01	-$0.38	$184.02	$12.47	$196.49
FY 2014 Estimate	200.00	0.38			-	200.38		200.38
FY 2015 Request	200.76					200.76		200.76
$ Change from FY 2014 Estimate								$0.38
% Change from FY 2014 Estimate								0.2%

Totals may not add due to rounding.

Explanation of Carryover

Within the **Major Research Equipment and Facilities Construction (MREFC)** account, $380,153 was carried over into FY 2014. The obligation of these no-year funds may be spread over several years for the following projects:

- $95,819 for Ocean Observation Initiative (OOI); $39,049 for the Atacama Large Millimeter Array (ALMA), and $4,817 for South Pole Station Modernization (SPSM) closing-out costs.

- The remaining $240,468 represents funding recovered very late in the fiscal year.

The MREFC Account in FY 2015

The following pages contain information on NSF's ongoing projects in FY 2015, grouped by sponsoring organization. These are:

ADVANCED LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY $0

No MREFC funds are requested for the Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO) in the FY 2015 Budget Request. The FY 2014 Request of $14.92 million represented the last funding year of a seven-year project totaling an estimated $205.12 million.

Appropriated and Requested MREFC Funds for the Advanced Laser Inteferomter Gravitational-Wave Observatory

(Dollars in Millions)

FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014 Estimate	FY 2015 Request	Total Project Cost
$32.75	$51.43	$46.30	$23.58	$20.96	$15.18	$14.92	-	$205.12

Totals may not add due to rounding.

Baseline History

NSF first requested FY 2008 construction funds for AdvLIGO through the MREFC account in the FY 2006 Budget Request to Congress. The original proposal, received in 2003, estimated a total construction cost of $184.35 million. A baseline review in June 2006 established the project cost at $205.12 million, based upon known budget inflators at the time and a presumed start date of January 1, 2008. A second baseline review held in June 2007 confirmed this cost, subject to changes in inflators. Final Design Review in November 2007 recommended that construction begin in FY 2008. The National Science Board approved the project at a cost of $205.12 million in March 2008, and the project began in April 2008.

AdvLIGO is the planned upgrade of the Laser Interferometer Gravitational-Wave Observatory (LIGO) that will allow LIGO to approach the ground-based limit of gravitational-wave detection. LIGO consists of the world's most sophisticated optical interferometers, operating at two sites 3,000 km apart: Hanford, WA and Livingston, LA. These interferometers measure minute changes in arm lengths resulting from the passing of wave-like distortions of spacetime called gravitational waves, caused by cataclysmic processes in the universe such as the coalescence of two black holes or neutron stars. LIGO is sensitive to changes as small as one one-thousandth the diameter of a proton over the 4-km arm length; the AdvLIGO upgrade is expected to make the instrument at least 10 times more sensitive. The LIGO program has stimulated strong interest in gravitational-wave research around the world, producing vigorous programs in other countries that provide strong competition as well as highly beneficial collaborations. LIGO has pioneered and led the field of gravitational-wave detection, and a timely upgrade is necessary to sustain progress in this area.

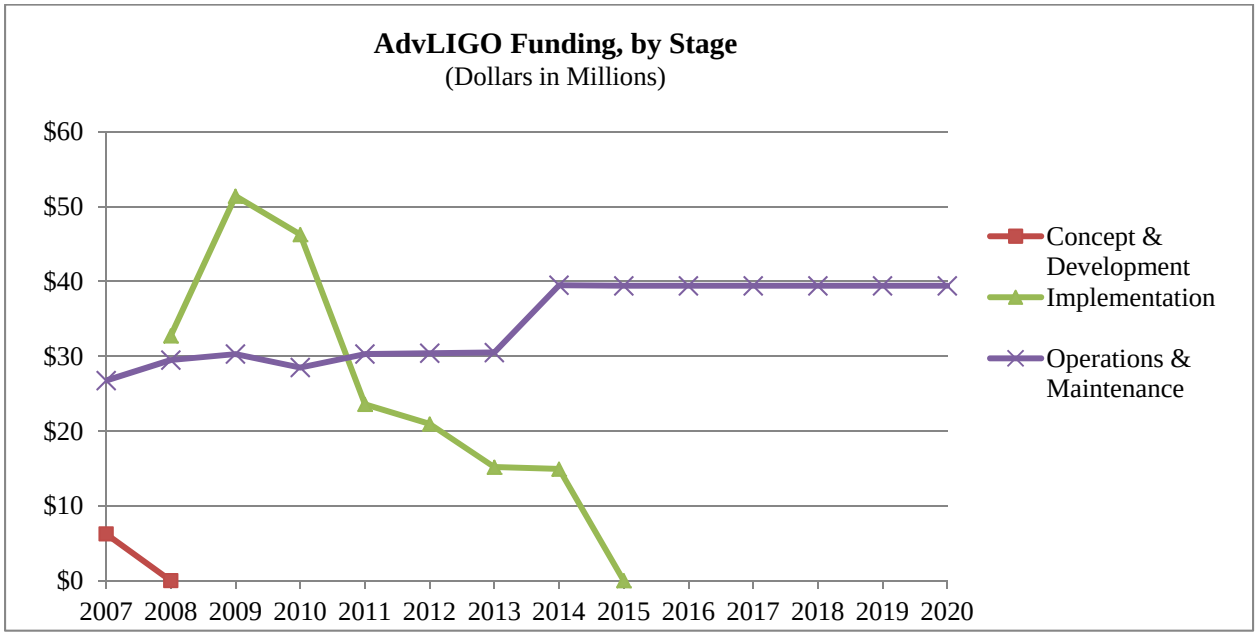
Total Obligations for AdvLIGO

(Dollars in Millions)

	Prior Years[1]	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	ESTIMATES FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
R&RA Obligations:									
Concept & Development	$40.74	-	-	-	-	-	-	-	-
Operations & Maintenance	30.40	30.50	39.50	39.43	39.43	39.43	39.43	39.43	39.43
Subtotal, R&RA Obligations	$71.14	$30.50	$39.50	$39.43	$39.43	$39.43	$39.43	$39.43	$39.43
MREFC Obligations:									
Implementation	175.02	15.18	14.92	-	-	-	-	-	-
Subtotal, MREFC Obligations	$175.02	$15.18	$14.92	-	-	-	-	-	-
TOTAL Obligations	$246.16	$45.68	$54.42	$39.43	$39.43	$39.43	$39.43	$39.43	$39.43

Totals may not add due to rounding.

[1] Concept & Development funding and Implementation funding are cumulative of all prior years. Operations & Maintenance funding reflects FY 2012 Actuals only.



Substantial connections with industry have been required for the state-of-the-art construction and measurements involved in the LIGO projects, with some partnerships leading to the development of new products and techniques. Areas of involvement include novel techniques for fabrication of LIGO's vacuum system, seismic isolation techniques, ultrastable laser development (new product introduced), high-power active optical components (new products), the development of new low-noise optical coatings, the development of new ultra-fine optics polishing techniques, and the development of new optical inspection equipment (new product).

LIGO has extensive international ties. The LIGO Scientific Collaboration, which sets the scientific agenda for LIGO, is an open collaboration of about 930 members that has formal ties with at least 86 institutions in 15 countries. Close collaboration is maintained with three other gravitational-wave

observatories: GEO, a UK-German collaboration; Virgo, a French-Italian collaboration; and the Kamioka Gravitational Wave Detector (KAGRA), a Japanese project. LIGO has signed an agreement with Virgo under which all data will be shared and analyzed cooperatively and all discoveries will be jointly credited. New technologies critical to AdvLIGO are being contributed by foreign institutions: the pre-stabilized laser source, funded and developed by the Max Planck Gesellschaft; the mirror/test mass suspension systems, funded and developed by the GEO collaboration; and auxiliary optical components, developed by the Australian National University and Adelaide University.

At its August 2012 meeting, the National Science Board authorized a change in scope to the project that would permit the LIGO Laboratory to relocate one of the three planned interferometers to India. The associated changes in schedule, costs to NSF, and risk to the scientific program are minimal. The resulting global array, if realized, will be capable of locating the sky positions of gravitational-wave sources so that telescopes and particle detectors could perform rapid follow-up observations of the events; much more information about the sources could be obtained by such "multi-messenger" observations. Should the current strong expression of Indian interest result in their construction of a LIGO-like facility in which the AdvLIGO interferometer components would be installed, observations could begin sometime after 2020. Should this opportunity not be realized, NSF will solicit proposals from the U.S. gravity wave research community for use of the third interferometer.

Management and Oversight

- NSF Structure: NSF oversight is coordinated internally by a dedicated LIGO program officer in the Division of Physics (PHY), working with staff from the Directorate for Mathematical and Physical Sciences (MPS); Offices of Budget, Finance, and Award Management (BFA); General Counsel (OGC); and Legislative and Public Affairs (OLPA). The Deputy Director for Large Facility Projects also provides advice and assistance. The Advanced LIGO project provides NSF with monthly technical and financial status reports. These are submitted to the LIGO program officer, who in turn reviews, analyzes, comments, and submits the reports to the Deputy Director for Large Facility Projects. The project also provides NSF with annual reports that provide a retrospective view of its financial and technical status, assessment of risks accompanied by a description of mitigation efforts, procurement and acquisition plans, and its intended work plan for the coming year. NSF also conducts periodic reviews of Advanced LIGO progress, using expert external panels comprised of individuals experienced in the scientific, technical, project management, and administrative areas necessary to accomplish the project. Advanced LIGO's financial status is reported monthly using Earned Value methodology. The project adheres to a formal Risk Management Plan (which was externally reviewed and formally approved by NSF prior to the start of the project) that reports all changes of scope, budget, and schedule to NSF, and that identifies potential risks and mitigation strategies. NSF explicitly approves all configuration changes and allocations of budget and schedule contingency that exceed budget and time thresholds defined in NSF's cooperative agreement funding the project.

- External Structure: LIGO is managed by the California Institute of Technology under a cooperative agreement with NSF. The LIGO Laboratory Directorate consists of the Executive Director, the Deputy Director, and the Spokesperson of the LIGO Scientific Collaboration (LSC). The Executive Director has overall responsibility for the LIGO Laboratory. The Deputy Director is responsible for executing the LIGO program and for organizing and directing the laboratory team. The LSC is responsible for assuring that the efforts of the LSC and LIGO Laboratory are well aligned. (The LSC carries out the LIGO advanced research and development program, the analysis of data, and the publication of scientific results, and it enables participation by collaborating external groups in appropriate LIGO activities). The Advanced LIGO construction project has its own management structure, which reports directly to the LIGO Executive Directorate. AdvLIGO management consists of a Project Leader, who is responsible for the overall management of the project, a Project Manager,

who oversees construction, and the Systems Engineer, who is responsible for all project engineering.

Reviews

- Technical Reviews: NSF conducts annual scientific and technical reviews involving external reviewers, participates in meetings of the LIGO Scientific Collaboration (LSC), and conducts site visits to the Hanford, WA and Livingston, LA interferometers.
- Management, Cost, and Schedule Reviews: (1) AdvLIGO construction proposal review in 2003; (2) first baseline review in June 2006; (2) second baseline review in June 2007; (3) final readiness review in November 2007.
- Project Reviews: (1) First review of the active project in November 2008; (2) first annual review in April 2009; (3) interim review in December 2009; (4) second annual review in April 2010; (5) interim review in December 2010; (6) third annual review in April 2011; (7) interim review in November 2011; (8) fourth annual review in April 2012, (9) interim review of LIGO's 2014-2018 operations and maintenance proposal in November 2012. In April 2013, NSF conducted a narrowly focused review of LIGO's plans to store the interferometer components anticipated for use in India, and this was followed about one month later by an annual review of construction progress. Panel reports resulting from these reviews confirm that the Advanced LIGO project currently meets NSF expectations for accomplishing the project's intended scope within its available budget and schedule.

Project Status

The National Science Board approved funding for AdvLIGO in March 2008, and the project began in April 2008. Installation of major subassemblies is proceeding at both sites, and initial tests of interferometer sub-systems are in progress. Project completion is expected in March 2015, when interferometers at both sites will be fully operational but not yet tuned to achieve maximum sensitivity. Upon project completion, the LIGO Observatory will commence an interleaved sequence of engineering studies and scientific operations aimed at attaining design sensitivity and making the first direct detection of gravitational waves during the 2015-2018 timeframe.

Cost and Schedule

The projected length of the project is seven years, with an 11-month schedule contingency. Advanced LIGO is currently nearly 90 percent complete. Current project performance is consistent with ending on time and within budget. Total project contingency usage as of January 31, 2014 was $32.40 million of the initial $39.10 million included in the $205.12 Total Project Cost.

Risks

The AdvLIGO project has undergone a sequence of comprehensive external annual reviews, most recently in May 2013. Based on these reviews, NSF program staff is confident that risk is being managed effectively and actions that mitigate risk are being appropriately reported to NSF and handled transparently. NSF maintains frequent communications with the project managers through weekly teleconferences, frequent reviews, and regular updates on special topics.

Technical risks include uncertainties about such topics as eliminating parametric acousto-optic instabilities in the interferometers, minimizing thermal noise in the mirror optical coatings, mitigating possible degrading effects of the very high optical powers in the interferometers and input optics, and the maintenance and repair of a mature infrastructure. The LIGO Laboratory has been conducting research to minimize these and other risks, and an internal risk management team oversees these efforts. Some of these risks have been successfully retired. For example, a highly successful quantum-mechanical squeezing experiment demonstrated that the interferometer can attain its desired sensitivity at lower than planned optical power.

Remaining known risks primarily consist of uncertainties in estimates for labor to complete

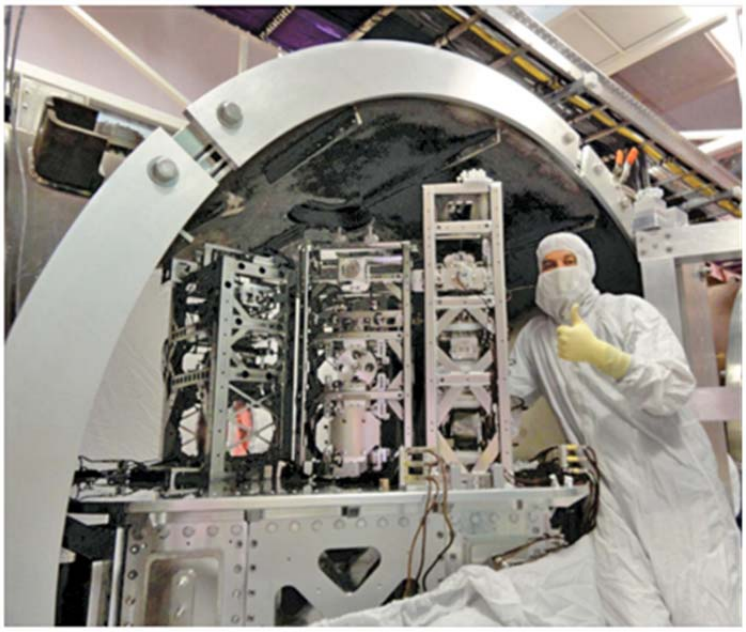
interferometer component installation, and identification by the project of about ten small technical changes that could require rework or additional labor and material to achieve design performance of system elements, depending on the outcome of initial installation and system testing.

Environmental risk is being effectively mitigated. The freely-suspended optical elements at the core of the observatory are carefully protected from earthquakes. Anthropogenic noise at the Livingston site due to logging and oil exploration has been mitigated by communication with local industry and by the early adoption of AdvLIGO seismic noise isolation technology.

Safety is maintained by strict adherence to institutional guidelines and to published LIGO Laboratory safety practices, overseen by dedicated safety officers at both sites. Hazard analysis is conducted before work is begun and mitigation is performed. External reviews have found satisfactory safety procedures.

Future Operations Costs

Operations and maintenance costs for the LIGO laboratory during the period FY 2015-FY 2018 are $39.43 million per year, funded by the MPS Division of Physics. Additional information on operations and maintenance costs is presented in the Facilities chapter.



Dr. Matt Heintze, a University of Florida and LIGO scientist, celebrates the installation of suspensions in AdvLIGO's most complex vacuum chamber at LIGO. *Credit Caltech/MIT LIGO Laboratory*.

DANIEL K. INOUYE SOLAR TELESCOPE $25,120,000

Note: On December 15, 2013, the Advanced Technology Solar Telescope (ATST) was renamed after the late Senator Daniel K. Inouye.

The FY 2015 Budget Request for the Daniel K. Inouye Solar Telescope (DKIST) is $25.12 million. This represents the seventh year in what is now expected to be an eleven year funding profile, with an estimated total project cost of $344.13 million. This is a revised estimate of the total project cost that was approved by the National Science Board (NSB) in August 2013.

The original total project cost to NSF, $297.93 million, was finalized after a Final Design Review (FDR) in May 2009. The NSB approved an award for this amount at the NSF Director's discretion, contingent upon completion of compliance with relevant environmental and cultural/historic statutes. The environmental compliance requirements were completed on November 20, 2009, and the Record of Decision authorizing the construction was signed by the NSF Director on December 3, 2009. The Hawaii Board on Land and Natural Resources (BLNR) approved the project's application for a Conservation District Use Permit (CDUP) on December 1, 2010. A challenge to the CDUP organization was resolved in November 2012 and full access to the site atop Haleakala on Maui, Hawaii followed shortly thereafter. Site preparation and excavation began in December 2012.

The unexpected length of the delay associated with the environmental compliance process led to a reassessment of the project schedule and total project cost in early 2012. The revised baseline and an increase in the total project cost of approximately $46.20 million was reviewed by an external panel of experts and subsequently considered by the NSB, which approved a revised total project cost of $344.13 million at their August 2013 meeting. This adjustment impacts funding in FY 2017 through FY 2019 and is reflected in the tables that follow.

Appropriated and Requested MREFC Funds
for the Daniel K. Inouye Solar Telescope
(Dollars in Millions)

	Prior Years	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	FY 2016 Estimate	FY 2017 Estimate	FY 2018 Estimate	FY 2019 Estimate	Total Project Cost
MREFC Approp	$35.00	$25.00	$36.88	$25.12	$20.00	$20.00	$20.00	$16.13	$198.13
ARRA MREFC Appropriation	146.00	-	-	-	-	-	-	-	146.00
Total, DKIST	**$181.00**	**$25.00**	**$36.88**	**$25.12**	**$20.00**	**$20.00**	**$20.00**	**$16.13**	**$344.13**

Totals may not add due to rounding.

Baseline History

DKIST will enable the study of magneto-hydrodynamic phenomena in the solar photosphere, chromosphere, and corona. Determining the role of magnetic fields in the outer regions of the Sun is crucial to understanding the solar dynamo, solar variability, and solar activity, including flares and coronal mass ejections. These can affect civil life on Earth through the phenomena generally described as "space weather" and may have impact on the terrestrial climate. The relevance of DKIST's science drivers was reaffirmed by the National Academy of Sciences 2010 Astronomy and Astrophysics Decadal Survey: *New Worlds, New Horizons* as well as the 2012 Solar and Space Physics Decadal Survey: *A Science for a Technological Society.*

Beginning in 2001, NSF provided funds to the National Solar Observatory (NSO) for an eight-year design and development program for DKIST and its initial complement of instruments through the Division of Astronomical Sciences (AST) in MPS and the Division of Atmospheric and Geospace Sciences (AGS) in GEO. The current design, cost, schedule, and risk were scrutinized in an NSF-conducted Preliminary Design Review in October-November 2006. The FDR held in May 2009 determined that the project was fully-prepared to begin construction.

In FY 2009, $153.0 million was provided through the Major Research Equipment and Facilities Construction (MREFC) account to initiate construction. Of these MREFC funds, $146.0 million was appropriated through the American Recovery and Reinvestment Act (ARRA). Given the timing of the receipt of budget authority and the complexity of project contracting, the entire $153.0 million was carried over from FY 2009 and subsequently obligated in FY 2010. Since then, detailed design and fabrication contracts for the DKIST major subsystems and instruments have been issued. A Habitat Conservation Plan, designed to protect and rehabilitate habitats of the endangered Hawaiian petrel and Hawaiian goose that could potentially be affected by the construction of the DKIST, has been approved by the Hawaii Board on Land and Natural Resources. Formal consultation with the U.S. Fish and Wildlife Service with regard to the endangered Hawaiian petrel was completed in calendar year 2011.

Total Obligations for DKIST

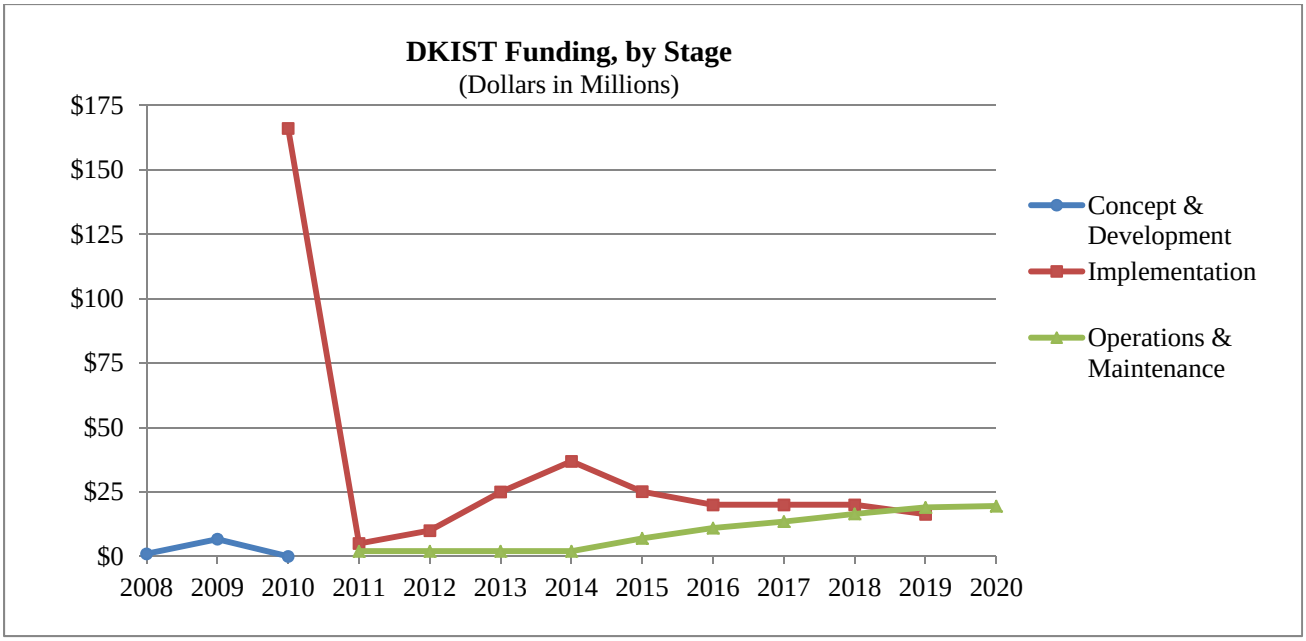
(Dollars in Millions)

	Prior Years[1]	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	ESTIMATES FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
R&RA Obligations:									
Concept & Development	20.41	-	-	-	-	-	-	-	-
Operations & Maintenance[2]	2.00	2.00	2.00	7.00	11.00	13.50	16.50	19.00	19.50
ARRA	3.10	-	-	-	-	-	-	-	-
Subtotal, R&RA Obligations	$25.51	$2.00	$2.00	$7.00	$11.00	$13.50	$16.50	$19.00	$19.50
MREFC Obligations:									
Implementation	35.00	25.00	36.88	25.12	20.00	20.00	20.00	16.13	-
ARRA	146.00	-	-	-	-	-	-	-	-
Subtotal, MREFC Obligations	$181.00	$25.00	$36.88	$25.12	$20.00	$20.00	$20.00	$16.13	-
TOTAL Obligations	$206.51	$27.00	$38.88	$32.12	$31.00	$33.50	$36.50	$35.13	$19.50

Totals may not add due to rounding.

[1] Concept & Development and Implementation funding is cumulative of all prior years. Operations & Maintenance reflects FY 2012 Actuals only.

[2] Of the total Operations & Maintenance funding, $2.0 milllion per year for FY 2011 through FY 2020 is for cultural mitigation activities as agreed to during the compliance process.



The project is a collaboration of scientists and engineers at more than 20 U.S. and international organizations. Other potential partners include the Air Force Office of Scientific Research and international groups in Germany, the United Kingdom, and Italy. Now that there is firm funding for construction, details of these partnerships are being discussed. These include the following activities:

- The U.S. Air Force has replaced the aluminizing chamber at their Advanced Electro-Optical System telescope on Maui and sized it to accommodate the DKIST primary mirror. This obviates the need to build a new aluminizing chamber for DKIST.
- Kiepenheuer-Institut fuer Sonnenphysik (Freiburg, Germany) is constructing a narrow-band visible tunable filter based first-light instrument.
- Queens University Belfast (Belfast, Northern Ireland) is considering contributing high speed cameras for DKIST instrumentation.

Discussions of other possible contributions for, for example, second-generation instruments, algorithm development, coordinated observations, and student exchange are ongoing.

Management and Oversight

- NSF Structure: Oversight from NSF is handled by a program officer in AST working with staff from the Directorate of Mathematical and Physical Sciences; Offices of Budget, Finance and Award Management; and the Offices of the General Counsel and Legislative and Public Affairs. The Deputy Director for Large Facilities also provides advice and assistance.
- External Structure: The project is managed by NSO. NSF funds NSO operations and maintenance and DKIST design and development via a cooperative agreement with the Association of Universities for Research in Astronomy, Inc. (AURA). The NSO cooperative agreement will expire at the end of FY 2014. As of now, the plan is to renew the agreement with AURA for a period of ten years covering the DKIST construction phase and initial operations of the completed facility. The DKIST director is a senior NSO scientist who was a leader in the development of the science case and an expert in the field of solar adaptive optics, a critical technology for the DKIST. The project manager has experience in several other NSF-funded large projects including the Atacama Large Millimeter/submillimeter Array and the Expanded Very Large Array. Several councils and working groups provide input from the solar and space physics communities.

Reviews

- Technical Reviews: Reviews have been conducted throughout the design and development phase. The preliminary design was found to be robust in the NSF-conducted Conceptual Design Review in March 2005 and Preliminary Design Review in October-November 2006. The project has completed a comprehensive set of system-level design reviews for all major sub-systems.
- Management, Cost, and Schedule Reviews: DKIST scope, schedule, budget estimate, and risk-adjusted total project cost were scrutinized and validated at the Preliminary Design and Final Design Reviews.
- The Final Design Review (FDR): The FDR was held on May 18-21, 2009 in Tucson, Arizona. The unanimous finding of the review panel was that the DKIST project was fully prepared to begin construction.
- Re-baseline Review: A review of the revised project baseline was held in October 2012. The project responded to the recommendations of the review panel and follow-up discussions were completed in April 2013.

Project Status

Current activities include finalizing the detailed designs, ongoing fabrication of DKIST subsystems and instruments, and site preparation and excavation.

Haleakala High Altitude Observatory on the island of Maui was chosen as the DKIST site. The Final Environmental Impact Statement was submitted to the Environmental Protection Agency on July 24, 2009. Consultation with Native Hawaiian stakeholders has resulted in a fully-executed Programmatic Agreement that details steps to minimize impacts on the traditional cultural assets on Haleakala, thereby completing compliance with the National Historic Preservation Act. The record of decision authorizing the commencement of construction in FY 2010 was signed by the NSF Director and published in the Federal Register on December 9, 2009. All federal environmental compliance requirements are now complete. Following a challenge to the issuance of the State of Hawaii's Conservation District Use Permit, site access was granted in November 2012, at which time all relevant permits were in place.

Highlights of construction include:

- Clearing of the DKIST site and excavation of utility trenches began in December 2012, followed in January 2013 by the beginning of excavation for the DKIST foundation. Major excavation at the Haleakala site is complete. The construction of the foundation for the telescope pier and infrastructure improvements are nearly complete.
- The primary mirror commissioning blank was delivered to the University of Arizona's College of Optical Sciences where it is being ground to its off-axis figure. The final blank is in production with delivery expected in 2014.
- The telescope mount assembly is in production and the enclosure fabrication is nearing completion.
- Final designs for the first-light instruments are being completed by the instrument partners and prototyping of critical components is underway.
- Beneficial occupancy of the DKIST Utility Building, the first Level 1 milestone, was achieved in December 2013.

In FY 2015, the construction of the telescope enclosure and its rotating dome will be completed, made weather tight, and readied for the installation of the telescope structure. Off the mountain, the primary mirror polishing will be finished with acceptance testing scheduled for the end of FY 2015. The construction of the deformable mirror system, which is essential to achieve the telescope's spatial resolution, will be completed as well.

Cost and Schedule

The original baseline not-to-exceed, risk-adjusted cost was established following the FDR. A review of a revised project baseline was held in October 2012, and the new baseline was approved by the National Science Board in August 2013. The total project cost of $344.13 million is derived from ARRA ($146.0 million) and annual appropriations in the MREFC account ($198.13 million). Full science operations will begin in mid-2019.

Risks

Project management control, interface control, and change controls are in place. Delay in obtaining full access to the site and associated complexities and legal fees have impacted the total projected cost and schedule, resulting in a revised baseline cost and schedule.

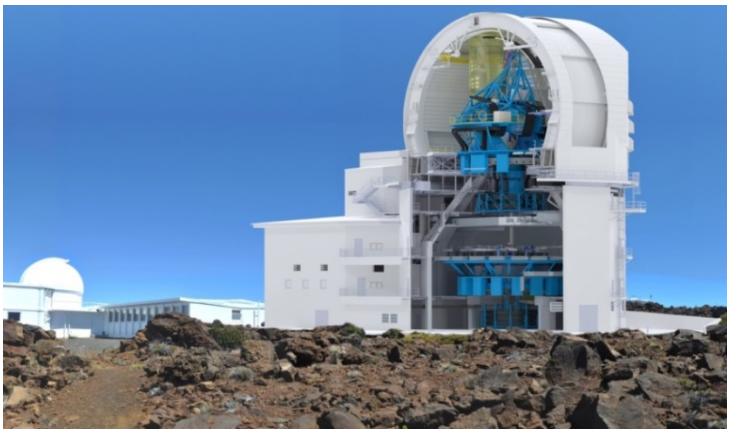
Technical: The remaining technical risk is very low as a result of the long design and development phase.

Environmental and Cultural Compliance: Given the recent history of telescope construction on mountains sacred to Native American and Native Hawaiian people, some delay in obtaining permission to begin construction was anticipated. However, the actual delay exceeded project estimates by approximately 30 months. The MPS Division of Astronomical Sciences, NSF's Office of the General Counsel, and the DKIST project have worked carefully through the processes of the applicable statutes and a cultural monitor has been retained during construction. All required permits are in place.

Environmental Health and Safety: NSO has a well-developed safety program engendered in the DKIST project. The DKIST project has developed a site safety plan and conducted a thorough construction readiness review in 2011 and the first annual safety review in 2012.

Future Operations Costs

The estimated annual operations and maintenance cost is $19.50 million in FY 2020, including $2.0 million annually for cultural mitigation. DKIST will become the flagship telescope for the solar community and will render some current facilities obsolete. NSO will realize significant cost savings through the closure or divestment of telescopes that will be replaced by DKIST. A transition plan regarding the divestment of these facilities will be part of the renewal of the NSO cooperative agreement and will be externally reviewed. Cultural mitigation commitments have been made pursuant to terms of DKIST environmental and cultural compliance as described in the final environmental impact study and the subsequent Record of Decision, and the Programmatic Agreement. These include $2.0 million of R&RA funding to be provided annually for 10 years for programs on Maui, supporting science, technology, engineering, and mathematics education and workforce development with an emphasis towards Native Hawaiian students. A ten-year award to develop and administer these programs was made to the University of Hawaii, Maui College (UHMC) in 2011.



A cutaway rendering of the DKIST facility at its site atop Haleakala on Maui, Hawaii. *Credit: NSF/AURA/NSO.*

LARGE SYNOPTIC SURVEY TELESCOPE $79,640,000

The FY 2015 Budget Request for the Large Synoptic Survey Telescope (LSST) is $79.64 million. This is the second year of support for a nine-year project that will begin in July 2014. The total project cost to NSF is estimated at $473.0 million.

Requested MREFC Funds for the Large Synoptic Survey Telescope

(Dollars in Millions)

FY 2014 Estimate	FY 2015 Request	FY 2016 Estimate	FY 2017 Estimate	FY 2018 Estimate	FY 2019 Estimate	FY 2020 Estimate	FY 2021 Estimate	FY 2022 Estimate	Total Project Cost
$27.50	$79.64	$99.67	$67.12	$55.80	$47.89	$45.75	$39.90	$9.73	$473.00

Totals may not add due to rounding.

LSST Science Mission

The Large Synoptic Survey Telescope will be an 8-meter-class wide-field optical telescope designed to carry out surveys of nearly half of the sky. The initial 10-year survey has a cadence enabling repeat observations of each survey field approximately twice weekly. The requirements for the LSST were defined by considering four key science areas:

- Understanding the physics of dark energy and dark matter;
- Making a census of the small bodies in the solar system, including potentially hazardous Near Earth Objects;
- Mapping the structure and contents of the Milky Way galaxy; and
- Understanding the nature of transient astronomical objects on time scales ranging from seconds to years.

By satisfying the requirements defined by these key investigations, the LSST survey also will result in a comprehensive data set that will enable hundreds of other fundamental astrophysical studies by the entire research community. Thus, LSST has the potential to change every field of astronomical study, from the inner Solar System to the large-scale structure of the Universe.

Baseline History

Construction of LSST is a joint NSF/Department of Energy (DOE) effort to realize an instrument that has been in design and development for nearly 15 years, and which was ranked as the top large ground-based astronomy project by the National Academy of Sciences (NAS) 2010 Decadal Survey.

To date, over $130.0 million has been invested by NSF, DOE, and private (non-federal) partners. About 70 percent of this funding has gone to design and development, and the other 30 percent (from private funding) to early construction. The non-federal funding has supported casting, figuring, and preliminary polishing of the innovative combined primary-tertiary mirror, initial site preparation, and prototype detector creation and evaluation, all of which have significantly reduced construction risks.

Rendering of LSST as it will appear along the ridgeline from the existing SOAR and Gemini South telescopes. *Credit: C.Claver, NOAO/LSST.*

The project was originally baselined following a series of reviews conducted by NSF and DOE together in 2011 and 2012, including the NSF Preliminary Design Review (PDR) and a subsequent cost estimation review. Since that time, the construction plan has been kept up-to-date to synchronize the DOE and NSF funding profiles and adjust schedule contingency, as described below in the Cost and Schedule section.

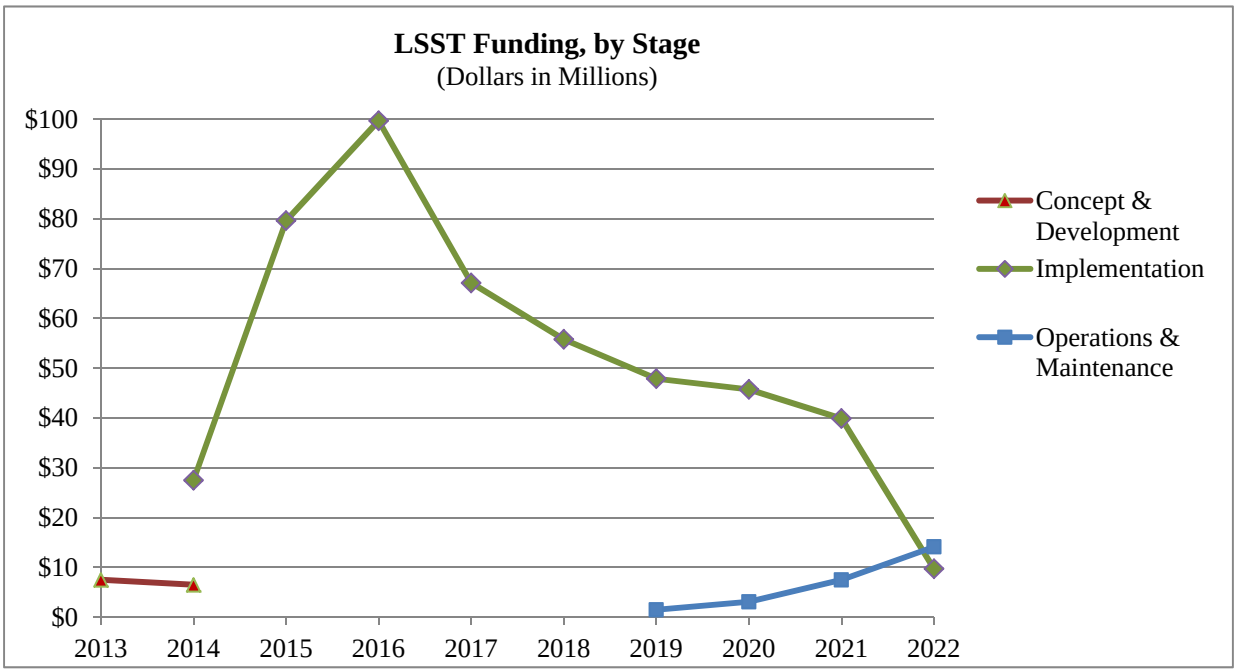
Total Obligations for LSST

(Dollars in Millions)

	Prior Years[1]	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	ESTIMATES FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
R&RA Obligations:									
Concept & Development	$43.13	$7.50	$6.50	-	-	-	-	-	-
Operations & Maintenance	-	-	-	-	-	-	-	1.49	3.10
Subtotal, R&RA Obligations	$43.13	$7.50	$6.50	-	-	-	-	$1.49	$3.10
MREFC Obligations:									
Implementation	-	-	27.50	79.64	99.67	67.12	55.80	47.89	45.75
Subtotal, MREFC Obligations	-	-	$27.50	$79.64	$99.67	$67.12	$55.80	$47.89	$45.75
TOTAL Obligations	$43.13	$7.50	$34.00	$79.64	$99.67	$67.12	$55.80	$49.38	$48.85

Totals may not add due to rounding.

[1] Concept & Development funding and Implementation funding are cumulative of all prior years. Operations & Maintenance funding begins in FY 2019.



LSST Science Plan

LSST will be an 8.4-meter primary, 6.7-meter effective aperture, special purpose optical telescope to be located on Cerro Pachón, Chile. The Chilean site was selected because of the excellent sky transparency and image quality ("seeing"), dark skies, small fraction of cloudy nights, and the geological characteristics that enable the rapid telescope motions required to carry out the LSST survey. LSST will collect nearly 40 terabytes of multi-color imaging data every night for 10 years, producing a long-lived dataset of considerable utility. It will produce the deepest, widest-field sky image ever, and issue alerts for moving and transient objects within 60 seconds of their discovery. Repeated deep imaging of every part of the accessible sky will turn up transient and explosive events such as cataclysmic variable stars, supernovae, and the optical counterparts of X-ray flashes, as well as less spectacular moving objects.

LSST data will be widely accessible, and discovery opportunities will be available to the K-12 student as well as to the professional astronomer. An innovative citizen science program will involve people of all ages in LSST discoveries. More than half of the cost during operations is for data management, including user-friendly interfaces tailored for the different anticipated communities. The survey strategy makes the same dataset usable for almost all of the astronomy community as well as for educators and the general public. The primary data archive will be located at the National Center for Supercomputing Applications, in Illinois.

Management and Oversight

- NSF Structure: Oversight from NSF is the responsibility of the LSST program officer in the Division of Astronomical Sciences (AST) working with staff from the Directorate for Mathematical and Physical Sciences (MPS) and the Office of Budget, Finance and Award Management, which includes the Large Facilities Office. The NSF program officer works closely with counterparts in the DOE Office of High Energy Physics, who have oversight responsibility for the LSST Camera sub-project. Coordination is accomplished through regular meetings of a Joint Oversight Group (JOG) scheduled each week, and was formalized through a memorandum of understanding (MOU) between the agencies signed in July 2012.
- External Structure: The responsible awardee for LSST construction is the Association of Universities for Research in Astronomy (AURA), Inc., a non-profit science management corporation consisting of 39 U.S. institutional members and seven international affiliates. AURA works closely with the LSST Corporation (LSSTC), which initiated the LSST development and remains responsible for the privately raised funding. AURA and LSSTC established the LSST Project Office as an AURA-managed center for the construction period; this Project Office is overseen by the AURA Management Council for LSST. The LSST Project Director and the LSST Project Manager are experienced in large facility construction and operation and are appointed by AURA, with the involvement and approval of the LSSTC and NSF.

Reviews

- Technical Reviews: Reviews have been conducted throughout the design and development phases. A Conceptual Design Review (CDR), conducted in September 2007, found the design to be robust. The PDR followed release of the NAS 2010 Decadal Survey and was completed in September 2011. The DOE Critical Decision (CD) review of the camera led to CD-1 approval ("Approve Alternative Selection and Cost Range") in April 2012. All major sub-systems undergo regular system-level design reviews organized by the LSST Project Office with external participants.
- Management, Cost, and Schedule Reviews: Cost, schedule, and risk are scrutinized by all of the regular technical reviews. During construction, NSF and DOE will hold annual joint progress reviews. Specific milestone reviews for management, cost, and schedule also are described below:
    - Recommendations from the NSF PDR and the DOE CD-1 review led to a Joint Interface and Management Review and a Cost Estimation Review, both held in May 2012. DOE later held a

status review of the camera sub-project in June 2013, which led to an increased duration for the LSST construction project, including additional schedule contingency, and a small increase in scope. These changes were necessitated when DOE was not permitted to begin the camera construction within their FY 2013 appropriation.

  - NSF's Final Design Review (FDR) was held in December 2013 with DOE involvement. Fifteen panelists with wide-ranging experience in large projects gave the project a thorough review. Although the final report includes 34 recommendations, these recommendations only adjust the relative emphasis of project activities or endorse existing plans. The panel concluded: "We have no hesitation in our assessment that the project will be ready for the start of construction on July 1, 2014." This conclusion will be the basis for requesting approval for this construction start from the National Science Board (NSB).
  - NSF is currently conducting a Cost Estimation Sufficiency Review using an independent contractor to validate the LSST Project's Basis of Estimate documentation. This check will be in addition to the FDR and to the 2012 and 2011 reviews.
- DOE CD-3a review (long lead procurements) is expected during FY 2014.
- DOE CD-2 review is expected no earlier than October 2014. This review is the primary step towards setting a not-to-exceed Total Project Cost for the DOE sub-project.

Project Status

The project is currently assimilating the recommendations of the FDR, held in December 2013. Design and development support from both agencies has enabled complete preparations for construction, including the preparation of "design with option to build" bid packages that can quickly be awarded as funds become available. This will speed up project activities during the first full year of MREFC support, with major contracts anticipated for the telescope and site, and for the data management systems, in FY 2015. Significant hardware purchases are planned from DOE support for the camera in FY 2014-FY 2015. NSF and DOE supported activities remain tightly coordinated, both at the project level and between agency program officers.

While the facility, telescope, and camera are being built, the project will continue to address data access, computation, and collaboration needs. Because there will be different communities of users, there will be various concurrent modes of access. Development of the data access policy is expected to be a continuing activity as there are multiple promising approaches, and the details continue to be the subject of very active discussion within the project, with internal and external advisory committees, and with potential international partners.

Cost and Schedule

After a delay in the camera construction schedule, a DOE status review in June 2013 concluded that additional time would be needed. This led to a complete bottom-up re-planning of the project prior to the NSF FDR. The FDR panel found that the NSF Total Project Cost (TPC) of $473.0 million to be reasonable and justifiable if the project implements descoping options and also generates additional descope options that can be implemented later if additional risk reduction is necessary. The resulting extended schedule and TPC increase are predicated on a July 1, 2014 start for MREFC funding from NSF.

In addition to NSF's contribution, DOE currently estimates a range of $120.0 million to $175.0 million for the camera. DOE's fixed baseline will be determined following their CD-2 review no earlier than October 2014. Project construction includes $38.97 million from non-federal sources, nearly all of which has been expended.

Risks

Technical: Much of the technical risk identified early in the project, including as late as the CDR, has now been retired by further design and development effort and by investment of non-federal funds in construction, notably for the primary-tertiary mirror, whose polishing is on track to be completed in mid-2014. Both PDR and CD-1 external reviewers identified the detectors in the camera as a possible source of risk; this risk continues to be reduced and the project mitigation strategy was again endorsed by a DOE-led status review in June 2013. The risk registry is continually monitored and updated and was again reviewed at FDR.

Environmental and Cultural Compliance: The Chilean environmental and cultural impact assessment has been completed and was reviewed and subsequently approved by NSF in October 2010, under Executive Order 12114 for extraterritorial projects. Mitigation work has started with the propagation of threatened plant species, and the beginnings of reintegration at the site. There are no further issues.

Site: The above environmental and cultural impact assessment, and the subsequent finding equivalent to no significant impact, cleared the way for the preliminary site work. Local contractors have leveled the planned location for LSST and confirmed the geological results from the original test borings. They found no problems that could compromise the stability and rigidity of the mount as currently designed. There appear to be no remaining site risks.

Environmental Health and Safety: AURA operations in Chile have a long positive record of safety, and continued vigilance leads to regular updates of the safety plans. DOE laboratories similarly have a strong safety culture. Early construction supported by non-federal funds has proceeded without incident, including on-site blasting and complex mirror casting. The project safety plan was reviewed at PDR and FDR, and the project has recently appointed a full-time Head of Safety in anticipation of the start of construction.

Partnership Risk: The LSST Project Director oversees the entire project and will be assisted by a Deputy Project Director (to be appointed) with complementary skills and experience. Detailed project management is handled by a single Project Manager, agreed to by both NSF and DOE program management. Budgetary management details will be clearly set out between the Project Director, the Project Manager, the project's Change Control Board, the AURA Management Council for LSST, and the agency program officers, grants officers, and financial managers. The commitments by DOE and by NSF were officially recorded in an MOU between the agencies that was signed in July 2012. As noted in that MOU, the management structure treats the project as a single team and includes mechanisms and authority to make changes on either side of the DOE/NSF budgetary boundary, and even across that boundary, if necessary.

Operations Costs: A formal proposal for LSST Operations will be requested approximately two years before the start of early operations. Review of that proposal will result in the baseline project execution plan and operating costs. The project team has spent some effort on possible scope reduction to shrink the total annual cost but has primarily focused on finding partners willing to contribute towards the necessary non-federal contribution of approximately $9.0 million per year. Letters of commitment have been received from 68 institutions in 26 countries for a total annual contribution of over $10.0 million, providing strong confidence that the necessary non-federal contributions will be forthcoming. Negotiations are starting for firm agreements and possible advance contributions. An LSST@Europe meeting in September 2013 had attendees from 20 countries and led to detailed discussions about those contributions and agreements. Given the signed NSF/DOE MOU and the high level of signatories to the partner letters of commitment, operational support risk is low. The LSST Project Office plans to form an international finance committee to oversee the use of contributed funds during operation.

Future Operations Costs

Estimated operations costs, calculated in FY 2013 U.S. dollars, are $36.63 million per year. Following the recommendation of the NAS 2010 Decadal Survey, MPS/AST has prepared a plan to provide approximately 50 percent of that amount, and the DOE Office of High Energy Physics has committed to another 25 percent. As mentioned above, the total estimated cost, and the amount required from the non-federal partners, will be determined in review of a future LSST Operations proposal. In their joint MOU, NSF and DOE have agreed together to fund operations, increasing agency support and/or revising the operations plans, as appropriate.

THE NATIONAL ECOLOGICAL OBSERVATORY NETWORK $96,000,000

The FY 2015 Budget Request for the National Ecological Observatory Network (NEON) is $96.0 million, which represents the fifth year of a six-year project that totals an estimated $433.72 million.

Appropriated and Requested Funding for the National Ecological Observatory Network

(Dollars in Millions)

Prior Years	FY 2012	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	FY 2016 Estimate	FY 2017 Estimate	FY 2018 Estimate	Total Project Cost
$12.59	$60.30	$91.00	$93.20	$96.00	$80.64	-	-	$433.72

Totals may not add due to rounding.

NEON consists of geographically distributed field and lab infrastructure networked via cybertechnology into an integrated research platform for regional to continental scale ecological research. Cutting-edge sensor networks, instrumentation, experimental infrastructure, natural history archive facilities, and remote sensing will be linked via the internet to computational, analytical, and modeling capabilities to create NEON's integrated infrastructure.

Baseline History

In 2004, the National Research Council (NRC) evaluated the original NEON design of loosely confederated observatories and recommended that it be reshaped into a single integrated platform for regional to continental scale ecological research. Congress appropriated a total of $7.0 million through the Major Research Equipment and Facilities Construction (MREFC) account for NEON in FY 2007 and FY 2008, $4.0 million of which was rescinded in FY 2008. A Preliminary Design Review (PDR) was completed in June 2009 and a Final Design Review (FDR) was completed in November 2009. The FDR also included a formal construction baseline review and cost review; an additional baseline review was conducted in April 2011 prior to initiation of construction that confirmed the baseline scope, cost, and schedule. Project planning continued through FY 2011 until construction began in August 2011.

Total Obligations for NEON

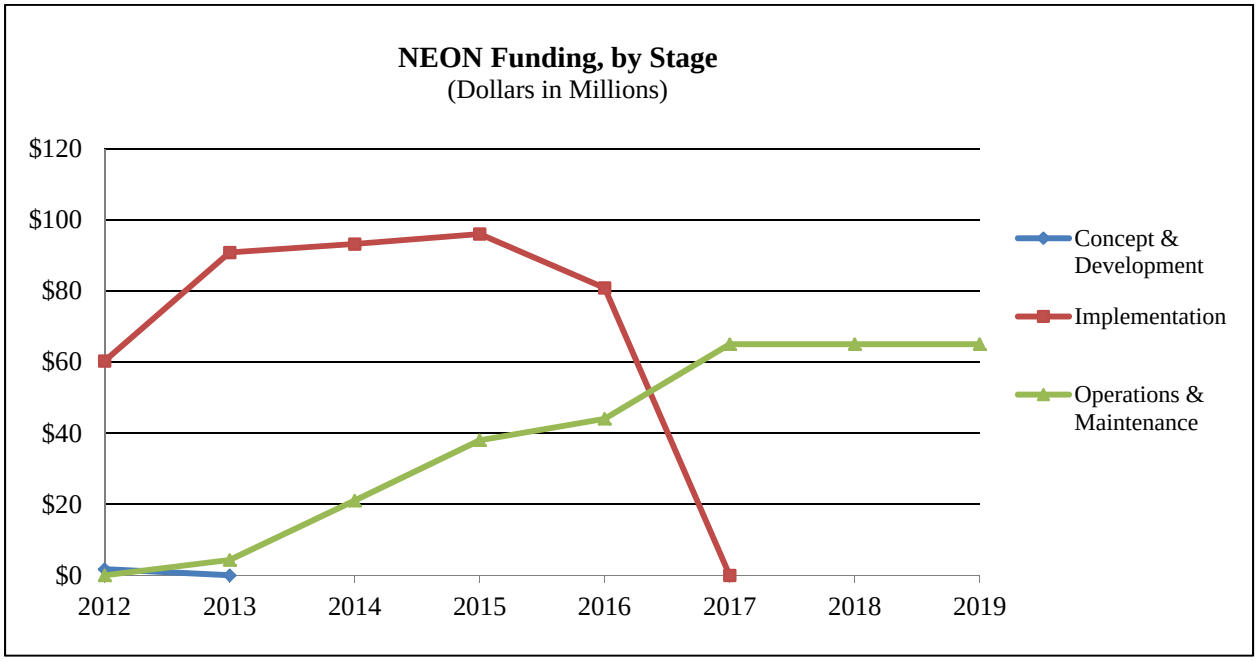
(Dollars in Millions)

	Prior Years[1]	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	ESTIMATES FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
R&RA Obligations:									
Concept & Development	$90.52	$1.21	-	-	-	-	-	-	-
Operations & Maintenance[2]	-	-	21.00	38.00	44.04	65.00	65.00	65.00	65.00
ARRA	9.96	-	-	-	-	-	-	-	-
Subtotal, R&RA Obligations	$100.48	$1.21	$21.00	$38.00	$44.04	$65.00	$65.00	$65.00	$65.00
MREFC Obligations:									
Implementation	72.89	90.80	93.20	96.00	80.84	-	-	-	-
Subtotal, MREFC Obligations	$72.89	$90.80	$93.20	$96.00	$80.84	-	-	-	-
TOTAL Obligations	**$173.37**	**$92.01**	**$114.20**	**$134.00**	**$124.88**	**$65.00**	**$65.00**	**$65.00**	**$65.00**

Totals may not add due to rounding.

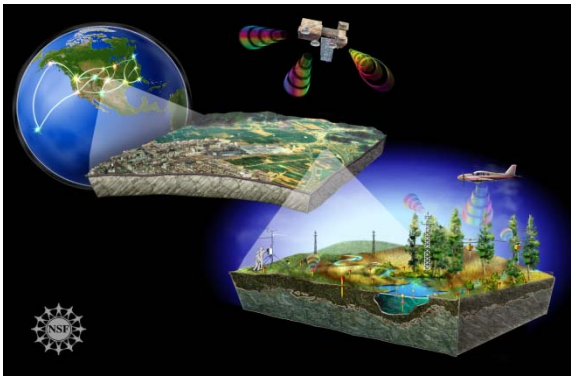
[1] Concept & Development funding and Implementation funding are cumulative of all prior years. Operations & Maintenance funding reflects FY 2012 Actuals only.

[2] Funding for Operations & Maintenance (O&M) in outyears has been capped at now-year dollars, pending the results of a three year initial O&M testing. A final O&M award, to be made after the three years concludes, will reflect these results.



NEON is the first research platform and the only national experimental facility specifically designed to collect consistent and standardized sensor and biological measurements across 106 sites nationwide in close to real-time, enabling basic research on complex phenomena driving ecological change and at the scales appropriate for studying many grand challenge questions in ecology. NEON allows researchers to expand the scale of their research to understand large scale dynamics affecting ecosystems.

A NEON cyberinfrastructure gateway provides resources to support formal and informal public education and provide opportunities for citizens to participate in scientific investigations. NEON data is open-access via web portals and available as soon as possible, once basic quality assurance and quality control procedures have been applied. Private organizations including the Heinz Center, National Geographic Society, Nature Serve, and the Ecological Society of America are assisting NEON, Inc. to broaden the impact of NEON science and education to the next generation of scientists and educators.



NEON will be a collaborative research platform of geographically distributed infrastructure connected via the latest information technology. By combining in-situ sensing with remote sensing observations, NEON will address pressing environmental questions on regional to continental scales. *Credit: NSF.*

Recent United States Global Change Research Program (USGCRP) assessments[1] indicate that U.S. ecosystems will experience abrupt and unpredictable changes from a suite of human-driven processes in the near future. NEON enables research on the impacts of climate and land use change, water use, and invasive species on the Nation's living ecosystems at temporal and spatial scales that are relevant to human well-being. NEON's unique statistically-determined, continental-scale design, with data products, data management, and standardization supports research on the dynamics of complex coupled systems needed for modeling and understanding rates of change on regional and continental scales. No other standalone system – federal or private – can provide the scientifically validated suite of data measurements that NEON provides.

The scientific techniques, sensor data, and basic research knowledge gained through NEON will inform federal resource management decisions necessitated by climate and land use change, water use, and invasive species. They will contribute to societal benefits as identified by the 2013 National Strategy for Civil Earth Observations and the international Group on Earth Observations 2004 Framework Document. Formal agreements have been signed with the European Union, including the Integrated Carbon Observing System (ICOS) Ecosystem Thematic Center, AnaEE (Infrastructure for Analysis and Experimentation on Ecosystems), Czech Climate Change Research Center (CzechGlobe), and Australia's Terrestrial Ecosystem Research Network (TERN). Areas of coordination include planning, design, construction, deployment, environmental assessment, data management, geospatial data exchange, cyberinfrastructure, research, and modeling. As described in an August 2013 article in the "Engineering News-Record"[2], NEON construction models are also having an impact on establishment of new standards for construction in environmentally sensitive areas.

Management and Oversight

- NSF Structure: The NEON program is managed in the Directorate for Biological Sciences (BIO) Office of the Assistant Director (OAD/BIO) as part of the Emerging Frontiers (EF) subactivity. OAD/BIO provides overall policy guidance and oversight, and the location of the NEON program in EF within BIO fosters its broader biological and interdisciplinary science connections. The NEON program is managed by a dedicated program officer and a project manager advisor with experience from another NSF MREFC project; two additional program officers participate in planning, development, and oversight of NEON construction and NEON operations and maintenance. A

[1] Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

[2] http://enr.construction.com/technology/construction_technology/2013/0828-reaching-zero-the-realities-of-ecologicallyfriendly-engineering-on-a-continental-scale.asp

business oversight team chaired by the NEON program officer advises and assists with the business framework of the project. A BIO-NEON committee, which includes the Deputy Director for Large Facility Projects in the Office of Budget, Finance and Award Management (BFA) and a cross-NSF Program Advisory Team (PAT), assists in program planning for NEON. The NEON program officer served as the contracting officer's technical representative (COTR) for the NEON environmental assessment completed in FY 2010. A NEON Environmental Assessment Team (EA) provides ongoing technical advice on the National Environmental Policy Act (NEPA) compliance and NSF environmental policy.

- External Structure: The NEON project is funded through cooperative agreements with NEON, Inc., a non-profit, membership-governed consortium established to oversee the design, construction, management, and operation of NEON for the scientific community. Within NEON, Inc., the CEO provides overall leadership and management; the Project Manager oversees all aspects of the project design, review, construction, and deployment; the Director of Biology and Observatory Director provide scientific leadership; and the Director of Computing is responsible for oversight of the cyberinfrastructure and embedded sensor development. A Board of Directors and a Science, Technology, and Education Advisory Committee (STEAC) composed of members of the NEON user community, each provide oversight and guidance to the project and help ensure that NEON will enable frontier research and education. A Program Advisory Committee (PAC) will be appointed in the second quarter of FY 2015, to provide advice and guidance to the NEON Observatory on the use of NEON facilities.

Reviews

- Technical reviews: The NEON Observatory Design Review (including site selection and deployment design) was successfully completed in February 2009.
- Environmental review: The NEPA environmental assessment was completed in November 2009. A "Finding of No Significant Impact" was signed by NSF in December 2009; the U.S. Fish and Wildlife Service concurred with this finding, as well as with NSF's compliance with the Endangered Species Act. In July 2011, the NSF Record of Decision was signed.
- Construction, Cost, and Schedule reviews:
  - A Conceptual Design Review was held in November 2006.
  - A combined Preliminary Design Review (PDR)/Final Design Review (FDR) of the airborne observation platform was successfully completed in February 2009.
  - A PDR for the entire project was successfully completed in June 2009.
  - An FDR was successfully completed in November 2009, including construction and cost reviews.
  - A Baseline Review, to ascertain readiness to begin construction, was conducted in April 2011 prior to construction.
  - A second Baseline Review was held May 2013 to ascertain the impacts of funding delays on project schedule. A Delta Review – to assess progress in implementing scheduling recommendations received from the baseline review panel – was held in December 2013.
  - A Construction Review is conducted annually during the fourth quarter.
- National Science Board (NSB) Review: The Board reviewed and authorized NEON construction subject to final appropriation of funds in May 2010. The Board reviewed and authorized NEON O&M in February 2013.
- Management, Business, and Operations Reviews:
  - NSF conducted a Business Systems Review (BSR) and issued a final report in November 2011.
  - An Operations Review of the project's operating plan and costs for the first three years of operations was held in January 2012.
  - Annual Management Reviews will be conducted each year starting in FY 2015

- A cost review is proposed at the end of the first three years of operations prior to the next 5-year funding.

Project Status

The National Science Board approved funding for NEON in May 2010 and construction was initiated in August 2011. Construction of technical support facilities was completed in September 2013 and these facilities were used to support other construction activities. NEON's airborne observation platform provides remote sensing through aircraft-mounted instrumentation, including an imaging spectrometer operating in the visible to shortwave IR spectral region, a waveform light detection and ranging (wLiDAR) instrument, and a high-resolution digital camera deployed on three aircraft. The first two airborne observatories were constructed and pathfinder missions were conducted in FY 2013 with NASA and supported research studies and management of major forest fires. The third airborne observatory was delivered ahead of schedule and its pathfinder flights are planned for FY 2014. By the fourth quarter of FY 2015, the three airborne observatories will begin to transition to full Observatory operations with the transition complete in FY 2016.

While civil construction of distributed infrastructure is ahead of schedule, deployment of sensor assemblies continued to lag by six to nine months in FY 2014 due to procurement and production difficulties. In FY 2014, funds were requested for civil and facility construction of thirty-one sites in nine domains. By the end of FY 2014, 50 percent of civil and facility support construction will be complete. In FY 2014, instrumentation deployment and site commissioning is planned for 24 sites in five of the nine domains with completed civil construction. In FY 2015, civil and facility construction activities are planned for 35 sites in nine domains. By the end of FY 2015, 88 percent of the total civil and facility construction will be complete. The rate of instrumentation deployment and site commissioning will increase, with deployment and commissioning completion anticipated at 43 sites in 15 domains. In FY 2014, biological sampling will occur at thirteen sites in eight domains. In FY 2015, biological sampling expands greatly: it is proposed for thirty-four sites with completed civil construction in fourteen domains. Aquatic and Stream Experimental and Observatory Network (STREON) site construction is proposed to continue in the fourth quarter of FY 2014 and FY 2015. In FY 2015, three of the STREON sites will transition to operations.

A major milestone was completed in July 2013: the NEON data portal that will provide open access to NEON Observatory data was commissioned. In FY 2014 and FY 2015, MREFC funds are requested to support continuation of the NEON cyberinfrastructure hardware and software deployments in support of sites and domain Support Facilities acceptance. Funds are requested in FY 2015 to continue data center expansion, to complete biological sampling PDAs and NEON central operational support system, and ongoing development of data algorithms and related data release via NEON's web portal.

The FY 2014 Estimate provides $21.0 million of Research and Related Activities (R&RA) account funding for operations and maintenance of the four domains commissioned, including related management and technical support, seasonal biological sampling, and domain facilities costs.

In FY 2015, $38.0 million is requested from the R&RA account for operations and maintenance of the ten domains commissioned, including related management and technical support, seasonal biological sampling, and domain facilities costs. Funds also will support the Calibration & Validation Laboratories and headquarters functions, such as maintenance of the data center, Observatory monitoring and quality assurance and control. Funds will support the operation and maintenance of the Airborne Observation Platform and related technical facility.

Cost and Schedule

The projected length of the project is six fiscal years, with a six-month schedule contingency included. NEON is currently 31.6 percent complete. Current project performance is consistent with ending on time and within budget. Total project contingency usage as of December 2013 was $9.74 million of the initial $74.17 million included in the $433.72 Total Project Cost. The remaining unallocated contingency ($64.43 million) is equivalent to about 23.5 percent of the current Estimated Cost to Complete.

Risks

Technical: Dependence on commercial off-the-shelf technology from single vendors will be mitigated by procurements to enable testing and identification of alternative vendors. Production quality, embedded and system-level cyberinfrastructure will be addressed by a combination of "in-house" design, commercial, contracts, and targeted research (e.g., cyber-dashboard). While the bulk of NEON's infrastructure and instrumentation will be "commercial off-the-shelf," NEON's scientific and networking design required certain technological innovations for a small number of components. Consequently, the Directorate for Biological Sciences (BIO) has provided Research and Related Activities (R&RA) funds for advanced research and development (R&D) activities in the areas of sensors, cyberinfrastructure, and remote sensing technology. These development activities are progressing with adequate margin to meet the delivery milestones.

Deployment: Environmental assessment and permitting may impact schedule and costs. These risks have been and continue to be addressed through multiple means, including: the direct contracting of the environmental assessment by NSF; the hiring of two national firms by NEON, Inc. for engineering and permitting; the identification of alternative sites if the primary sites are determined to have significant risk; and the allocation of two full-time equivalents (FTE) by the U.S. Forest Service to assist with environmental compliance issues on Forest Service lands.

Geospatial Data Acquisition: A potential risk is the long-term availability of satellite (e.g., LANDSAT and MODIS) borne sensors. This risk is mitigated through a partnership with the USGS Earth Resources Observation and Science (EROS) Data Center, which has the federal responsibility for curation and management of LANDSAT and MODIS images. This partnership allows NEON to have alternative satellite sensor sources to purchase images (e.g., SPOT - France, AWIFS – India, Terra and Aqua – U.S.). Experienced flight design engineers were contracted by NEON, Inc. to provide the baseline operations plans, aircraft analysis, and assessment of commercial companies that could potentially support NEON flight operations, and experienced research aircraft pilots served on the design team.

Future Operations Costs

NEON will be the first research observatory that will maintain and operate in-situ instrumentation and conduct biological sampling in twenty domains (106 locations); three airborne observatories; a central operating facility; and a cyberinfrastructure center. Support will be provided to monitor the sensors, and receive, process, and archive the data from all measurement systems. NEON operations include significant labor costs due to the labor-intensive processes required for biological sampling and data collection. NEON is reliant on sensors and cyberinfrastructure that have a defined lifecycle, so operations costs include scheduled replacement and refreshing of sensor, instrumentation, and cyberinfrastructure technology. Operations is planned to ramp up commensurate with commissioned sites.

A three year initial award for operations and maintenance funding will begin in FY 2014 to allow NEON to explore opportunities for schedule and cost efficiencies and provide the basis for funding for the outyears of full Observatory operations. For FY 2017 – FY 2019, the costs are held constant at the projected operations ceiling reviewed at both PDR and FDR pending results of the three year award.

OCEAN OBSERVATORIES INITIATIVE $0

No MREFC funds are requested for the Ocean Observatories Initiative (OOI) in the FY 2015 Budget Request. The FY 2014 Request of $27.50 million represented the last funding year of a six-year project totaling $386.42 million. Funding for the OOI operations and maintenance is included in the FY 2015 Request for the Directorate for Geosciences, Division of Ocean Sciences.

Appropriated and Requested MREFC Funds for the Ocean Observatories Initiative

(Dollars in Millions)

	Prior Years[1]	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014 Estimate	FY 2015 Request	Total Project Cost
Regular Approps	$5.91	$0.00	$14.28	$65.00	$102.80	$65.00	$27.50	-	$280.49
ARRA	-	105.93	-	-	-	-	-	-	$105.93
Total, OOI	**$5.91**	**$105.93**	**$14.28**	**$65.00**	**$102.80**	**$65.00**	**$27.50**	**-**	**$386.42**

Totals may not add due to rounding.

[1] This amount is net of $5.12 million that was rescinded from prior year unobigated balances, per P.L. 110-161.

OOI will provide the oceanographic research and education communities with continuous, interactive access to the ocean through an integrated network of observatories. Deployed in critical parts of the global and U.S. coastal ocean, OOI's instrumentation will capture climate, carbon, ecosystem, and geodynamic changes on the time scales at which they occur. Data streams from the air-sea interface through the water column to the seafloor will be openly available to educators and researchers in any discipline, making oceanography available to citizens and scholars who might never go to sea. Science themes for OOI include the ocean carbon cycle and its response to global change, ocean acidification, the impact of climate variability and ocean circulation, coastal ocean dynamics and ecosystem response, and the interplay of tectonically-driven fluid flow on the carbon cycle, deep ocean ecosystems, and earthquakes.

The OOI has three elements: 1) deep-sea buoys with designs capable of deployment in harsh environments such as the Southern Ocean; 2) cabled regional scale nodes on the seafloor spanning several geological and oceanographic features and processes; and 3) an expanded network of coastal observing arrays. A cutting-edge, user-enabling cyberinfrastructure will link the three components of OOI and facilitate experimentation using assets from the entire network. Data from the network will be made publicly available.

Baseline History

NSF first requested construction funding for OOI through the MREFC account in FY 2007 and received an initial appropriation of $5.12 million in that year. The OOI has undergone a series of technical reviews, with the Final Design Review (FDR) conducted on November 6-7 and 12-14, 2008. The FDR panel determined that OOI was ready to move to construction, assuming some adjustments to the baseline with respect to schedule and overall project contingency. Following the FDR, in an effort to focus OOI more specifically on high priority science issues related to climate change, ocean acidification, carbon cycling, and ecosystem health, NSF initiated a rapid turn-around process to develop a modified network design in January 2009, referred to as the Variant Design. An additional Science Review Panel and Cost/Schedule Review Panel convened by NSF in March 2009 supported proceeding with the Variant Design, and the project was approved at the May 2009 National Science Board meeting.

The project baseline has been maintained via change control processes and procedures that are part of the NSF terms and conditions of the award to the Consortium for Ocean Leadership. The cost baseline is adjusted for contingency when previously identified, predicted risks are realized. These include elements such as procurement bid risk and subaward/subcontract execution risk. Technical baselines are maintained via change control and document any changes related to observatory performance that impact science delivery. Sensor vendor and model changes have caused slight decreases in delivery, yet in other cases, newer sensor models on the market have increased capabilities due to technology maturity. Schedule is maintained via change control and reviewed in external panel reviews.

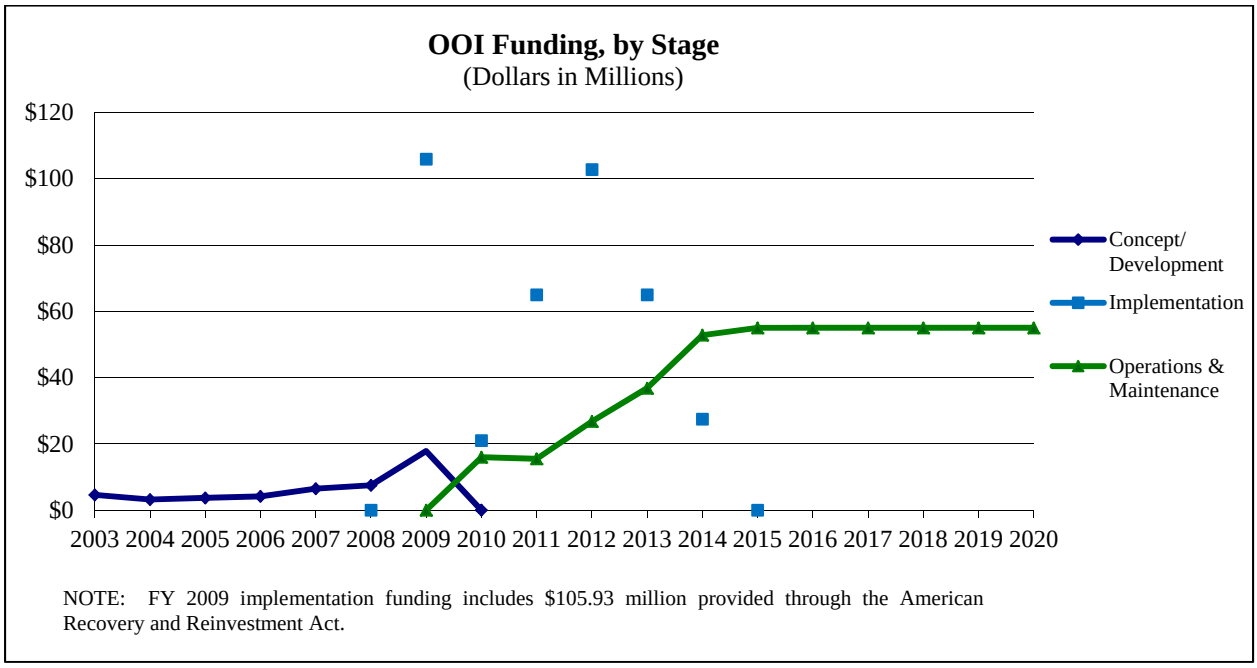
Total Obligations for OOI

(Dollars in Millions)

	Prior Years[1]	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	ESTIMATES FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
R&RA Obligations:									
Concept & Development	$74.90	-	-	-	-	-	-	-	-
Operations & Maintenance	26.80	36.80	52.80	55.00	55.00	55.00	55.00	55.00	55.00
Subtotal, R&RA Obligations	$101.70	$36.80	$52.80	$55.00	$55.00	$55.00	$55.00	$55.00	$55.00
MREFC Obligations:									
Implementation	187.99	65.00	27.50	-					
ARRA	105.93	-	-	-	-	-	-	-	-
Subtotal, MREFC Obligations	$105.93	-	-	-	-	-	-	-	-
TOTAL Obligations	**$207.63**	**$36.80**	**$52.80**	**$55.00**	**$55.00**	**$55.00**	**$55.00**	**$55.00**	**$55.00**

Totals may not add due to rounding.

[1] Concept & Development funding and Implementation funding are cumulative of all prior years. Operations & Maintenance funding reflects FY 2012 Actuals only.



Management and Oversight

- NSF Structure: The project is managed and overseen by a program officer in the Division of Ocean Sciences (OCE) in the Directorate for Geosciences (GEO). The program officer receives advice and oversight support from an NSF Project Advisory Team (PAT) that includes representatives from GEO, the Directorates for Biological Sciences (BIO) and Engineering (ENG); the Office of Budget, Finance and Award Management (BFA); the Office of International and Integrative Activities (OIIA); the Office of General Counsel (OGC); and the Office of Legislative and Public Affairs (OLPA). The Deputy Director for Large Facility Projects (DDLFP) in BFA is also a member of the PAT and provides advice and assistance. NSF has established an Ocean Observing Science Committee (OOSC) via the University National Oceanographic Laboratory System (UNOLS). The committee is made up of ocean science community representatives. The OOSC is charged with providing guidance on decisions and plans from the science perspective related to all NSF observing systems. The OOSC will be an essential element in the process of communicating the science use perspective to NSF and project teams involved in deploying and operating ocean observatories.
- External Structure: NSF established a cooperative agreement with the Consortium for Ocean Leadership (Ocean Leadership) for the construction and initial operations of the OOI in September 2009. The program director at Ocean Leadership is responsible for designing, building, deploying, testing, commissioning, and conducting initial operations and maintenance for the OOI. The Ocean Leadership program director is accountable to NSF, the Ocean Leadership Board of Trustees, and an external scientific and technical advisory committee called the OOI Project Advisory Committee, which has membership drawn from individuals with expertise in ocean observing science and engineering. Subawards have been issued by Ocean Leadership to establish Implementing Organizations (IOs). These IOs deliver the cabled regional scale nodes (led by the University of Washington), education (led by Rutgers, The State University of New Jersey) and the coastal/global arrays (led by Woods Hole Oceanographic Institution and Oregon State University). These IOs report directly to Ocean Leadership, which ensures integration, cooperation, and coordination between the IOs. In 2013, Ocean Leadership decided to decrease the number of implementing organizations and deliver the cyberinfrastructure scope directly from Ocean Leadership. The result was that University of California San Diego (UCSD) retained subawardee status to assist in the delivery, but Ocean Leadership became the implementing organization for cyberinfrastructure.
- NSF Oversight: NSF conducts a weekly meeting, attends weekly calls, convenes external panels and reviews monthly Earned Value Management reports from the project team. NSF attends internal project reviews; critical design reviews, and conducts vendor site visits as required.

Reviews

Preconstruction Phase Reviews

- Technical reviews: NSF organized a series of external science reviews for OOI, including the Blue Ribbon Review in July 2006, which assessed whether the ocean observing network proposed in the OOI Conceptual Network Design would provide capabilities for researchers to answer high priority science questions that require *in situ*, real-time measurements across the three scales of OOI. A second Blue Ribbon Review in October 2007 assessed whether the OOI Preliminary Network Design provided the experimental capabilities needed to address the scientific scope outlined for OOI. These reviews provided a general endorsement of OOI, supplemented by a series of recommendations for improvement. These reviews also served as input to the paired design reviews (Conceptual and Preliminary). NSF convened a Blue Ribbon Review in March 2009 to assess a modified OOI network design and its ability to provide transformative research capabilities for the ocean science community. This OOI Variant Design is a modification to the previous network design that more closely focuses OOI infrastructure on climate processes, carbon cycling, ocean acidification, and ecosystem health. The Blue Ribbon Review panel noted that the OOI, as described by the Variant Network Design, remains a worthy investment, providing a transformative capability for the ocean science community.

Management, Cost, and Schedule Reviews

- The OOI Conceptual Design Review (CDR), held in August 2006, reviewed the scope and system-level implementation plans for OOI, including management plans and budgeting. It discussed whether all major risks with this project had been identified and whether appropriate initial system development specifications (performance requirements, major system components, and interfaces) had been established for each sub-element of OOI.
- The Preliminary Design Review (PDR) in December 2007 assessed the robustness of the technical design and completeness of the budget and construction planning for the OOI. The PDR panel also reviewed progress made by the OOI Project Team on the findings of the CDR.
- The FDR in November 2008 assessed whether OOI's project plans were fully ready for construction and determined that there was a high degree of confidence that the scope, as proposed, could be delivered within the parameters defined in the project baseline.
- A Cost-Schedule Review Panel in March 2009 assessed whether the OOI Variant Design project plans were fully ready for construction and determined that there was a high degree of confidence that the scope, as proposed, could be delivered within the parameters defined in the project baseline.
- A Business Systems Review (BSR) was conducted in 2012. In 2013 Ocean Leadership made progress on the implementation of the actions to address the report findings. Close out of the BSR report is expected in 2014.

Construction Phase and Initial Operations Reviews

- Construction Reviews: NSF conducted four external panels to review the construction progress of the OOI. The panels took place in June 2010, May 2011, November 2012, and May 2013. The May 2011 panel recommended the project produce a revised, fully integrated master schedule for the 66-month project. As this revision matured, Ocean Leadership recognized that delays in completion of the Coastal Global mooring design required significant adjustments be made to the baseline schedule and project management structure. Oregon State University (OSU) is now a direct subawardee to Ocean Leadership and will construct the Endurance Array moorings at OSU versus at Woods Hole as originally planned. Woods Hole, as planned, will deliver all four Global arrays as well as the Pioneer Array. This new management structure and schedule realignment will allow delivery of the observatory within the 66-month schedule. NSF supported this transition and conducted an external review in November 2012. The review scrutinized performance, execution, integration, and management of the full project scope, schedule, budget, and risk. The panel acknowledged the project is proceeding on budget and significant project milestones have been achieved. The panel recommended incorporation of an Integrated Project Team management structure to improve integration across the project. The project has applied this recommendation to the deployment efforts and communications and integration have improved. The panel also reviewed the fully integrated master schedule that utilizes a partial deployment strategy in order to align the vendor deliveries, the build phase activities, and the deployment weather windows.

  In May 2013 an external panel reviewed the project with a focus on cyberinfrastructure and pre-deployment status. While pre-deployment readiness reviewed well, the panel recommended that the project improve cyberinfrastructure and systems engineering management for the software Release 2 and instrument driver coding. The OOI Project Lead Systems Engineer was tasked with engaging his group in both the verification and the validation testing of the Release 2 software. These efforts resulted in improved efficiency of the software testing process. The panel reported that due to the delay in completing the Release 2, the project software scope would need to be assessed and prioritized for incorporation into the final software release. The software and science teams developed a prioritized scope for OOI's software and project completion on the project's timeline. OL also transferred software management responsibility from UCSD to OL and retained an experienced commercial software engineering manager to lead the cyberinfrastructure effort. The

cyberinfrastructure activity will undergo an external review in spring 2014. NSF will also host an external review of the OOI data management plan in April 2014.

- NSF conducted two transition to Operations and Maintenance (O&M) reviews of the OOI in August 2010 and December 2011. The August 2011 panel recommended tighter linkages between the construction schedule and O&M ramp-up plans. A second O&M review was conducted in December 2011. The panel recommended production of higher quality cost estimates for O&M prior to staff ramp up. The project continues to apply the recommendations of this panel and will present activity-based cost estimates at an O&M review in summer 2014.

Project Status

The project is in the final year of construction and will begin transition to O&M. NSF signed a Site-specific Environmental Assessment Finding of No Significant Impact (FONSI) in January 2011 which enabled the build and permitting phase of the project to commence. The cabled Regional Scale Nodes was the first segment of the project to enter the build phase. L3 Maripro, under a University of Washington subcontract, successfully deployed the ocean cable in July 2011 and landed it on shore in Pacific City, Oregon. In July 2012, the power step-down Primary Nodes were successfully connected to the deployed cable. During the primary cable system acceptance testing process in late 2012 and early 2013, the University of Washington and L3 Maripro were unable to successfully activate Medium Voltage Power Converter Isolation Relays on two of the seven Primary Nodes. L3 Maripro retrieved one of the nodes in October 2013 and found component issues with the switch. The investigation indicated that the node failure was caused by very small cracks surrounding one wire lead of a crystal oscillator. Ocean Leadership is reviewing documentation and will update NSF in March 2014. If resolution to the problems proceeds as expected, the project is scheduled to deploy the mooring platforms and seafloor instrumentation in summer FY 2014 and complete the Regional Scale deployments.

Woods Hole Oceanographic Institution, Oregon State University, and Scripps Institution of Oceanography conducted major at-sea tests of moorings, subassemblies, and components during the summer and fall of 2011. Recovery of these test assets in 2012 informed the final critical designs in the summer of 2012. Completion of the critical design reviews enabled the institutions to enter the build phase for the coastal and global moorings. Deployment began in FY 2013 and will continue in FY 2014 and FY 2015 during available weather windows. Coastal Gliders were procured, tested, and delivered for deployment in FY 2013. Autonomous Underwater Vehicle designs will be finalized and tested in FY 2014. Ocean Gliders were procured and deployed during the summer of FY 2013 at Station Papa. The pre-commissioned data is being delivered to the community via an interim website and the shakedown of the operation of the Station Papa Array is in progress. Supply chain management and on-time delivery of components, subassemblies, and assemblies are critical to the project management in the remaining months of the project.

The completion of the cyberinfrastructure network software, screen designs and instrument drivers are the project's highest risk areas. In August 2013, Ocean Leadership transitioned management of the delivery of the cyberinfrastructure from SIO/UCSD to Ocean Leadership. User testing of the second of three software releases is in progress. In 2014, the instrument deployments and linkage of the data and data signals to the OOI network for internet dissemination are on the project risk watch list. NSF has increased the external review panel frequency to assure quality oversight of schedule and budget performance.

OOI's transition to operations and maintenance continues to be monitored, and additional refinement of the project's O&M plan is expected in spring 2014. Many of OOI's construction contracts contained options for the O&M phase allowing the fixed costs to be well understood and the variable costs to be analyzed. Incremental transition to operations costs will increase through FY 2015 as seafloor, water

column, coastal and global components are deployed during multiple ocean cruises. At the end of FY 2014, the majority of the moorings, cables, and instruments will be deployed and become operational, and the transition to O&M will be completed by the end of FY 2015. A review of the OOI operations plan will take place in summer 2014 prior to major deployment phases.

The request for O&M funding for FY 2015 is $55.0 million. The $55.0 million operating budget will support the 900 km cabled array with seafloor sensors and moorings, 15 global moorings with 20 ocean gliders, 22 coastal moorings, and 12 coastal gliders along with two Autonomous Underwater Vehicles. Major operations tasks include: procurement of replacement parts and maintenance and refurbishment of moorings returned from the initial construction deployments; redeployment of moorings and instruments as well as supporting labor and non-labor elements involved in maintaining the ocean sensors; labor to support glider operations, data management and daily observatory operations at the on-shore facilities is included in this budget request. Data from all deployed instruments will be available via the internet to the public, ocean science research community, educators, and students. Operations tasks will be managed by the Consortium for Ocean Leadership.

Cost and Schedule

The projected length of the construction phase of the project is 66 months. OOI is currently 79 percent complete and project performance is consistent with completion of the project on time and within budget. Total project contingency usage as of November 2013 was $61.60 million of the initial $88.10 million included in the $386.42 Total Project Cost. The remaining unallocated contingency ($26.50 million) is equivalent to about 25 percent of the current remaining work estimated to complete.

Risks

- Management and Oversight Risk: The complexity of the OOI scope and the organizational structure of a prime Project Office with tiered Implementing Organizations present an integration risk. A detailed project tracking system has been implemented to assure that the scope, schedule, and budget are continuously monitored.
- Scope Contingency: The Project Team has requested an appropriate level of contingency for OOI as informed by a comprehensive (top-down and bottom-up) risk analysis. Should this contingency be exhausted, reductions in the scope of the OOI network plan will be required. These potential reductions, or scope contingency, must be implemented based on clearly articulated scientific priorities. Any changes to technical scope (as well as cost or schedule) will follow the OOI Change Control Process, which has a tiered evaluation process for evaluating and determining any change to the project. There have been minor instrumentation adjustments to the project scope as some instrument vendor capacities have changed. The project schedule contains go/no-go decision points for critical designs and milestones for where Plan B designs will be implemented. The cyberinfrastructure scope to complete contained descoping of higher level functionalities of the software that were prioritized through science community input. Scope management is now part of the project's risk management planning for the remaining nineteen months of the construction phase of the project.
- Risks Related to the OOI Cyberinfrastructure (CI): The OOI CI will not only provide the network integration needed to achieve the scientific goals of OOI, but a robust, user-friendly CI will be essential to develop a vigorous OOI user community. Ensuring the "usability" of the CI was a key topic of discussion at all of the OOI reviews. The testing and design process will allow for real users to be involved in the final acceptance of the cyberinfrastructure. The most significant risk for cyberinfrastructure in FY 2014 is the schedule and delivery impact due to the later than originally planned delivery of software Release 2 and the management transition from UCSD/SIO to OL. NSF is closely monitoring progress and the awardee is developing mitigation strategies to recover progress during FY 2014 and FY 2015. A spring 2014 review will assess progress and results.

- Risks Related to Environmental Compliance and Permitting: The OOI FONSI was approved in January 2010. The project is currently processing permits and notifications for the coastal, regional, and global arrays. NSF is managing risk by assuring close agency coordination for federal permits. NSF is overseeing the efforts of the awardee and subawardees processing permits through regular reports and call updates.
- Schedule Management and Schedule Contingency: As stated above, supply chain management and vendor quality are critical to meeting schedule for the deployments within the weather windows. The cyberinfrastructure schedule management has daily attention and weekly reviews.

Future Operations Costs

The project is working toward a smooth transition from construction to operations and maintenance. Staff, spare parts, integrated logistics, and facility readiness will ramp up as the construction elements are completed and commissioned for operations. The completion of the construction project procurements has provided clear budget and funding values for spare and replacement parts. The project is currently working on the implementation of the concept of operations, supporting organizational structures, and improved labor estimates. The OOI will be fully transitioned to operations by the end of FY 2015 with a current budget estimate of $55.0 million per year. The expected operational lifespan of this project is 25 years. Operations cost reviews will be conducted in 2014 and throughout the operations phase to assess the project and inform future budget requests. Upon completion of construction, high quality ocean data will be delivered to the scientific community, educators, and the public.