

**National Science Foundation (NSF) Program Plan American Recovery and
Reinvestment Act of 2009
Updated May 2010**

**Major Research Equipment and Facilities Construction (MREFC) Recovery
Plan CFDA Number: 47.082**

Objectives

Program Purpose

The Major Research Equipment and Facilities Construction (MREFC) Program aims to build a new national telescope: the Advanced Technology Solar Telescope (ATST); build a new multipurpose research ship to operate in seasonal sea ice and open ocean waters in the Bering Sea and the Gulf of Alaska: the Alaska Region Research Vessel (ARRV); and create an integrated observatory network to study the complex, interlinked physical, chemical, biological, and geological processes operating throughout the global ocean: the Ocean Observatories Initiative (OOI).

The **ATST** will enable the study of solar activity in unprecedented detail. 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 mass ejections that can affect civil life on Earth. The telescope will also contribute to our improved understanding of space weather, which is critical to the safety of astronauts in space, or on the Moon, and it will also enhance greatly our understanding of the activity and variability of solar-type stars.

The **ARRV**, which will replace the R/V *ALPHA HELIX*, is the first new NSF ship built since the early 1980s and is a major federal contribution to academic fleet renewal. The anticipated operational lifetime of the ARRV is at least 30 years. This 242-foot, multipurpose research ship is designed specifically to operate in seasonal sea ice and open ocean waters near Alaska, including the Chukchi, Beaufort, and Bering Seas as well as the eastern Arctic. To do so, the hull will be ice-strengthened to American Bureau of Shipping (ABS) ice classification standards. The ARRV will provide a much needed, technologically-advanced oceanographic platform to enable multidisciplinary teams to conduct field research at the ice edge and in seasonal sea ice up to 3.9 feet thick. It is designed to have a minimal influence on its own environment, including low underwater radiated noise (URN) for fisheries and acoustics research, and reduced stack emissions to enable atmospheric research.

OOI is an integrated observatory network that will provide the first major new way of studying the oceans since environmental satellites were launched. Deployed in critical parts of the U.S. and global coastal ocean, its 24/7 telepresence will capture climate, carbon, ecosystem, and geodynamic changes on the time scales on which they occur, rather than when research vessels are able to be in the area. The OOI will dramatically alter ocean science by providing the means to collect unique, sustained, time-series data sets that will enable researchers to study complex, interlinked physical, chemical, biological, and geological processes operating throughout the global ocean. The three elements of the OOI are: deep-sea buoys with designs capable of withstanding harsh conditions deployed in the Gulf of Alaska, the Irminger Sea, the Southern Ocean, and the Argentine Basin; regional electro-optical

cabled nodes at sites where extensive methane venting creates gas hydrates and/or sustains chemosynthetic vent communities off the Pacific Northwest coast; and an expanded network of fixed and relocatable coastal observatories off the East and West coasts. A cutting edge, open access, user-enabling cyberinfrastructure will link the marine components and facilitate experimentation using assets from the entire OOI network.

Public Benefits

ATST: As a national facility, ATST would enable training of the next generation of solar physicists and instrument builders at the undergraduate and graduate levels. ARRA funding for ATST will support a larger project team (staff retentions and new hires) at the National Solar Observatory and the issuance of large contracts for the construction of the telescope and its building, support facilities, as well as the procurement of components for its complex optical systems and instruments. As the first new large solar telescope constructed in nearly 30 years and because of the new range of scientifically compelling questions that ATST can address, its construction, which still requires National Science Board approval, is expected to help rejuvenate the solar research community in U.S. universities.

ARRV: The vessel will provide a technologically-advanced, safe, and highly effective oceanographic platform to enable multidisciplinary teams to conduct field research at the ice edge and in seasonal sea ice. The Bering Sea and the Gulf of Alaska sustain more than half of the total annual national fish catch and supports one of the most productive marine ecosystems in the world, as well as rich and varied marine mammal populations. The Alaska region is also seeing significant impacts from climate change. Perennial sea ice has been estimated to be decreasing by about nine percent per decade, potentially leading to a summer ice-free Arctic Ocean by the end of the century or even sooner. The ARRV will provide scientific access to these remote and inhospitable waters surrounding Alaska that are of such great national and international importance. The ARRV will have many advanced capabilities including a modern suite of satellite communications to link the ship to educational facilities ashore giving them virtual access to the Arctic. With 26 dedicated science berths, the ARRV will be able to accommodate over 500 researchers and students annually while spending as many as 300 days at sea.

OOI: Recent science advances have highlighted the role of the ocean in climate change, the impact of carbon cycling on ocean acidification and ocean carbon sequestration, and the degradation of coastal marine ecosystems. These advances and the national attention they have garnered emphasize the multiple stakeholders in OOI. Additionally, the magnitude and mechanisms of air-sea exchange, the fundamental processes that control turbulent ocean mixing on all scales and the biophysical consequences thereof, and the impact of plate tectonics on the sea floor and society underpin these topics. These science drivers are also part of a national ocean research effort, the Ocean Research Priorities Plan, which provides a framework for research investments to advance our understanding of critical ocean processes that tie to societal need. The OOI will also include educational infrastructure that will support “free choice” learning in a variety of both physical and virtual settings with a focus on raising public awareness about ocean science, climate change, and enabling technology, while also supporting online postsecondary career, technical, and educator training programs.

Measures

ATST: Keep negative cost and schedule variance to less than 10 percent while monitoring percentage of as built-capacity as compared to the final, construction-ready design. Explanation: This measure has two components:

- <10% negative cost and schedule variance. Earned Value Management (EVM), a widely accepted project management tool for measuring progress, is used for this goal.
 - Technical and financial status will be reported monthly throughout the project. Variances are expected to be meaningful indicators of performance by the time the project is ten percent complete.
- Monitoring percentage of as-built capability as compared to the final, construction-ready design. This supplements the EVM target noted above by establishing a formal process for monitoring how much (if any) scope is eliminated from projects in order to adhere to the cost & schedule target. The baseline for this analysis is the scope of the project when the award is initiated following National Science Board approval. This information will be included in monthly reports provided to NSF Senior Management, who will then determine if the eliminated scope jeopardizes the overall viability of the project.
 - No scope has been eliminated from the project and the planned scientific capability of the ATST remains unchanged.

ARRV: Keep negative cost and schedule variance to less than 10 percent while monitoring percentage of as built-capacity as compared to the final, construction-ready design. Explanation: This measure has two components:

- <10% negative cost and schedule variance. Earned Value Management (EVM), a widely accepted project management tool for measuring progress, is used for this goal.
 - Schedule of Values and Integrated Master Schedule have recently been received from the shipyard as part of the Design Verification and Transfer (DVT) phase.
 - Latest metrics indicate a 29% schedule variance due to lower actual orders of subcontractor supplied materials than estimated.
 - Cost variance is 0%.
 - Because actual production has not begun, the metrics are not considered particularly meaningful. NSF program officers will be monitoring closely with the expectation that the variances will decrease as DVT ends and the project moves towards production in October 2010.
- Monitoring percentage of as-built capability as compared to the final, construction-ready design. This supplements the EVM target noted above by establishing a formal process for monitoring how much (if any) scope is eliminated from projects in order to adhere to the cost & schedule target. The baseline for this analysis is the scope of the project when the award is initiated following National Science Board approval. This information will be included in monthly reports provided to NSF Senior Management, who will then determine if the eliminated scope jeopardizes the overall viability of the project.
 - No scope has been eliminated from the project and the planned scientific capability of the vessel remains unchanged.
 - The ARRV is on track to achieve 100% of the originally planned scientific capability when compared to the construction-ready design.

OOI: Keep negative cost and schedule variance to less than 10 percent while monitoring percentage of as-built-capacity as compared to the final, construction-ready design. Explanation: This measure has two components:

- <10% negative cost and schedule variance. Earned Value Management (EVM), a widely accepted project management tool for measuring progress, is used for this goal.
 - The project management control system is set up and earned value management variance reporting will begin in June 2010
- Monitoring percentage of as-built capability as compared to the final, construction-ready design. This supplements the EVM target noted above by establishing a formal process for monitoring how much (if any) scope is eliminated from projects in order to adhere to the cost & schedule target. The baseline for this analysis is the scope of the project when the award is initiated following National Science Board approval. This information will be included in monthly reports provided to NSF Senior Management, who will then determine if the eliminated scope jeopardizes the overall viability of the project.
 - No scope has been eliminated from the project and the planned scientific capability of the OOI remains unchanged.

Schedule and Milestones

Advanced Technology Solar Telescope (ATST)

- Final Design Review was held May 18-22, 2009.
- ARRA Construction Funding was awarded effective, January 1, 2010 for \$146M; MREFC first award for Construction Funding was made effective, January 1, 2010 for \$7M from FY 2009 funds.
- Telescope Mount RFP was issued on or before March 1, 2010; responses are due mid-May 2010.
- Mirror Blank RFP was issued on or before April 1, 2010. RFP responses have been received and reviewed, and a recommendation has been made; contract negotiations are in progress.
- 2010 Safety Review is projected for July 2010. In order for the Safety review to be effective, it must occur after all major contractors are on board (including the Support Building, the Telescope Mount Assembly and the Enclosure).
- First construction progress review – September 2010 (on schedule).
- Telescope Mount Contract Placed – September 15, 2010 (on schedule).
- Mirror Blank Contract Awarded – September 30, 2010 (on schedule).
- Mirror Polish RFP Issued – September 30, 2010 (on schedule).

Alaska Region Research Vessel (ARRV)

Shipyard selection milestones were achieved as follows:

- Shipyard Inspections were completed on June 26, 2009.
- Shipyard “Best Value” Selection was completed on November 16, 2009.
- Contract Award was made on December 18, 2009.

Original construction milestones were preliminary pending actual shipyard selection. Revised milestones based on the Integrated Master Schedule from the shipyard are shown below and represent the major project milestones that NSF will now be tracking:

- Complete Design Verification and Transfer – August 30, 2010.
- Begin Construction: October 26, 2010.
- Lay Keel: February 16, 2011.
- Delivery of Owner-furnished Propulsors (Z-drives): December 21, 2011.
- Launch: April 30, 2012.
- Delivery: January 22, 2013.

Ocean Observatories Initiative (OOI)

- Primary Infrastructure Cable Contract was awarded to L3Maripro on November 2, 2009.
- Education and Public Engagement (EPE) Implementing Organization award was rescheduled and will be awarded in August 2010. There is enough schedule float to accommodate the re-planning and achieve the scope of the EPE effort at the end of the 66-month construction period. The EPE procurement required additional integration in order to write an effective Request for Proposal and source selection plan.
- The first External Performance Review is scheduled for June 2010.
- The Medium Voltage Converter (MVC) readiness decision was made at the design review held in March 2010. The MVC design proposed was evaluated as acceptable and released to proceed to the final design stage.
- Prototype Testing of Extension Cables and Cable Terminations Complete – June 30, 2010
- Coastal Winched Profiler Readiness Decision – September 30, 2010.

Projects and Activities

ATST: ARRA funds will be used to partially fund the construction of the four-meter telescope designed to study the causes of solar activity. The project scope includes the construction of the telescope and its enclosure building, support facilities, and an initial complement of scientific instruments. ARRA funds provide \$146M of a projected total cost of \$298M.

ARRV: ARRA funds were awarded solely to the University of Alaska, Fairbanks for a single, fixed-price subcontract with a U.S. shipyard for ship construction. The fixed-price shipyard contract was awarded to Marinette Marine Corporation in Wisconsin for \$123.18M with approved changes orders being negligible (\$30K) at this point in time. The ARRA funds are only \$148M of the total project cost of \$199.5M, which includes the base shipyard contract price plus change orders during construction.

OOI: ARRA funds provide \$106M out of the total project cost of \$386.4M, and will include supporting the first release of cyberinfrastructure subsystems; awarding the primary infrastructure cable contract, conducting key portions of prototyping activities for the secondary cable infrastructure; developing shore station management systems; conducting key production engineering activities for essential water column components, including hybrid and winched profilers; conducting critical project management, systems engineering, and environmental compliance activities; and supporting implementation of education and public engagement at the implementing organization.

Review Process

The three projects selected for ARRA funding are subject to the oversight process described in NSF's Large Facilities Manual. (See http://www.nsf.gov/publications/pub_summ.jsp?ods_key_nsf0738).

During construction, NSF exercises oversight of each project through a variety of mechanisms. In addition to normal day-to-day discussions with awardees, each project reports at least monthly to the cognizant NSF Program Officer on its technical and financial status relative to a baseline schedule utilizing earned-value management techniques. NSF program staff conduct site visits throughout the construction period, and periodic external reviews are held at least annually that utilize panels of outside experts to advise NSF on a wide variety of topics. Review topics may include, but are not limited to, technical performance, adherence to cost and schedule baselines, and awardee management. Each project follows a documented change control procedure, and each award contains terms and conditions that require NSF concurrence for major changes to a project's intended scope, budget, or schedule. The progress of each project is closely monitored, and cost and schedule information is compiled and reported monthly to NSF senior management. As an additional mitigation measure, NSF will conduct a review of the business systems of each awardee within the duration of the award period to monitor compliance with administrative requirements for grants and agreements (Chapter 2, Part 215 of OMB Circular A-110).

Cost and Performance Plan

NSF monitors the progress of construction of the MREFC facilities through various mechanisms such as site visits and reviews by external panels of experts. Review topics may include, but are not limited to, technical performance, adherence to cost and schedule baselines, and project management. Each project follows a documented change control procedure, and each award contains terms and conditions that require NSF concurrence for major changes to a project's intended scope, budget, or schedule. The progress of each project is closely monitored, and awardees report to NSF on a monthly basis. NSF makes information from awardees available to the public annually before the end of the first quarter of the subsequent fiscal year. For example, information on progress made during FY 2009 was made available by December 31, 2009 on NSF's Recovery website. (www.nsf.gov/recovery).

Obligations and Outlays Actuals and Projections

MREFC actual and projections for outlays and obligations *as of March 31, 2010* are included in the table on the last page.

Energy Efficiency Spending Plans: NSF will encourage relevant ARRA award recipients to consider sustainability, energy efficiency, and environmental impact when undertaking major renovations, repairs, and alterations. NSF will point to the energy efficiency and green building requirements (in statute and executive order) for Federal infrastructure as a possible model for the recipient's infrastructure investments.

Program Plan Award Types: Cooperative Agreements or Contracts

Recipient Applicant Type

Other Private Institution/Organizations
Other Public Institution/Organizations

Beneficiary Type: U.S. Citizen

National Science Foundation: MREFC Account Detail
ARRA Obligations and Outlays as of March 31, 2010

(Dollars in Millions)

	FY10 Target	Total, FY 2009	Oct 2009	Nov 2009	Dec 2009	Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	Jun 2010	Jul 2010	Aug 2010	Sept 2010
ARRV														
Projected Obligations (Submitted Nov 2009)	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148
Actual Obligations through March & Revised Projections (as of April 2010)	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148	\$148
Projected Outlays (Submitted Nov 2009)	\$24	-	-	-	-	\$1	\$1	\$2	\$2	\$2	\$8	\$8	\$9	\$24
Actual Outlays through March ¹ & Revised Projections (as of April 2010)	\$12	-	-	-	-	-	-	-	\$1	\$3	\$5	\$7	\$10	\$12
<i>Delta</i>														
Obligations	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Outlays	(\$11)	-	-	-	-	(\$1)	(\$1)	(\$2)	(\$1)	\$1	(\$3)	(\$1)	\$1	(\$11)
ATST														
Projected Obligations (Submitted Nov 2009)	\$146	-	-	-	\$146	\$146	\$146	\$146	\$146	\$146	\$146	\$146	\$146	\$146
Actual Obligations through March & Revised Projections (as of April 2010)	\$146	-	-	-	-	\$146	\$146	\$146	\$146	\$146	\$146	\$146	\$146	\$146
Projected Outlays (Submitted Nov 2009)	\$24	-	-	-	\$20	\$20	\$21	\$21	\$22	\$22	\$23	\$23	\$24	\$24
Actual Outlays through March ¹ & Revised Projections (as of April 2010)	\$11	-	-	-	-	-	-	-	\$3	\$4	\$5	\$7	\$9	\$11
<i>Delta</i>														
Obligations	-	-	-	-	(\$146)	-	-	-	-	-	-	-	-	-
Outlays	(\$13)	-	-	-	(\$20)	(\$20)	(\$21)	(\$21)	(\$19)	(\$18)	(\$17)	(\$16)	(\$15)	(\$13)
Subtotal, ARRV and ATST														
Projected Obligations (Submitted Nov 2009)	\$294	\$148	\$148	\$148	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294
Actual Obligations through March & Revised Projections (as of April 2010)	\$294	\$148	\$148	\$148	\$148	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294
Projected Outlays (Submitted Nov 2009)	\$48	-	-	-	\$20	\$22	\$22	\$23	\$24	\$24	\$31	\$31	\$32	\$48
Actual Outlays through March ¹ & Revised Projections (as of April 2010)	\$23	-	-	-	-	-	-	-	\$4	\$7	\$10	\$14	\$18	\$23
<i>Delta</i>														
Obligations	-	-	-	-	(\$146)	-	-	-	-	-	-	-	-	-
Outlays	(\$24)	-	-	-	(\$20)	(\$22)	(\$22)	(\$23)	(\$20)	(\$18)	(\$21)	(\$17)	(\$14)	(\$24)

National Science Foundation: MREFC Account Detail
ARRA Obligations and Outlays as of March 31, 2010
(Dollars in Millions)

	FY10 Target	Total, FY 2009	Oct 2009	Nov 2009	Dec 2009	Jan 2010	Feb 2010	Mar 2010	Apr 2010	May 2010	Jun 2010	Jul 2010	Aug 2010	Sept 2010
Subtotal, ARRV and ATST														
Projected Obligations (Submitted Nov 2009)	\$294	\$148	\$148	\$148	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294
Actual Obligations through March & Revised Projections (as of April 2010)	\$294	\$148	\$148	\$148	\$148	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294	\$294
Projected Outlays (Submitted Nov 2009)	\$48	-	-	-	\$20	\$22	\$22	\$23	\$24	\$24	\$31	\$31	\$32	\$48
Actual Outlays through March ¹ & Revised Projections (as of April 2010)	\$23	-	-	-	-	-	-	-	\$4	\$7	\$10	\$14	\$18	\$23
<i>Delta</i>														
Obligations	-	-	-	-	(\$146)	-	-	-	-	-	-	-	-	-
Outlays	(\$24)	-	-	-	(\$20)	(\$22)	(\$22)	(\$23)	(\$20)	(\$18)	(\$21)	(\$17)	(\$14)	(\$24)
OOI														
Projected Obligations (Submitted Nov 2009)	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106
Actual Obligations through March & Revised Projections (as of April 2010)	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106	\$106
Projected Outlays (Submitted Nov 2009)	\$72	-	\$5	\$10	\$22	\$30	\$33	\$37	\$41	\$49	\$57	\$63	\$68	\$72
Actual Outlays through March ¹ & Revised Projections (as of April 2010)	\$39	-	-	-	\$0	\$0	\$7	\$7	\$12	\$18	\$23	\$31	\$36	\$39
<i>Delta</i>														
Obligations	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Outlays	(\$33)	-	(\$5)	(\$10)	(\$22)	(\$30)	(\$26)	(\$30)	(\$29)	(\$31)	(\$33)	(\$33)	(\$31)	(\$33)
GRAND TOTAL, MREFC ACCOUNT														
Projected Obligations (Submitted Nov 2009)	\$400	\$254	\$254	\$254	\$400	\$400	\$400	\$400	\$400	\$400	\$400	\$400	\$400	\$400
Actual Obligations through March & Revised Projections (as of April 2010)	\$400	\$254	\$254	\$254	\$254	\$400	\$400	\$400	\$400	\$400	\$400	\$400	\$400	\$400
Projected Outlays (Submitted Nov 2009)	\$119	-	\$5	\$10	\$42	\$52	\$56	\$60	\$65	\$73	\$87	\$94	\$100	\$119
Actual Outlays through March ¹ & Revised Projections (as of April 2010)	\$62	-	-	-	\$0	\$0	\$7	\$7	\$16	\$24	\$33	\$45	\$55	\$62
<i>Delta</i>														
Obligations	-	-	-	-	(\$146)	-	-	-	-	-	-	-	-	-
Outlays	(\$57)	-	(\$5)	(\$10)	(\$42)	(\$52)	(\$48)	(\$53)	(\$49)	(\$49)	(\$54)	(\$50)	(\$45)	(\$57)

Italicized data indicate projections.

Totals may not add due to rounding.

¹Actual Outlays for October through March are subject to change up to 40 days from the end of the second quarter (March 31).