MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION — $147,510,000

The FY 2009 Budget Request for the Major Research Equipment and Facilities Construction (MREFC) account is $147.51 million, a decrease of $73.23 million, or 33.2 percent, from the FY 2008 Estimate of $220.74 million.

Major Research Equipment and Facilities Construction Funding
(Dollars in Millions)

	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	Change Over FY 2008 Estimate Amount	Change Over FY 2008 Estimate Percent
Major Research Equipment and Facilities Construction	$166.21	$220.74	$147.51	$73.23	-33.2%

The 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 follow on operations and maintenance costs of the facilities are provided through the Research and Related Activities (R&RA) account.

MREFC Account Funding
(Dollars in Millions)

	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate
Ongoing Projects								
AdvLIGO	-	$32.75	$51.43	$46.30	$15.21	$23.73	$15.50	$19.78
ARRV	2.58	42.00	-					
ALMA[1]	64.30	102.07	82.25	42.76	13.91	3.00	-	-
EarthScope[2]	25.93	-	-					
IceCube	24.38	25.91	11.33	0.95	-			
NEON	-	3.00	-					
OOI	-	5.91	-					
SODV[2]	42.83	-	-					
SPSM	6.19	9.10	-					
New MREFC Funding								
ATST	-	-	2.50	-				
MREFC Account Total	$166.21	$220.74	$147.51	$90.01	$29.12	$26.73	$15.50	$19.78

Totals may not add due to rounding.

[1]The FY 2009 Request for ALMA is increased by $7.50 million relative to the re-baselined profile in order to allow more strategic use of project contingency to buy down near-term risk, as recommended by the 2007 annual external review. The increase in FY 2009 is offset by a matching decrease in FY 2011.

[2]EarthScope and SODV received the final year of MREFC funding in FY 2007. Information on these projects can be found in the Facilities chapter of this document.

A 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.

Among federal agencies, NSF is a primary supporter of forefront instrumentation and facilities for the academic research and education communities. In recent years, the number of funding requests for the construction of major research facilities and equipment from the S&E community has increased. Many of these requests have received reviews from research peers, program staff, management and policy officials, and the National Science Board (NSB); however, many projects have experienced schedule delays, increased costs, and/or decreased scope. NSF's FY 2009 request for the MREFC account adheres to tighter standards that projects must meet to receive funding from this account. These standards should minimize future cost overruns and schedule slips, allowing NSF to more effectively direct its funds to meet the future needs and opportunities of the research community.

In accordance with the plan outlined in *A Joint National Science Board-National Science Foundation Management report on Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation,* NSF developed guiding documentation for the MREFC process. NSF is releasing its *Facility Plan* in conjunction with this Budget Request, and the *Large Facilities Manual*, which supersedes and incorporates the former *Guidelines for Planning and Managing the Major Research Equipment and Facilities Construction (MREFC) Account* and the *Facilities Management and Oversight Guide*, was released in May 2007. These documents can be found on the NSF website[1].

In order for a project to be considered for MREFC funding, NSF requires that it represent an exceptional opportunity that enables research and education. In addition, the project should be transformative in nature in that it should have the potential to shift the paradigm in scientific understanding and/or infrastructure technology. The projects included in this Budget Submission meet these criteria based on NSF and NSB review.

MREFC projects under consideration for MREFC funding must undergo a multi-phase review and approval process that is described in detail in the *Large Facilities Manual*. As a general framework for priority setting, NSF assigns highest priority to ongoing projects, which are those that have received funding for implementation and where outyear funding for the full project has already been included in a Budget Request to Congress.

All of the projects in the MREFC account are undergoing or have undergone major cost and schedule reviews, as required by guidelines instituted by NSF over the last few years. NSF requests funding for three ongoing projects: Advanced LIGO (AdvLIGO), the Atacama Large Millimeter Array (ALMA) and the IceCube Neutrino Observatory (IceCube).

No additional MREFC funding is requested for the Alaska Region Research Vessel (ARRV), the National Ecological Observatory Network (NEON), or the Ocean Observatories Initiative (OOI) in FY 2009. To help avoid future cost and schedule overruns, MREFC funds will only be requested once a risk adjusted cost has been defined for each project that defines, with high confidence, the budgetary resources and schedule needed to accomplish the requested scope. These projects will be eligible for additional MREFC construction funding in a future budget request following successful completion of Preliminary and Final Design Reviews (FDRs). Until they have passed these approved performance baselines, these projects will continue to be supported by the sponsoring research directorates as they carry out the range of activities necessary to achieve sufficient project maturity.

[1] *A Joint National Science Board-National Science Foundation Management report on Setting Priorities for Large Research Facility Projects Supported by the National Science Foundation*: www.nsf.gov/pubs/2005/nsb0577/nsb0577_1.pdf
NSF 2008 Facility Plan: www.nsf.gov/pubs/2008/nsf0824/nsf0824.pdf
Large Facilities Manual: www.nsf.gov/pubs/2007/nsf0738/nsf0738.pdf

In FY 2009, NSF is requesting funding for the Advanced Technology Solar Telescope (ATST). MREFC funding in the amount of $2.50 million is requested to support design activities. The use of these funds will require a determination by the NSF Director – in consultation with the NSB – that these funds are necessary to complete a construction-ready design. The use of MREFC funding for design and other pre-construction activities is a principal focus of ongoing reviews of NSF's MREFC processes by NSF management and the NSB.

NSF is implementing a "no cost overrun" policy, which will require that cost estimate developed at the Preliminary Design Stage have adequate contingency to cover all foreseeable risks, and that any cost increases not covered by contingency be accommodated by reductions in scope. NSF senior management is developing procedures to assure that the cost tracking and management processes are robust and that the project management oversight has sufficient authority to meet this objective. As project estimates for the current slate of projects are revised, NSF will identify potential mechanisms for offsetting any cost increases in accordance with this policy.

Appropriation 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, as amended (42 U.S.C. 1861-1875), including authorized travel, ~~$220,740,000,~~*$147,510,000*, to remain available until expended: *Provided, That funds may be utilized for design, subject to the approval of the Director of the National Science Foundation in consultation with the National Science Board.*

Major Research Equipment and Facilities Construction
FY 2009 Summary Statement
(Dollars in Millions)

	Enacted/ Request	Carryover/ Recoveries	Transfers	P.L. 110-161 Rescission	Total Resources	Obligations Incurred/Est.
FY 2007 Appropriation	$190.88	$2.93	-		$193.81	$166.21
FY 2008 Estimate	220.74	27.60	-	-15.27	233.07	233.07
FY 2009 Request	147.51	-	-		147.51	147.51
$ Change from FY 2008						-$85.56
% Change from FY 2008						-36.7%

Totals may not add due to rounding.

Explanation of Carryover:

Within the **Major Research Equipment and Facilities Construction (MREFC)** appropriation, a total of $27.60 million was carried forward into FY 2008, of which $15.27 million is rescinded as required under P.L. 110-161. The remaining $12.33 million of MREFC carryover will be applied to ongoing projects.

A total of $5.12 million was carried forward into FY 2008 for the *Ocean Observatories Initiative* (OOI). This amount is rescinded, as required under P.L. 110-161.

A total of $4.0 million was carried forward into FY 2008 for the *National Ecological Observatory Network* (NEON). This amount is rescinded, as required under P.L. 110-161.

A total of $51,934 was carried forward into FY 2008 for the *Scientific Ocean Drilling Vessel* (SODV). This amount is rescinded, as required under P.L. 110-161.

South Pole Station Modernization carried forward a total of $3.08 million into FY 2008 of which $2.55 million is rescinded, as required under P.L. 110-161. The remaining $531,375 will be applied toward the logistics and warehousing facility at South Pole, completion of exterior activities for the elevated station, and demolition of the existing station and other construction as the project approaches its scheduled completion in 2010.

A total of $4.27 million was carried forward into FY 2008 for the *IceCube Neutrino Observatory* (IceCube) of which $3.53 million was rescinded, as required under P.L. 110-161. The balance of $736,170 will be applied toward remaining construction items for IceCube as the project approaches its scheduled completion in 2010.

A total of $4.21 million was carried forward for remaining construction items for *EarthScope* as the project approaches its scheduled completion in 2008.

NSF obligated $2.58 million of the appropriated $9.43 million for the *Alaska Region Research Vessel* (ARRV) for updated engineering drawings and preparing the project execution plan, awarded during FY 2007. The remaining carryover of $6.85 million will be competed and awarded in FY 2008 and will include acquisition planning, shipyard contract award, design verification, and ordering of long lead equipment items.

Unallotted funds totaling $26,222 were rescinded, as required under P.L. 110-161.

ONGOING PROJECTS IN FY 2009:

NSF's ongoing projects in FY 2009 include:

- Advanced LIGO,
- the Alaska Region Research Vessel,
- the Atacama Large Millimeter Array,
- the IceCube Neutrino Observatory,
- the National Ecological Observatory Network,
- the Ocean Observatories Initiative, and
- The South Pole Station Modernization project.

Information on these projects follows.

Advanced Laser Interferometer Gravitational-Wave Observatory $51,430,000

The FY 2009 Budget Request for the Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO) is $51.43 million, which represents the second year of a seven-year project totaling an estimated $205.12 million.

MREFC Funding for the Advanced Laser Interferometer Gravitational-wave Observatory

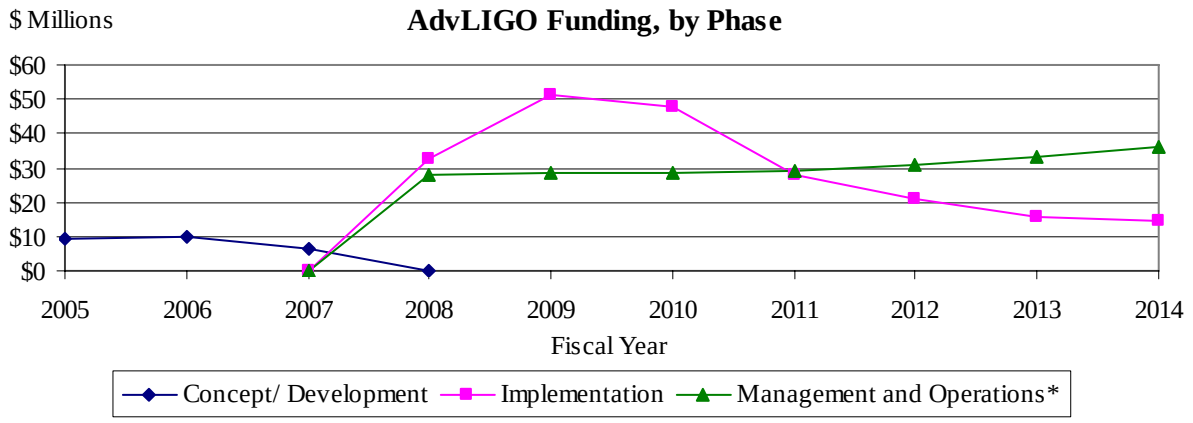
Appropriations and Requests

(Dollars in Millions)

FY 2008 Estimate	FY 2009 Request	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Total
$32.75	$51.43	$46.30	$15.21	$23.73	$15.50	$19.78	$0.42	$205.12

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. The baseline review in June 2006 established the project cost at $205.12 million, based upon the 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 budget inflators. The Final Design Review in November 2007 recommended that construction begin in FY 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 (Hanford, WA and Livingston, LA) 3000 km apart. These interferometers are designed to measure the changes in arm-lengths resulting from the wave-like distortions of spacetime caused by the passage of gravitational waves. LIGO is sensitive to changes as small as one-one thousandth the diameter of a proton over the 4-km arm-length; AdvLIGO is expected to be 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 the field of gravitational-wave detection, and a timely upgrade is necessary to reap the fruits of this bold initiative.

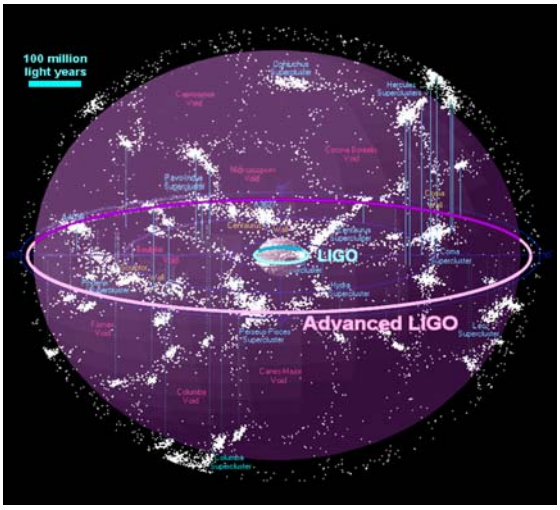


*Operations and Management refers to the continued operations of LIGO during the construction phase and the onset of operations for the newly constructed Advanced LIGO in FY 2015.

Total Obligations for AdvLIGO

(Dollars in Millions)

	Prior Years	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	ESTIMATES FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
R&RA Obligations:									
Concept & Development	34.50	6.24	-						
Management and Operations	-	33.00	29.50	28.50	28.50	29.00	31.00	33.00	36.00
Subtotal, R&RA Obligations	$34.50	$39.24	$29.50	$28.50	$28.50	$29.00	$31.00	$33.00	$36.00
MREFC Obligations:									
Construction	-	-	32.75	51.43	46.30	15.21	23.73	15.50	19.78
Subtotal, MREFC Obligations	-	-	$32.75	$51.43	$46.30	$15.21	$23.73	$15.50	$19.78
Total: AdvLIGO Obligations	$34.50	$39.24	$62.25	$79.93	$74.80	$44.21	$54.73	$48.50	$55.78



The MREFC Project Advanced LIGO will improve the sensitivity of LIGO by more than a factor of 10, which will expand the volume of space LIGO will be able to "see" by more than 1,000. Each small dot in the figure represents a galaxy. Credit: R. Powell, www.anzwers.org/free/universe/nearsc.html

LIGO has been a significant source of highly trained Ph.D. graduates for the country's workforce. Active outreach programs have been developed at both the Livingston and Hanford sites. Teams at both sites have provided visual displays, hands-on science exhibits, and fun activities for visiting students and members of the public. In the last three years an average of over 2,000 students per year have taken advantage of this opportunity. More formal programs at the sites include participation in the Research Experiences for Teachers (RET) Program, a set of "scientist-teacher-student" research projects in support of LIGO, and participation in the Summer Undergraduates Research Fellowships/Research Experiences for Undergraduates (SURF/REU) programs for college students. Both sites have developed Web-based resources for teachers that include information on research opportunities for schools and a set of standards-based classroom activities, lessons, and projects related to LIGO science. The LIGO Science Education Center at the Livingston, LA site was recently dedicated and has been filled with Exploratorium exhibits; it will be the focal point for augmenting teacher education at Southern University and other student-teacher activities state-wide through the Louisiana Systematic Initiative Program.

Substantial connections with industry have been required for the state-of-the-art construction and measurements involved in the LIGO projects. Some have led to new products. 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 introduced) development of new ultra-fine optics polishing techniques, and optical inspection equipment (new product).

LIGO has extensive international ties. The LIGO Scientific Collaboration, which sets the scientific agenda for LIGO, has formal ties with institutions from 11 foreign countries, and close collaboration is maintained with two other gravitational-wave observatories: GEO, a UK-German collaboration, and Virgo, a French-Italian collaboration. LIGO has recently 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, and the mirror/test mass suspension systems, funded and developed by the GEO collaboration. The former has essentially attained its design specifications; the latter are being tested in European gravitational-wave facilities.

Project Report:

Management and Oversight:

- NSF Structure: NSF oversight is coordinated internally by a dedicated LIGO program director in the Division of Physics (MPS), who also participates in the LIGO Advisory Team (LIGO PAT). The LIGO PAT includes staff from the Offices of Budget Finance and Award Management (BFA), General Counsel (OGC), and Legislative and Public Affairs (OLPA). Formal reporting consists of a submitted annual report, submitted quarterly reports, and brief monthly update reports to the LIGO program officer, who in turn reviews, edits, comments and submits the final reports to the Deputy Director–Large Facility Projects. LIGO also submits periodic progress indicators within the provisions of the Government Performance and Results Act (GPRA) of 1993.

- External Structure: LIGO is managed by California Institute of Technology (Caltech) under a Cooperative Agreement. The project has a detailed management structure in place.

- Reviews:

    - Technical Reviews: NSF conducts annual scientific and technical reviews involving external reviewers and participates in meetings of the LIGO Scientific Collaboration (LSC) as well as making 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.
    - Upcoming Reviews: A technical and management, cost, and schedule review is planned for June, 2008.

Current Project Status:

A request for MREFC funding for AdvLIGO construction to begin April 1, 2008, is being submitted to the National Science Board for final approval at the March 2008 meeting.

Cost and Schedule:

The projected length of the project is 7 years, with an 11-month schedule contingency. The risk-adjusted cost of $205.12 million includes a contingency budget of 23.7 percent.

Alaska Region Research Vessel $0.0

No additional funds are requested for the Alaska Region Research Vessel (ARRV) through the MREFC account in FY 2009.

MREFC Funding for the Alaska Region Research Vessel

Appropriations and Requests
(Dollars in Millions)

FY 2007 Appropriation	FY 2008 Estimate	FY 2009 Request
$9.43	$42.00	-

Baseline History: NSF first requested construction funding for ARRV through the MREFC account in FY 2007, and received an initial appropriation of $9.43 million in that year. In FY 2009, NSF is delaying acquisition of the ARRV to incorporate updated pricing information into the construction plan. Rapid inflation in the shipbuilding industry has made it difficult to accurately project the final construction cost for the ARRV, but revised funding estimates are planned prior to a Final Design Review (FDR), expected to be held later in 2008. The current notional baseline for the ARRV project will be refined in accordance with an ongoing update of the technical scope of the ship design to meet current regulatory body requirements, the recently updated science mission requirements, the update of the University of Alaska Fairbanks-proposed construction schedule, and the independent cost estimates for construction. The formal baseline will be established once the ARRV construction contract is awarded to a shipbuilding firm. If the FDR later this year is successful, the project will be eligible to request additional MREFC funding for construction.

The ARRV will replace the R/V *Alpha Helix*, which, at 40 years of age prior to its decommissioning, was the oldest ship in the national academic research fleet. Science activities in this region have been limited by the capabilities of the Alpha Helix, which was restrictively small and could not operate in ice or in severe winter weather in the open seas. With its ice-strengthened hull, the ARRV will be built to operate year round in the challenging waters of the Chukchi, Beaufort, and Bering Seas, as well as the open Gulf of Alaska, coastal Southeast Alaska, and Prince William Sound, including operations in seasonal ice up to 2.5 feet in thickness.

Total Obligations for the ARRV
(Dollars in Millions)

	Prior Years	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	ESTIMATES FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
R&RA Obligations:									
Concept & Development	2.24	-							
Management and Operations	-								
Subtotal, R&RA Obligations	$2.24	-	-	-	-	-	-	-	-
MREFC Obligations:									
Implementation	-	2.58	48.85	-					
Subtotal, MREFC Obligations	-	$2.58	$48.85	-	-	-	-	-	-
Total ARRV Obligations	**$2.24**	**$2.58**	**$48.85**	**-**	**-**	**-**	**-**	**-**	**-**

Satellite observations have shown that the perennial ice in the Arctic is thinning at a rate of 9 percent per decade, which is beginning to have major regional and global consequences. Research is urgently needed on topics ranging from climate change, ocean circulation, ecosystem studies, and fisheries research to natural hazards and cultural anthropology. Further, the ARRV will provide a sophisticated and significantly larger platform for scientists and graduate and undergraduate students to participate in complex multidisciplinary research activities and will enable the training of the next generation of scientists with the latest equipment and technology. Broadband satellite connections capable of relaying data, including high definition video from tools such as remotely operated vehicles that explore under the ice and the ocean depths, will bring research into the K-12 classroom and to the general public.

The construction phase of the project is being lead by UAF. To date, extensive design work has been undertaken by Glosten and Associates.

It is anticipated that the ARRV will greatly expand research capabilities in the region, going from a maximum of 160 ship operating days with the R/V *Alpha Helix*, up to 275-300 days with the ARRV. The vastly increased capability of the ARRV, both with regard to its ability to accommodate much larger interdisciplinary research teams and greatly enlarged geographical and seasonal ranges, will dramatically increase the number of proposals addressed to NSF for its utilization. Individual projects vary greatly in cost, as do the number of projects supported onboard at any given time. Assuming two simultaneous projects onboard for 3-4 weeks at a time and average grant size in the Division of Ocean Sciences, over $7.0 million in research would be supported annually.

This image is an artist's rendition of the ARRV, proposed to replace the R/V *Alpha Helix*, which, at 39 years is the oldest ship in the national academic research fleet.

A phased approach for ARRV project execution has been established within the cooperative agreement with UAF, in which successful achievement and review of sequential milestones for each phase are essential for proceeding to successive phases. Phase I, which is primarily updating engineering drawings and preparing the project execution plan, was awarded during FY 2007 and funded in the amount of $2.58 million. Phase 2, which includes acquisition planning, verification of shipyard qualification, and design verification, will be awarded in FY 2008 and completed in FY 2009. Phase 3, shipyard construction, testing and sea trials of the vessel, is contingent on successful completion of Phase 2 and future appropriation of construction funds. Phase 4 of the project, the final construction phase, includes Science Outfitting and Ice Operational Testing.

Project Report

Management and Oversight:

- NSF Structure: The NSF coordinator is the Program Director for Ship Acquisition and Upgrades, within the Integrative Programs Section (IPS) in the Division of Ocean Sciences, Directorate for Geosciences (GEO). Additional staff in IPS provides project management assistance. Internal oversight for the construction cooperative agreement is provided by a Project Advisory Team (PAT) which includes staff from GEO, the Office of Budget, Finance, and Award Management (BFA), including the BFA Deputy Director for Large Facility Projects, and the Office of the General Counsel (OGC). The baseline will be established following award of the shipyard contract but prior to any construction funds being released. In addition, the University-National Laboratory System (UNOLS)

Fleet Improvement Committee, an external committee composed of representatives from the community that meets several times a year, will review progress and provide advice regarding scientific outfitting of the vessel.

- External Structure: UAF has established a project management office in Fairbanks, AK, a component of which includes an on-site team that will remain in the shipyard throughout the construction process. The ARRV Oversight Committee, which includes community experts in research vessel design, construction, and operations, has been commissioned and convenes monthly to review project status and provide technical and project management advice to UAF and NSF personnel.

- Reviews:

  - Technical reviews: The Design Verification Review, during which time the shipyard will review and refine the contract design to build the ARRV to suit their production facilities within the contract price, will be completed during early FY 2009.
  - Management, Cost, and Schedule reviews: The Oversight Committee will continue to hold monthly teleconferences of project status and quarterly reviews of ARRV project management, cost, and schedule.
  - Upcoming reviews: A formal ARRV Final Design Review will be held during late FY 2008, and, contingent on appropriation of operating funds and following shipyard selection, a Baseline Review will be held to clearly articulate the project's cost, schedule, and scope, against which progress will be measured.

Current Project Status:

Phase 1 tasks, which will be completed in early FY 2008, include update of the ship design technical package and cost estimate, finalization of the UAF project management team and oversight committee, development of the Project Execution Plan, establishment of an earned value management reporting system for the project, and market surveillance of interested and qualified shipyards. Phase 2 will be awarded in FY 2008 and includes verification of shipyard interest and design verification, and will be completed during FY 2009. Phase 2 work will include a Final Design Review to ensure that all University of Alaska plans for construction and risk mitigation are sound and in place prior to the solicitation of bids from shipyards.

Cost and Schedule:

Phase 1 of the ARRV project will be completed within cost and in accordance with the schedule set forth in the cooperative agreement with the University of Alaska. Phase 2 is similarly expected to fall within the cost and schedule requirements of the cooperative agreement upon completion in FY 2009. The Final Design Review will firmly establish the Earned Value parameters reflecting project cost, schedule, and overall progress.

Risks:

A formal risk assessment and management plan will be developed in accordance with NSF guidelines. The Risk Management Plan and Risk Register will be continually updated and formally reviewed prior to the execution of each Phase of the project. Significant risks at this stage of the project include: schedule slip, which would result in project cost increases due to inflation; shipyard market risk; shipyard contract disputes and claim potential; risks associated with design development due to changing regulatory body requirements and; owner initiated design changes.

Future Operations Costs:

Initial science operations, to be governed by the terms of a separate cooperative agreement with UAF, have an estimated vessel operating cost of $8.50 million, with funding provided by NSF and other agencies according to use level. This estimate is based on NSF's extensive experience operating research vessels in a variety of environments.

Atacama Large Millimeter Array $82,250,000

The FY 2009 Budget Request for the Atacama Large Millimeter Array (ALMA) is $82.25 million, which represents the eighth year of an eleven year project totaling an estimated $499.26 million.

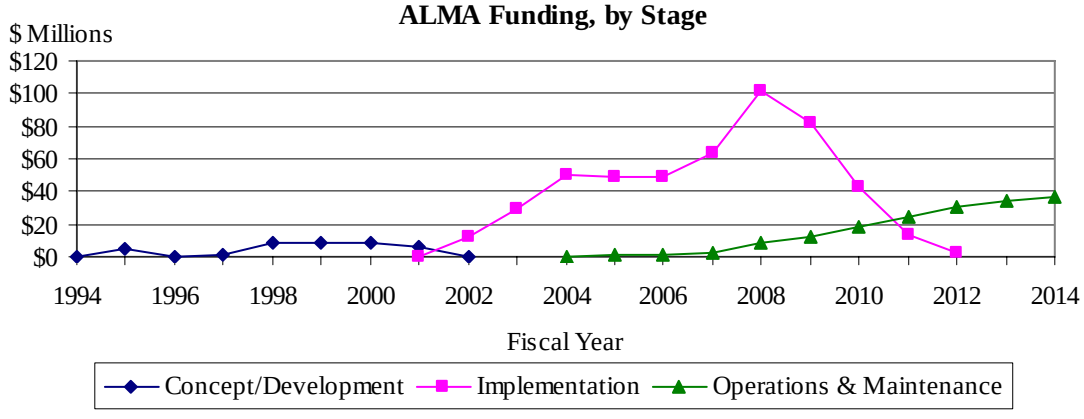
Appropriated and Requested MREFC Funds for the Atacama Large Millimeter Array
(Dollars in Millions)

FY 2005[1] &Earlier	FY 2006	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	Total
$142.31	$48.66	$64.30	$102.07	$82.25	$42.76	$13.91	$3.00	$499.26

[1]An additional $31.99 million was appropriated through the MREFC account prior to FY 2005 for concept and development.

Baseline History: NSF first requested design and development funds through the MREFC account for ALMA, then called the Millimeter Array, in FY 1998. Construction funding for ALMA was first appropriated in FY 2002, and the U.S. cost of the project was established at $344.13 million. The ALMA Board initiated rebaselining in the fall of 2004 under the direction and oversight of the Joint ALMA Office (JAO) Project Manager. The project was at that point sufficiently mature that the baseline budget and schedule established in 2002, prior to the formation of the partnership, could be refined based on experience. The rebaselining process took approximately one year, scrutinizing cost and schedule throughout the project, assessing technical and managerial risk, and ultimately revising the assumptions on the scope of the project. The new baseline plan developed by the JAO assumed a 50-antenna array as opposed to the original number of 64, extended the project schedule by 24 months, and established a new U.S. total project cost of $499.26 million. The FY 2009 Request is increased by $7.50 million relative to the re-baselined profile in order to allow more strategic use of project contingency to buy down near-term risk, as recommended by the 2007 annual external review. The increase in FY 2009 is offset by a matching decrease in FY 2011.

The global ALMA project will be an aperture-synthesis radio telescope operating in the wavelength range from 3 to 0.4 mm. ALMA will be the world's most sensitive, highest resolution, millimeter-wavelength telescope, combining sub-arcsecond angular resolution with the sensitivity of a single antenna nearly 100 meters in diameter. The array will provide a testing ground for theories of planet formation, star birth and stellar evolution, galaxy formation and evolution, and the evolution of the universe itself. The interferometer is under construction at 5,000 meter altitude near San Pedro de Atacama in the Second Region of Chile, the ALMA host country.



Total Obligations for ALMA
(Dollars in Millions)

	Prior Years	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	ESTIMATES FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
R&RA Obligations:									
Concept & Development	6.50	-							
Management and Operations	2.50	3.71	8.22	11.77	17.57	23.50	30.65	33.92	36.41
Subtotal, R&RA Obligations	$9.00	$3.71	$8.22	$11.77	$17.57	$23.50	$30.65	$33.92	$36.41
MREFC Obligations:									
Concept & Development	31.99	-							
Implementation	190.97	64.30	102.07	82.25	42.76	13.91	3.00	-	
Subtotal, MREFC Obligations	$222.96	$64.30	$102.07	$82.25	$42.76	$13.91	$3.00	-	-
Total: ALMA Obligations	**$231.96**	**$68.01**	**$110.29**	**$94.02**	**$60.33**	**$37.41**	**$33.65**	**$33.92**	**$36.41**

Once completed, ALMA will function as the most capable imaging radio telescope ever built and will bring to millimeter and submillimeter astronomy the high-resolution aperture synthesis techniques of radio astronomy. ALMA will image at 1 millimeter wavelength with the same 0.1 arcsecond resolution achieved by the Hubble Space Telescope at visible wavelengths, and will form a critical complement to the leading-edge optical, infrared, ultraviolet, and x-ray astronomical instruments of the twenty-first century.

ALMA will play a central role in the education and training of U.S. astronomy and engineering students; at least 15 percent of ALMA's approximately 1,000 yearly users are expected to be students. There is already substantial involvement by graduate students in applied physics and engineering at universities participating in the ALMA Design and Development program, providing an opportunity to broaden participation in science and engineering by members of under-represented groups.

Extensive public and student ALMA outreach programs will be implemented in North America, Europe, and Chile as ALMA approaches operational status. A visitors' center will be constructed at the 2,800 meter-altitude Operations Support Facility gateway to the ALMA site near San Pedro de Atacama in northern Chile. The project also supports a fund for the Antofagasta (II) Region of Chile that is used for economic, scientific, technical, social, and cultural development, particularly within the nearby towns of San Pedro de Atacama and Toconao.

The first Vertex antenna under assembly at the ALMA site in Chile. *Credit NRAO/AUI*

North America and Europe are equal partners in the core ALMA instrument. Japan joined ALMA as a third major partner in 2004, and will deliver a number of enhancements to the baseline instrument. The North American side of the project, consisting of the U.S. and Canada, is led by Associated Universities Incorporated/National Radio Astronomy Observatory (AUI/NRAO). Funding and execution of the project in Europe is carried out through the European Southern Observatory (ESO). Funding of the project in Japan is carried out through the National Institutes of Natural Sciences of Japan and project execution is the responsibility of the National Astronomical Observatory of Japan.

From an industrial perspective, ALMA instrumentation will push gallium arsenide and indium phosphide transistor amplifier technology to high frequencies, will challenge production of high-density, high-speed integrated circuits for computational uses, and is expected to stimulate commercial device and communication technologies development.

Peer-review telescope allocation committees will provide merit-based telescope time but no financial support. NSF will not provide awards targeted specifically for use of ALMA. Most U.S. users will be supported through NSF or NASA grants to pursue research programs that require use of ALMA.

Construction progress continues in FY 2008, both at the site in Chile and within the ALMA partner countries. The most significant events for the project in FY 2007 were delivery of the first antenna to Chile and astronomical interferometry between two prototype antennas in Socorro, New Mexico demonstrating the end-to-end electronics system. Early science operations are expected to commence in FY 2010 and completion of the construction project and the start of full science operations are planned to occur around the end of FY 2012.

Project Report:

Management and Oversight:

- NSF Structure: Programmatic management is the responsibility of the ALMA Staff Associate in the Division of Astronomical Sciences (AST) in the Directorate for Mathematical and Physical Sciences (MPS). An NSF advisory group consisting of representatives from the Office of General Counsel, the Office of Budget, Finance, and Award Management, the Office of International Science and Engineering, and the Office of Legislative and Public Affairs, serves as a standing ALMA Project Advisory Team. The NSF Deputy Director for Large Facility Projects (DDLFP) is a member of the PAT and provides advice and assistance.

- External Structure: AST's external Millimeter Array Oversight Committee has been advising NSF on the project since early 1998, and comprises half of the International ALMA Management Advisory Committee. Management of the NRAO effort on ALMA is carried out under a cooperative agreement with AUI. Oversight of the full international project is vested in the ALMA Board, whose membership includes an NSF member; coordination and management of the merged international efforts is the responsibility of the Joint ALMA Office (JAO), whose staff includes the ALMA Director, Project Manager, and Project Engineer.

- Reviews:

    - Technical reviews: The JAO holds frequent technical reviews at appropriate design and fabrication milestones. For example, a review of the readiness to begin receiver production was held in November 2007. A primary function of the AMAC is to audit the internal reviews on behalf of the ALMA Board.
    - Management, Cost, and Schedule reviews: NSF, through the ALMA Board, holds external reviews of the broad Project and in targeted areas. A review of the Operations Plan was conducted in February 2007. A project-wide annual review, held in September 2007, assessed management, cost and schedule performance, status, issues, and risks. NSF also directly charges external assessments, both broad-based e.g. through its review of the performance of the managing organization (AUI), and of specific areas as warranted. For example, a review of the computing group management and performance was held in May 2007.

- Upcoming reviews: Receiver production review in March 2008. Annual External Review in October 2008.

Current Project Status:

- Major project milestones attained in FY 2007 included:

  - Completion and provisional acceptance of AOS technical building
  - Delivery of first North American antenna to Chile
  - Integration of the first cryostat with receivers for each of the four initial wavebands in the North American integration center
  - Completion of operations reviews
  - Placement of European front end integration center contract

- Major milestones for FY 2008 are expected to include:

  - Delivery of the second through fifth North American production antennas to Chile
  - Delivery of the two antenna transporters
  - Delivery of the first two North American receiver front ends to Chile
  - Installation of the first quadrant of the correlator at the high-altitude site
  - Test interferometry at the mid-level facility in Chile using two antennas (very end of FY 2008)

- Major milestones for FY 2009 are expected to include:

  - Delivery of the first three European antennas to Chile
  - Installation of the second quadrant of the correlator
  - Delivery of the first four European and third through fifth North American front ends
  - Transport of several antennas to the final, high-altitude site in Chile
  - Start of commissioning

Cost and Schedule:

The current schedule performance is slightly behind plan due to equipment delivery delays, in particular delivery of the first antennas and receivers. The major milestones of early-science and full-science are under a tight schedule but remain achievable. Cost performance is very good at this stage in the project – cost variance is +1% and schedule variance is -5% relative to the 2005 baseline -- with approximately 40 percent contingency remaining in the uncommitted budget.

Risks:

- The transition from prototype and pre-production devices into production lines will occur across many areas of the project in the coming 18 months and is one of the key challenges for the project.
- The supply of 5MW of electricity to operate the full array has not been finalized due to the unstable power economy in Chile and South America. The original plan for gas-fed generators was eliminated following the cessation of gas exports from Bolivia. Consequently, project management is pursuing alternative options of electricity supply via a 160km-long overhead line to the nearest grid access point or on-site diesel power generation.
- For operations, the principal challenge is to ramp-up the staffing to 200 technically qualified personnel over the next three years.

Future Operations Costs:

Operations and maintenance funds phase in as initial site construction is completed and antennas begin to be delivered. Funds will be used to manage and support site and instrument maintenance, array operations in Chile, early science (FY 2011) and eventually full science operations, and in support of ALMA observations by the U.S. science community. Full ALMA science operations are anticipated to begin around the end of FY 2012. An Operations Plan and a proposal for North American operations were externally reviewed in FY 2007 and a funding profile through FY 2011 was authorized by the National Science Board in December 2007. The operations estimates for FY 2012 and beyond are based on current cost projections. The anticipated operational lifespan of this project is at least 30 years.

IceCube Neutrino Observatory **$11,330,000**

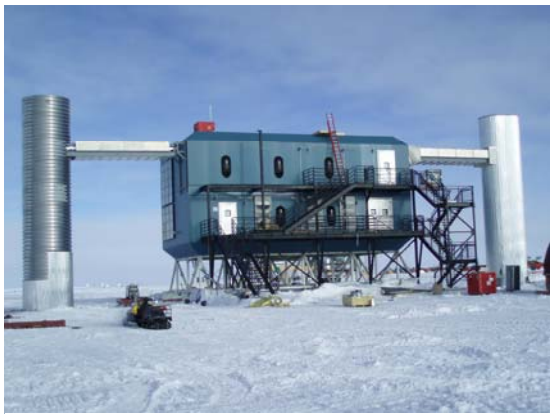
The FY 2009 Budget Request for the IceCube Neutrino Observatory is $11.33 million, which represents the eighth year of a nine-year project totaling an estimated $276.63 million. $242.07 million is funded through NSF's MREFC account, and the balance ($34.56 million) is provided by foreign partners in the project.

MREFC Funds for the IceCube Neutrino Observatory
Appropriations and Requests
(Dollars in Millions)

FY 2004 & Earlier	FY 2005	FY 2006	FY 2007	FY 2008 Estimate	FY 2009 Request	FY 2010 Estimate	Total
$81.29	$47.62	$49.85	$28.65	$22.38	$11.33	$0.95	$242.07

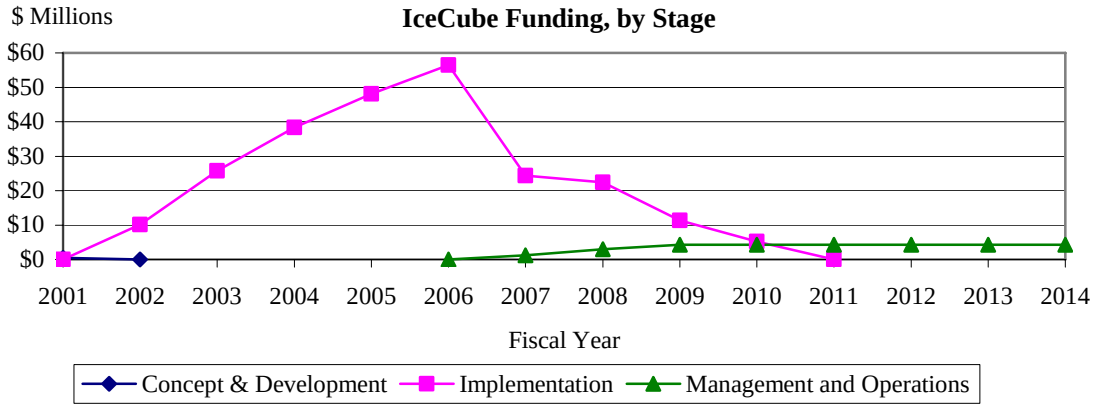
Baseline History: Congress provided an initial appropriation for IceCube of $15.0 million in FY 2002 and $24.54 in FY 2003 for "Start-up Activities", including development of an Enhanced Hot Water Drill. NSF requested construction funding for IceCube in the FY 2004 Budget Request, and the total cost of the project (including start-up activities) was estimated to be $271.77 million at that time ($242.07 from NSF and the balance from the international partners). NSF carried out a comprehensive external baseline review of the entire project, including cost, schedule, technical and management review, in February 2004; this rebaselining effort confirmed the U.S. total project cost of $242.07 million.

The total project cost is now $276.63 million, $4.86 million more than the initial estimate. This change is due to an increase in the value of the contributions made by foreign partners, which is now at $34.56 million. NSF's cost, however, remains constant at $242.07 million.



IceCube Laboratory at the South Pole Station. The large towers contain signal cables from strings of Digital Optical Modules frozen into the ice extending down 2450m below the surface (above). Courtesy of the University of Wisconsin and the IceCube Project.

IceCube will be the world's first high-energy neutrino observatory and will be located deep within the ice cap under the South Pole in Antarctica. It represents a new window on the universe, providing unique data on the engines that power active galactic nuclei, the origin of high energy cosmic rays, the nature of gamma ray bursters, the activities surrounding supermassive black holes, and other violent and energetic astrophysical processes. Approximately one cubic kilometer of ice is being instrumented with photomultiplier (PM) tubes to detect neutrino-induced, charged reaction products produced when a high energy neutrino interacts in the ice within or near the cubic kilometer fiducial volume. An array of Digital Optical Modules (DOMs), each containing a PM and associated electronics, will be distributed uniformly from 1.5 km to 2.5 km beneath the surface of the South Pole ice cap, a depth where the ice is highly transparent and bubble-free. When completed, IceCube will record the energy and arrival direction of high-energy neutrinos ranging in energy from 100 GeV (10^{11} electron Volts [eV]) to 10 PeV (10^{16} eV).



Total Obligations for IceCube

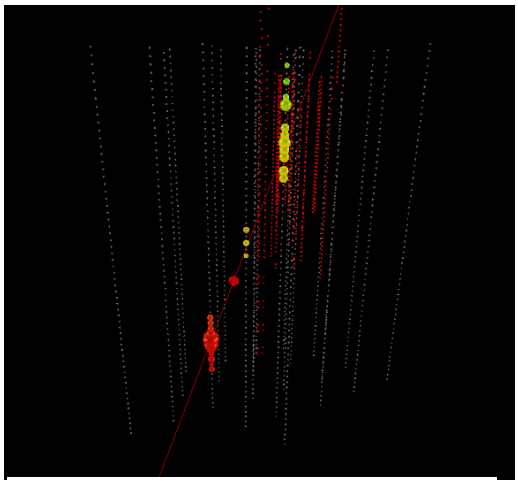
(Dollars in Millions)

	Prior Years	FY 2007 Actuals	FY 2008 Estimate	FY 2009 Request	ESTIMATES FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
R&RA Obligations:									
Concept & Development	0.50	-	-	-	-	-	-	-	-
Management and Operations	-	1.25	3.00	4.30	4.30	4.30	4.40	4.50	4.60
Subtotal, R&RA Obligations	$0.50	$1.25	$3.00	$4.30	$4.30	$4.30	$4.40	$4.50	$4.60
MREFC Obligations:									
Implementation	178.77	24.39	22.38	11.33	5.20	-	-	-	-
Subtotal, MREFC Obligations	$178.77	$24.39	$22.38	$11.33	$5.20	-	-	-	-
Total	**$179.27**	**$25.64**	**$25.38**	**$15.63**	**$9.50**	**$4.30**	**$4.40**	**$4.50**	**$4.60**

The principal tasks in the IceCube project are: production of the needed DOMs and associated electronics and cables; production of an enhanced hot water drill and a DOM deployment system capable of drilling holes for and deploying DOM strings in the ice at the Pole; refurbishment and outfitting of the IceCube Laboratory (ICL) at the South Pole; the actual drilling of the deep-ice holes, deployment of the needed DOMs, and their commissioning and verification; installation of a surface array of air shower detectors ('IceTop') to both calibrate and eliminate background events from the IceCube DOM array; construction of data acquisition, handling, archiving, and analysis systems; and associated personnel and logistics support.

IceCube construction is being carried out by the IceCube Collaboration, led by the University of Wisconsin (UW). The IceCube Collaboration consists of 12 U.S. institutions and institutions in three other countries: Belgium, Germany, and Sweden. NSF's foreign partners are contributing approximately $34.56 million to the project, as well as a pro rata share of IceCube Maintenance and Operations costs based on the number of PhD-level researchers involved. The Department of Energy, through its Lawrence Berkeley National Laboratory, is also participating.

NSF will support activities at U.S. institutions working on more refined and specific data analyses, data interpretation (theory support), and instrumentation upgrades through ongoing research programs. The annual support for such activities will be provided through the R&RA account and is currently estimated at approximately $4.00 million once the facility reaches full operation.



Upward-moving neutrino (ν) event candidate recorded in the current array of 22 strings taken during 2007 (below). *Courtesy of the University of Delaware and the IceCube Collaboration.*

IceCube provides a vehicle for helping to achieve national and NSF education and outreach goals. Specific outcomes include the education and training of next-generation leaders in astrophysics, including undergraduate students, graduate students, and postdoctoral research associates; K-12 teacher scientific/professional development, including development of new inquiry-based learning materials and using the South Pole environment to convey the excitement of astrophysics, and science generally, to K-12 students; increased diversity in science through partnerships with minority institutions; and enhanced public understanding of science through broadcast media and museum exhibits based on IceCube science and the South Pole environment (one is currently under construction). Some of these outcomes will result from separate R&RA grants to universities and other organizations for work associated with IceCube, selected following standard NSF merit review. Funding for education and outreach activities, estimated at $400,000 annually, will be provided through the R&RA account.

Project Report:

Management and Oversight:

- NSF Structure: Oversight responsibility for IceCube construction is the responsibility of OPP, and a Project Coordinator manages and oversees the NSF award. Support for operations, research, education, and outreach will be shared by OPP and MPS as well as other organizations and international partners. Besides annual progress reviews and other specialized reviews (e.g., a safety review), the project provides monthly progress reports and quarterly reports. NSF conducts site visits, weekly teleconferences with the project managers, and internal NSF project oversight and management meetings.

- External Structure: The UW management structure for the IceCube project includes leadership by a Project Director and a Project Manager. At lower levels, project management includes international participation as well as participation by staff at collaborating U.S. institutions. This framework was put in place during the start-up phase of IceCube and provided a sound basis for initiation of full construction with FY 2004 funding as soon as the project was baselined. UW has in place an external Scientific Advisory Committee, an external Project Advisory Panel, and a high-level Board of Directors (including the UW Chancellor) providing awardee-level oversight of the project.

- Reviews: NSF carried out a comprehensive external baseline review of the entire project (including cost, schedule, technical, and management) in February 2004. There was a follow-up external cost review in Fall 2004. Comprehensive external reviews are held each spring following the annual deployment season; such reviews were held in May of 2005, 2006, and 2007. The next review is scheduled for May 2008.

Current Project Status:

- During FY 2007, the ICL, which will house the data acquisition and data handling systems, was granted conditional occupancy and all systems were successfully transitioned from their temporary

location. The initial plan to drill, deploy, test, and commission 12-14 additional DOM strings and corresponding electronics and DAQ elements, for a total of 21-23 strings (30 percent of the planned array), was met with the completion of 13 strings and 20 new IceTop modules (two such modules are located over each string). Production and testing of the DOMs, IceTop modules, cables, and associated electronics needed for the 2007/2008 drilling and deployment season is complete. As of 24 January 2008, the high end of this season's goal of deploying 14-18 new DOM strings was met with the deployment of the 18th string. A significant milestone was reached when the IceCube Neutrino Observatory began limited operations for science at the beginning of May 2007, using 22 IceCube DOM strings, and the data acquisition system has performed well since then.

Cost and Schedule:

- IceCube is 79.7% complete in terms of earned value, well within the originally-proposed budget and approximately 2 quarters behind the originally-proposed completion schedule. The contingency on the budgeted cost of the work remaining is 23.6%, adequate to deal with remaining risk.

- Projected out-year milestones (FY 2008-2011) are based on current project planning and represent a general outline of anticipated activities. These activities are also dependent on weather conditions and the Antarctic logistics schedule.

- FY 2008-11 Milestones:
  - Completion, commissioning, and final acceptance of the ICL;
  - Continue DOM and IceTop module production and testing, and continue to drill, deploy, test, and commission strings (14 or more strings per season) and the corresponding IceTop modules, including installation and testing of the associated DAQ elements; and,
  - Ramp up to full operation of IceCube in FY 2011.

Risks:

- The Enhanced Hot Water Drill used to melt the 2.5 km water columns, into which the strings of DOMs are deployed, continues to perform well, with fuel efficiency better than planned and with a penetration rate that meets specifications. Of the DOMs deployed thus far, 98.5 percent are now working at or better than design specifications. Based on performance thus far, a mean-time-to-failure analysis predicts a survival fraction of 97 percent after 15 years, better than the original 95 percent reliability specification for the project. Installation of the IceTop surface array is proceeding according to schedule, with elements deployed on the surface at each string location. DOM production and cold-testing facilities in the U.S. and Europe continue to work with high efficiency, producing reliable DOMs that continue to meet or exceed requirements.

- Based on the above achievements, the project has retired major technical risks. A key factor to the success of IceCube, and a remaining risk, is the logistics support chain required to transport all material and personnel to the South Pole, and this, too, continues to perform at a very high level.

Future Operations Costs:

- Operations in support of scientific research began in FY 2007, and will ramp up in subsequent years to full science operations in FY 2011 following completion of drilling and DOM deployment in that year. The associated costs are and will continue to be shared by the partner funding agencies – U.S. (NSF) and non-U.S. – on a pro rata basis according to the number of PhD researchers involved (currently about 55:45). In the steady state, the annual cost of the data analysis that will be carried

out by the collaborating U.S. and foreign institutions is estimated at $8.0 million, of which $4.00 million will come from NSF for the U.S. groups, and which is outside of support for operations (e.g., the data acquisition and data handling systems, data quality monitoring, information technology (IT) upgrades).

- The general operations of South Pole Station, reported in a separate section, also contribute to supporting IceCube. The cost of IceCube operations shown in the table herein includes only those that are project-specific and incremental to general South Pole Station operations. Progress in IceCube operations will be reviewed annually, as it is for the MREFC construction project. The expected operational lifespan of this project is 25 years beginning FY 2011.

The National Ecological Observatory Network $0.0

The FY 2009 Budget Request does not request construction funds for the National Ecological Observatory Network (NEON).

MREFC Funding for the National Ecological Observatory Network
Appropriations and Requests
(Dollars in Millions)

	FY 2007 Appropriation	FY 2008 Estimate	FY 2009 Request
NEON Appropriations and Request	$4.00	$3.00	-
Rescission	-$4.00		
Total, NEON	-	$3.00	-

$4.0 million of the FY 2007 appropriated funds for NEON were rescinded per PL 110-161

Baseline History: NSF first requested funds for NEON in FY 2001. In 2004 an NRC report evaluated the original NEON proposal and made recommendations that significantly altered the design to make it better suited for regional to continental scale ecological research. Congress appropriated MREFC funding for NEON in FY 2007 and FY 2008. A formal baseline for NEON will be reviewed in FY 2009 as part of a Final Design Review (FDR). Assuming successful completion of the FDR, the project will be eligible for additional MREFC construction funding in a future budget request.

If constructed, the proposed NEON would consist 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 would be linked via the internet to computational, analytical, and modeling capabilities to create NEON's integrated infrastructure.

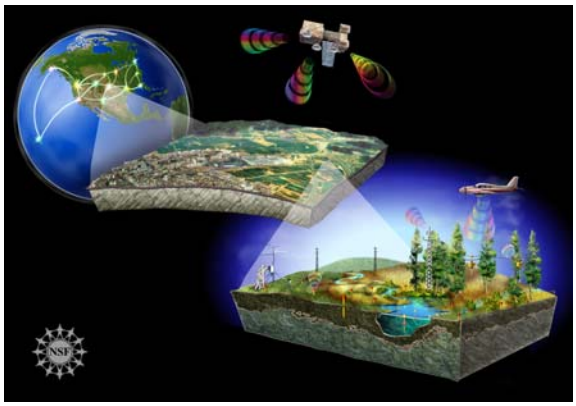
Total Obligations for NEON
(Dollars in Millions)

	Prior Years	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	ESTIMATES FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
R&RA Obligations:									
Concept & Development[1]	17.75	11.94	20.00	26.04	28.00	32.00	30.70	28.70	28.70
Management and Operations	-	-	-	-	-	-	-	-	-
Subtotal, R&RA Obligations	$17.75	$11.94	$20.00	$26.04	$28.00	$32.00	$30.70	$28.70	$28.70
MREFC Obligations:									
Construction	-	-	$3.00	-	-	-	-	-	-
Subtotal, MREFC Obligations	-	-	$3.00	-	-	-	-	-	-
Total: NEON Obligations	**$17.75**	**$11.94**	**$23.00**	**$26.04**	**$28.00**	**$32.00**	**$30.70**	**$28.70**	**$28.70**

[1] Included are costs for final Concept and Development and NEON, Inc. Consortium activities. In addition, costs for the NEON Project Office are included until construction begins.

Since NSF supports 63 percent of the fundamental environmental biology research at U.S. academic institutions, advances in the field of ecology, and the infrastructure to enable those advances, depend largely on support from NSF. Current research infrastructure is inadequate to enable studies to address the complex phenomena driving ecological change in real time and at the scales appropriate for studying

many grand challenge questions in ecology. As a continent-wide research instrument, NEON will support a large and diverse group of organizations and individuals; foremost are the scientists, educators, and engineers who will use NEON infrastructure in their research and educational programs. NSF will support research performed using the NEON platform through a special competition and through ongoing research and education programs. Based on prior experience with other new activities, BIO expects that within 3-5 years proposal submission to regular programs to use NEON will have grown sufficiently to negate the need for a special competition, and resources dedicated to the competition will be transferred to core programs. A NEON cyberinfrastructure gateway will provide resources to support formal and informal public education and provide opportunities for citizens to participate in scientific investigations. Data from standard measurements made using NEON will be publicly available.



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.*

Coordination with other federal agencies occurs through the NEON Federal Agency Coordinating Committee. Discussions have resulted in a signed Memorandum of Understanding (MOU) between NSF and the U.S. Geological Survey (USGS) that will facilitate the sharing of satellite remotely sensed data, in-situ verification, and archival storage of NEON aerial remote sensed data by USGS. Discussions are underway with NASA to partner on satellite remote sensing and ecological forecasting. Since a number of the NEON infrastructure deployment sites are located on USDA Forest Service lands, a draft agreement is under development for NEON to partner with Forest Service research stations, enable data exchange, and facilitate permitting at a national level. Discussions between NSF and Department of Energy (DOE) have focused on collaboration between NEON and DOE's Ameriflux network of sites. National Oceanic and Atmospheric Administration (NOAA) and NSF are discussing a partnership to use NEON sites as primary CO2 observation sites and to partner with NOAA's coastal observation initiative and the National Estuarine Research Reserve network. NOAA may also support NEON operations and measurements in sensitive coastal regions.

Private foundations, e.g., the Heinz Center, Nature Serve, and U.S. Landtrust, are participating in the NEON design, research, and development activities. While the bulk of NEON's infrastructure and instrumentation will be "commercial off the shelf", NEON's scientific and networking design requires certain technological innovations. Consequently, NEON has partnered with industry on R&D activities in the areas of sensors and cyberinfrastructure.

Project Report:

Management and Oversight:

- NSF Structure: The FY 2009 budget requests a realignment that will move NEON management and oversight from the Division of Biological Infrastructure to the Office of Emerging Frontiers. The realignment will strengthen management oversight of the project and foster its interdisciplinary science connections.

The project is managed by a Program Officer in Emerging Frontiers. The project is monitored closely by the Office of the Assistant Director/BIO where the BIO AD provides overall policy guidance and oversight. A Business Oversight Team chaired by the NEON Program Officer advises and assists the OAD/BIO on the business framework of the project. A BIO-NEON committee, which includes the BFA Deputy Director for Large Facility Projects, and a cross-NSF Program Advisory Team (PAT) formulates program planning for NEON.

- External Structure: The NEON Project is funded through cooperative agreements with NEON, Inc. The NEON, Inc.'s CEO provides overall leadership and management. A Project Manager at NEON, Inc. oversees all aspects of the project design, review, construction, and deployment. The NEON, Inc.'s Chief Technology Officer is responsible for oversight of the cyberinfrastructure and embedded sensor development. The NEON, Inc. Board of Directors, a Science, Technology, and Education Advisory Committee (STEAC) and a Program Advisory Committee (PAC), composed of members of the NEON user community help ensure that NEON will enable frontier research and education.

- Reviews:

  - Technical reviews: The NEON Integrated Science and Education Plan and Networking and Informatics plans were merit reviewed in FY 2006.
  - Management, Cost, and Schedule reviews:
    - The Conceptual Design Review (CDR) was conducted in November 2006.
    - A Preliminary Design Review (PDR) was held in May 2007. The review identified several issues that are currently being addressed by the project.
    - Cost and Schedule reviews: Scheduled for FY 2008
    - Readiness Review for Final Design Review scheduled for FY 2008.
    - Final Design Review scheduled for FY 2009.

Current Project Status:

The NEON, Inc. Project Office is currently completing the final NEON Project Execution Plan (PEP), addressing site selection and deployment issues, and beginning work on Environmental Compliance. They are finalizing the network design and addressing issues raised at the PDR in May 2007. A follow-up review of outstanding issues identified during the PDR will be held in FY 2008. In FY 2009 the final design and baseline, scope, schedule, and the risk-adjusted cost will be reviewed. Sufficient contingency will be built into the project design and budget to cover known risks.

Cost and Schedule:

FY 2008 MREFC funds will be carried over to FY 2009. In FY 2009, based on the outcome of the FDR, these MREFC funds will be used to begin construction of the first NEON Domain Core Site Fundamental Instrumentation Unit and embedded cyberinfrastructure. Prior to certification of construction-readiness following a final baseline review, support is requested through the R&RA account for the NEON Project Office, NEON, Inc, Consortium for oversight of the project, and ongoing R&D projects. The project will be eligible to receive additional MREFC funding for construction following successful completion of the Final Design Review.

Risks:

- Technical: Dependence on commercial off-the-shelf technology will be mitigated by long-lead purchase orders and alternative vendors. Production quality, embedded and system-level

cyberinfrastructure (CI) will be addressed by a combination of "In-house" design, commercial, contracts, and targeted research (e.g., cyber-dashboard).

- Deployment: Environmental Assessment and permitting may impact schedule and costs. These risks are being addressed through the contracting of two national legal firms by NEON, Inc., having alternative sites if the primary sites have significant risk, US Forest Service allocating an FTE to assist with Environmental compliance issues on Forest Service lands, and the direct involvement of local staff scientists in site analysis and preparation.

- Remote Sensing: 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 EROS Data Center that has the federal responsibility for curation and management of LANDSAT and MODIS images and having alternative satellite sensor sources to purchase images (e.g., SPOT - France, AWIFS – India, Terra and Aqua - US). The proposed NEON Airborne Sensor System design and aircraft availability provide technical and implementation risk. To minimize this risk the Airborne Sensor System is being prototyped by NASA and Carnegie Mellon University and designed to fit multiple aircraft, including commercial aircraft. Design engineers from Carnegie Mellon University are contracted by NEON, Inc. and experienced research aircraft pilots serve on the design team.

Future Operations Costs

Management and Operations Costs are being refined in response to issues raised in the Preliminary Design Review and will be reviewed at both the Readiness and Final Design Reviews.

Ocean Observatories Initiative $0.0

No additional funds are requested for the Ocean Observatories Initiative through the MREFC account in FY 2009.

MREFC Funding for the Ocean Observatories Initiative
Appropriations and Requests
(Dollars in Millions)

	FY 2007 Appropriation	FY 2008 Estimate	FY 2009 Request
OOI Appropriations and Requests	5.12	5.91	-
Rescission	-5.12		
Total, OOI	-	$5.91	-

$5.12 million of the FY 2007 appropriated funds for OOI were rescinded per PL 110-161.

Baseline History: NSF first requested construction funding for OOI through the MREFC account in FY 2007 and received initial appropriations of $5.12 million in FY 2007. A robust project execution plan, refined cost estimates, and well-developed risk mitigation strategy are planned in FY 2009. A final design review will be held in FY 2008; if the review is successful, the project will be eligible for additional MREFC construction funding in a future budget request.

If constructed, the proposed OOI would consist of an integrated observatory network that will provide the oceanographic research and education communities with continuous, interactive access to the ocean. The OOI would have three elements: 1) deep-sea buoys with designs capable of deployment in harsh environments such as the Southern Ocean; 2) a regional electro-optical cabled network on the seafloor spanning several geological and oceanographic features and processes; and 3) an expanded network of coastal observatories. A cutting edge, user-enabling cyberinfrastructure would link the three components of the OOI and facilitate experimentation using assets from the entire OOI network.

The Preliminary Design Review (PDR) was held December 4-7, 2007. The review panel found that OOI planning had progressed to the point that the project was essentially construction ready, but noted some minor outstanding issues for resolution by the project.

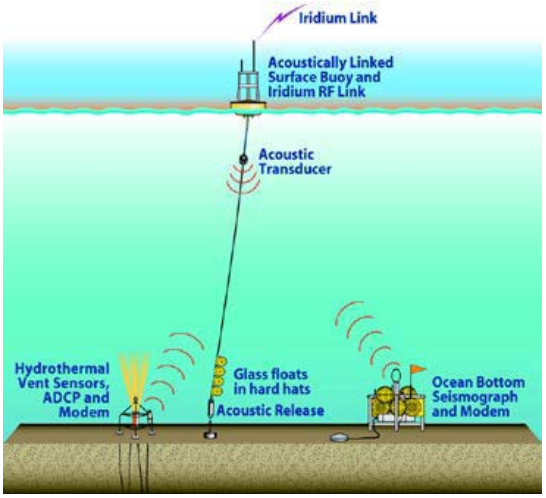
Total Obligations for the OOI
(Dollars in Millions)

	Prior Years	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	ESTIMATES FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
R&RA Obligations:									
Concept & Development	43.07	6.49	9.00	10.50	-				
Management and Operations	-								
Subtotal, R&RA Obligations	$43.07	$6.49	$9.00	$10.50	-	-	-	-	-
MREFC Obligations:									
Implementation	-	-	5.91	-					
Subtotal, MREFC Obligations	-	-	$5.91	-	-	-	-	-	-
Total: OOI Obligations	**$43.07**	**$6.49**	**$14.91**	**$10.50**	**-**	**-**	**-**	**-**	**-**

Once established, seafloor observatories will provide earth, atmospheric, and ocean scientists with unique opportunities to study multiple, interrelated processes over timescales ranging from seconds to decades; to conduct comparative studies of regional processes and spatial characteristics; and to map whole-earth and basin scale structures. Scientific discoveries arising from the OOI will provide new opportunities for ocean education and outreach through the capabilities for real-time data transmission and, particularly, real-time display of visual images from the seafloor. Desktop participation in oceanographic experiments will revolutionize access to the sea for students, educators and the general public. Educational links will be made with the Division of Ocean Sciences (OCE) Centers for Ocean Science Education Excellence (COSEE). In addition, with the planned establishment of the National Integrated Ocean Observing System (IOOS), there will be an unprecedented need for a STEM workforce and oceanographers skilled in the use and manipulation of large, oceanographic, time-series datasets. The facilities comprising the OOI will provide the ideal platforms to train this new generation of oceanographers.

Some of the component technologies that are part of the OOI are currently in use or in development as part of the telecommunication and exploration industries. These groups were involved in drafting the OOI Conceptual and Preliminary Network Designs as well as in reviews of OOI planning. Industry will also be important participants in the construction and implementation phase of the OOI as well as in the future development of sensors critical to the evolution of the OOI network.

Science proposals using the OOI network will be solicited as part of the normal competition for funds in the Division of Ocean Sciences. The research envisioned for the OOI encompasses a broad range of disciplines, and therefore no special research program will be established. Instead proposals will be reviewed and competed alongside all other research proposals submitted to OCE.



Pictured here is an artist's rendition of a a low-bandwidth discus buoy system that uses acoustic modems to transfer data intermittently from instruments on the seafloor or mooring to a surface buoy, and from there to shore via a low-power, omnidirectional satellite system. *Credit: DEOS Buoy Design Study, ORION.*

Project Report:

Management and oversight:

- NSF Structure: The project is managed and overseen by a program manager in OCE (in GEO). The program manager receives advice and oversight support from an NSF PAT that includes representatives from GEO, BIO, ENG; BFA; OISE; OGC; and OLPA. The BFA DDLFP is a member of the PAT and provides advice and assistance.

- External Structure: In the management structure for the construction phase of OOI, management, coordination, and oversight of the OOI will be the responsibility of the OOI Project Director operating from the Ocean Observatory Project Office at the Consortium for Ocean Leadership (Ocean Leadership) established through a cooperative agreement with NSF in 2004. This Project Director will be accountable to an external advisory structure consisting of scientific and technical advisory committees. Advisory committee membership will be drawn from individuals with expertise in ocean observing science and engineering. Subawards have been issued by Ocean Leadership, which houses the OOI Project Office, to establish three Implementing Organizations (IOs). These IOs will provide the detailed management and oversight for implementation the regional cabled observatory (led by the University of Washington), cyberinfrastructure (led by the University of California-San

Diego/Scripps Institute of Oceanography), and coastal/global observatories (led by Woods Hole Oceanographic Institution). These IOs will report directly to the Project Office, which will ensure cooperation and coordination between the IOs. The OOI will be coordinated with the IOOS that will support operational mission objectives of agencies such as the National Oceanic and Atmospheric Administration (NOAA), the U.S. Navy, the National Aeronautics and Space Administration (NASA), and the U.S. Coast Guard.

- Reviews:

  - Technical reviews: NSF has organized a series of external science reviews for the OOI including the Blue Ribbon Science Review (July 2006) which assessed whether the ocean observing network proposed in the OOI Conceptual Network Design (CND) would provide the capabilities for the ocean researchers to answer high priority science questions that require in situ, real-time measurements across the three scales of the OOI; and a second Blue Ribbon review (October 2007), which assessed whether the OOI PND provided the experimental capabilities needed to address the scientific scope outlined for the OOI. These science reviews provided a general endorsement of the OOI, supplemented by a series of recommendations for improvement; these reviews also served as input to the PDR.

  - Management, Cost, and Schedule reviews:
    - The OOI CDR, held August 2006, reviewed the scope and system level implementation plans for the OOI, including management plans and budgeting, and discussed whether all major risks with this project have been identified and whether appropriate initial system development specifications (performance requirements, major system components, and interfaces) have been established for each sub-element of the OOI
    - The 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.

  - Upcoming reviews:
    - A Final Design Review (FDR) is planed for October 2008 to determine the readiness of OOI design, execution plans, and risk analyses for full construction and establish the baseline for the OOI.
    - A cost review will be held after NSB approval for construction start and prior to the beginning of construction effort.

Current Project Status:

Informed by the December 2007 Preliminary Design Review, the OOI Project Office and Implementing Organizations are in the process of finalizing the network design, project execution plan, and risk analyses.

Cost and Schedule:

Project cost will be accurately determined at the Final Design Review and updated at subsequent cost reviews as needed.

Risks:

- Oversight risk: Although the lead organization (JOID) has experience integrating less complex projects, the complexity of the OOI and the need for the project teams to integrate amongst themselves and with the Project Office, and work effectively within the OOI Project Team under the schedule, cost, and scope constraints of the project presents a significant project risk. The OOI relies heavily on open lines of communication and effective cooperation between the managing entities (Project Office and IOs) and NSF. To mitigate this risk, monthly, quarterly and annual reports from the Project Office and IOs will be closely monitored by the OOI Program Manager and Contracts Officer for deviations from established baselines and annual site visits and reviews will be used to gain a more detailed impression of the integrative nature of the project teams. In addition, weekly teleconferences with the program staff from both the Project Office and IOs will help ensure that all groups are up to date with current activities. OOI programmatic reviews, conducted by NSF, and rotating internal reviews of the IOs (with external participation) will be performed annually, in addition to assessments by an external scientific oversight committee. Lastly, NSF's OOI Program Director will attend internal OOI project reviews being held by the Project Office to ensure that oversight of OOI implementation is proceeding according to established principles as outlined in the Cooperative Agreement with JOID and by agreement at baseline reviews.

- Scope contingency: The project team has been directed to develop an appropriate level of contingency for the OOI as dictated by a comprehensive 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 scope (as well as cost or schedule) will follow the Change Control Process, which has a tiered evaluation process for evaluating and determining any change to the project.

- Procurement Risk: Procurement delays for the OOI resulting from improper contracting methods or lack of oversight could impact the OOI scope, budget and schedule. To mitigate these risks, project acquisition plans, subawards and subcontracting strategies for each major work breakdown structure (WBS) element will be reviewed by a panel of experts prior to dispensing MREFC funds for OOI during the FDR. In addition, NSF will draft a special term and condition for inclusion in the Ocean Leadership Cooperative Agreement that requires the JOI to submit an annual procurement plan to NSF for review. The OOI Business Oversight Team will work jointly with the JOI to review critical procurements and ensure that project delays are minimized through appropriate procurement strategies.

- Technical Risk: Some aspects of the OOI network design have yet to undergo extensive field-testing and, therefore, delays in acceptance and commissioning of these elements could impact the overall project schedule and budget. Much of this testing will be the responsibility of the Implementing Organizations and, therefore, is dependent on the time needed for them to become fully established entities. To mitigate risks resulting from technical readiness, the Project Office will conduct system engineering and readiness reviews of all critical new technologies.

- Risks Related to the OOI Cyberinfrastructure - The OOI cyberinfrastructure will not only provide the network integration needed to achieve the scientific goals of the OOI, a robust, user-friendly cyberinfrastructure will be essential to develop a vigorous OOI user community. Delays in development of the OOI cyberinfrastructure, or development of a system that does not serve user needs, will greatly impact successful implementation of the OOI network. Both the OOI cyberinfrastructure network architecture and the selection of the cyberinfrastructure Implementation Organization were completed with significant input from Program Officers in the Office of

Cyberinfrastructure (OCI). Continued involvement of OCI Program Managers, via the PAT and participation in reviews of the OOI network, will be critical to mitigate risks associated with establishment of the OOI data management and acquisition system.

Future Operations Costs:

A steady state of $50.0 million in operations support (2013 dollars) is anticipated, and the expected operational lifespan of this project is 30 years.

South Pole Station Modernization **$0.00**

FY 2008 represented the final year of appropriations for the South Pole Station Modernization (SPSM) project; no funds are requested in FY 2009. Construction continues through FY 2010.

MREFC Funding for the South Pole Modernization Project
Appropriations and Requests
(Dollars in Millions)

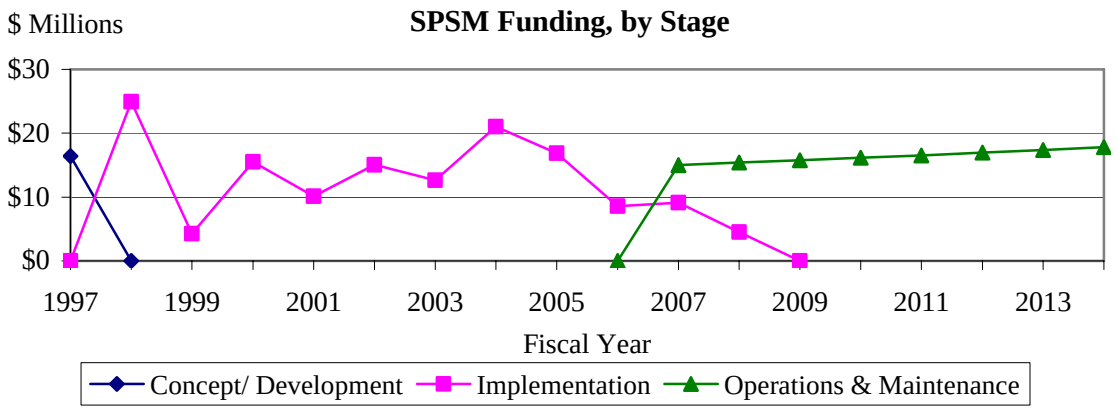
	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07 Actual	FY08 Est	FY09 Req	Total
Appropriations	$70.00	$39.00	$5.40	$13.47	-	$5.96	$1.29	-	-	$9.13	$6.55	-	$150.80
Reprogramming				-$1.00	-$0.50	-$0.24			$0.23				-$1.51
	$70.00	$39.00	$5.40	$12.47	-$0.50	$5.73	$1.29	-	$0.23	$9.13	$6.55	-	$149.29

NSF reprogrammed $1.0 million in FY 2001 to the Polar Support Aircraft Upgrades, $500,000 in FY 2002 to the South Pole Safety and Environmental project, and $235,000 in FY 2003 to HIAPER and LHC to cover final costs due to a rescission in that year. The FY 2004 appropriation for SPSM represents payback for the reprogrammings in FY 2001 and FY 2003. SPSM received $120,000 of available funds in FY 2006 from the Polar Support Aircraft Upgrades upon completion of that project, and $110,000 from other MREFC projects.

Baseline History: NSF first requested and received funds to modernize the South Pole station in FY 1998, and the total cost was estimated at that time to be $127.90 million. In FY 2001, the National Science Board approved a change in project scope, increasing station capacity from 110 people to 150 people, as well as a change to the project schedule, extending it due almost entirely to weather-imposed logistics delays. These changes increased the cost estimate to $133.44 million. In FY 2007, following an internal review of the remaining scope of the project, NSF requested an additional $9.13 million to continue the project, bringing the estimate at completion to $142.74 million; the possibility that final completion might require additional funding beyond this amount was noted at that time. Following a full external review of the remaining scope of the project conducted by a team of experts, OPP prepared a revised SPSM cost and schedule, taking into account several risk factors of concern to the review panel such as competition for skilled construction workers with reconstruction activities in Iraq and post-Katrina Louisiana and Alabama; weather uncertainties; and scientific projects competing for limited logistics capabilities. These and other risk factors were incorporated into associated contingency funds and added $6.55 million to the project cost, bringing the total current estimate to $149.29 million. The revised schedule calls for the project to be completed in 2010. As of FY 2006, U.S. Antarctic Program participants have full use of the modernized station. The new station was dedicated in January 2008.

SPSM provides a new station to replace the current U.S. station at the South Pole, built 30 years ago and inadequate in terms of capacity, efficiency, and safety. The new station is an elevated complex with two connected buildings, supporting 150 people in the summer and 50 people in the winter.

The recently dedicated South Pole Stations. *Credit: NSF*



Total Obligations for SPSM

(Dollars in Millions)

	Prior Years	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	ESTIMATES FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
R&RA Obligations:									
Concept & Development	16.40	-							
Management and Operations		15.00	15.38	15.76	16.14	16.53	16.94	17.38	17.81
Subtotal, R&RA Obligations	$16.40	$15.00	$15.38	$15.76	$16.14	$16.53	$16.94	$17.38	$17.81
MREFC Obligations:									
Implementation	133.47	6.19	6.55	3.08	-				
Subtotal, MREFC Obligations	$133.47	$6.19	$6.55	$3.08	-	-	-	-	-
Total	**$149.87**	**$21.19**	**$21.93**	**$18.84**	**$16.14**	**$16.53**	**$16.94**	**$17.38**	**$17.81**

The funds identified in the FY 2009 Request column, $3.08 million, are carryover funds from previous years. NSF expects to fully obligate MREFC funding for SPSM in FY 2009.

The prime contractor for the U.S. Antarctic Program is responsible for constructing the South Pole Station. In addition, there are approximately 385 separate subcontractors for supplies and technical services.

The completed South Pole Station will provide a platform for the conduct of science at the South Pole and fulfills NSF's mandate to maintain a continuous U.S. presence at the South Pole in accordance with U.S. policy.

NSF will also support education associated with the research projects at the South Pole. Along with direct operations and maintenance support for South Pole Station, NSF will support science and engineering research through ongoing programs. The annual support for such activities is currently estimated to be approximately $9.5 million.

Project Report:

Management and Oversight:

- NSF Structure: OPP has the overall oversight responsibility for SPSM, including development of the basic requirements, design, procurement, and construction. The project status, including cost

expenditures and cost projections, is monitored closely by the OPP Facilities Engineer and other OPP staff, and on a periodic basis by the project's Project Advisory Team, a group of experts drawn from all relevant NSF Directorates and Offices.

- External Structure: NSF has contracted for procurement and construction management for all phases of the project, including design reviews of all drawings and specifications; conformance of the designs and procurements with established standardization criteria; assistance in establishing functional interfaces; transition from the existing to the new facilities; and systems integration. Naval Facilities Engineering Command, Pacific Division (PACDIV) selects, monitors, and manages architectural and engineering firms for design, post-construction services, and construction inspection for the project.

- Reviews: Design, development, planning, and closely related activities in support of this project included preparation of more than 40 engineering studies and reports. The documents ranged widely in subject matter including subjects such as snowdrift minimization modeling, detailed analysis of power and heating requirements, preparation of a draft Environmental Impact Statement, energy conservation measures, efficiency and maintainability of diesel generators, fuel storage support system evaluation, design code criteria matrix, concept for signal/communication systems, gray-water system evaluation, minimization of ventilation requirements, control of diesel engine exhaust emissions, and jacking plan and concept.

The OPP Facilities Engineer, other OPP and NSF staff, and subject matter experts attend quarterly reviews at the contractor's facility for the purpose of reviewing all aspects of the project including cost, schedule, and plans. In September 2006, an external panel of experts reviewed the scope, cost, schedule, and effectiveness of management processes to complete the final 10 percent of the project. As a result, the project's baseline was increased to $149.29 million.

Current Project Status:

- Tasking Completed in FY 2007:
  - Construction of Cryogens Facility
  - Siding and chamfer panels on Elevated Station Pod A
  - Initiated construction of Water Well #3
  - Demolition – Science/Upper Berthing, Old Garage Shop, Comms/Ops/Store
  - Elevated Station Controls Balancing
  - IT Systems – SPTR-1 Upgrades, Commercial Global, Station Operations Center
  - Elevated Station Punch list

Cost and Schedule:

SPSM scope is slightly over 90% complete, with the elevated station and all science facilities in full use. Project cost performance index (CPI) and schedule performance index (SPI) are presently ranked green, indicating variances are within 10 percent, and current forecasts show the project completing on schedule. The project is currently over budget and ahead of schedule, with a cost performance index of 97.6 percent and a schedule performance index of 100.5 percent as of October 2007 financial data. Available contingency is approximately 10 percent of remaining costs.

- Tasking Scheduled for FY 2008:
  - Initiate construction of Logistics/Warehousing Facility
  - Complete Water Well #3

- Demolition – Old Power Plant, Dome Entry Arch
- Siding and chamfer panels on Elevated Station Pod B
- IT Systems Closeout – Telephone Systems/Network Backbone, Network Management, CCTV System

- Tasking Scheduled for FY 2009:
  - Conditional Acceptance of Logistics/Warehousing Facility
  - Completion of Siding Pod A
  - Begin Dome Demolition
  - Aircraft Fueling Module

- These are the current milestones:

Activity	Procurement	Transport to Antarctica	Airlift to South Pole	Start Construction	Conditional Acceptance
Vertical Circular Tower	FY98	FY99	FY99/00	FY00	FY02
Quarters/Galley	FY98	FY99	FY00/FY01	FY01	FY03
Sewer Outfall	FY98	FY99	FY00	FY01	FY02
Fuel Storage (100K gallons)	FY98	FY98	FY99	FY99	FY99
Medical/Science	FY99	FY00	FY01/02	FY02	FY04
Communications/Administration	FY99	FY01	FY02/03	FY03	FY06
Dark Sector Lab	FY98	FY99	FY99/00	FY00	FY06
Water Well	FY00	FY01	FY01/02	FY02	FY08
Remote RF Building	FY99	FY00	FY01	FY01	FY01
Emergency Power/Quarters	FY99	FY01	FY02/03	FY03	FY05
Liquid nitrogen and helium facility	FY02	FY03	FY04	FY04	FY07
Quarters/Multipurpose	FY99	FY02	FY04	FY05	FY06
Electronic Systems and Communications	FY00/03	FY01/04	FY01/05	FY01	FY06
Warehousing, SEH and Waste Management	FY99	FY02/03	FY04/05/06	FY07	FY09
Station Equipment	FY02/03	FY03/04	FY04/05	N/A	FY10

Risks:

Project performance could be affected if a full construction crew cannot be maintained for the remaining scope. Additional high impact risk elements to project completion include equipment failure, damaged materials, unforeseen downtime from power failures, inclement weather, and widespread illness – all of which have occurred to varying degrees. Risk management is ongoing and has produced multiple sets of back-up strategies to employ in the face of identified concerns.

Future Operations Costs:

Operational costs of the modernized station are expected to be higher than operational costs of the current station due to increased station size and increases in Science Support and Information Systems. A steady state of operational support is anticipated at $15.0 million, excluding inflation. The expected lifetime of the modernized station is 25 years, through FY 2031. These estimates are currently being reviewed to improve accuracy, taking into account estimated station population and cargo loads.

NEW MREFC FUNDING REQUESTED IN FY 2009:

The Advanced Technology Solar Telescope $2,500,000

The FY 2009 Budget Request for the Advanced Technology Solar Telescope (ATST) is $2.50 million to support design activities. The use of these funds will require a determination by the NSF Director – in consultation with the National Science Board (NSB) – that these funds are necessary to complete a construction-ready design. The use of MREFC funding for design and other pre-construction activities is a principal focus of ongoing reviews of NSF's MREFC processes by NSF management and the NSB.

MREFC Funding for the Advanced Technology Solar Telescope
(Dollars in Millions)

FY 2007 Appropriation	FY 2008 Estimate	FY 2009 Request
-	-	$2.50

If a decision is ultimately taken to proceed to the construction phase, ATST 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 mass ejections which can affect civil life on earth and may have impact on the terrestrial climate.

Beginning in 2001, NSF has provided funds to the National Solar Observatory (NSO) for an eight-year design and development program for the ATST and its first-light instruments through the Division of Astronomical Sciences and the Division of Atmospheric Sciences. The ATST project is a collaboration of scientists and engineers at more than 20 U.S. and international organizations. Potential partners include the Air Force Office of Scientific Research and international agencies and groups in Germany, the United Kingdom, Italy, Canada, and the Scandinavian countries.

An artist's rendition of the ATST.

The current ATST design, cost, schedule, and risk were scrutinized in an NSF-conducted preliminary design review in October-November 2006. A critical design review will be conducted in mid-2008, followed by a baseline review in the spring of 2009.

Project Report

Management and Oversight

- NSF Structure: Oversight from NSF is by a program manager in the Division of Astronomical Sciences in the Directorate of Mathematical and Physical Sciences working with staff from the Offices of the Deputy Director for Large Facilities, General Counsel, and Legislative and Public Affairs, and the Division of Atmospheric Sciences in the Directorate for Geosciences.

- External Structure: The ATST Project is managed by the NSO. NSO operation and maintenance and the ATST design and development is funded by NSF via a cooperative agreement with the

Association of Universities for Research in Astronomy, Inc. The NSO Director serves as the Director of the ATST project; a senior NSO scientist is the Project Scientist; and an experienced full-time Project Manager coordinates the Project activities. 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 an NSF-conducted Preliminary Design Review in October-November 2006. The Project is currently completing a comprehensive set of system-level design reviews for all major sub-systems.
  - Management, Cost, and Schedule Reviews: The ATST cost, schedule and risk were scrutinized and validated at the Preliminary Design Review.
  - Upcoming Reviews: A critical design review is planned for mid-2008, followed by a baseline review in the spring of 2009.

Current Project Status

Current activities include finalizing the design and retiring the remaining areas of risk. The project has chosen the Haleakala High Altitude Observatory on the island of Maui as the site for the ATST. Preparation of the environmental impact statement is in its final stages. Consultation with Native Hawaiian stakeholders is ongoing. Application for the final construction permits required for the ATST site will follow the publication of a record of decision. An allocation of $2.50 million in FY 2009 will allow the project to contract for detailed designs of critical-path systems, notably for the building and telescope pier foundations.