

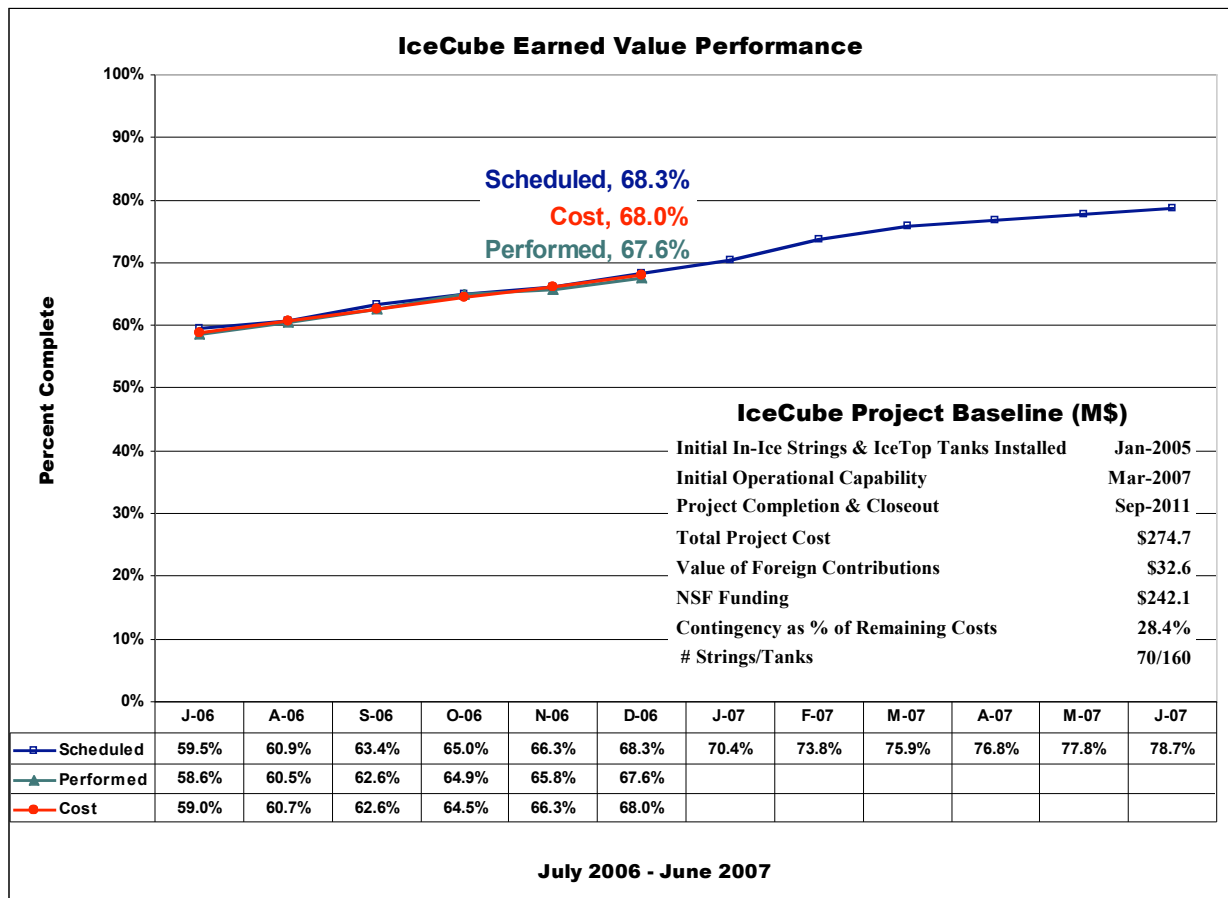
## IceCube Project Monthly Report January 2007

### Accomplishments

IceCube completed the third installation season at the South Pole at the end of January. A total of 13 detector strings and 20 surface tanks were deployed, and the independent firm drill was successfully demonstrated on three holes. The drill equipment was winterized in the dark sector for the first time, promising an earlier start to drilling for the 2007/2008 field season. We are confident that we can exceed the current out-year drilling and installation baseline plan in future years. The current high level of confidence is based on: 1) the production rates sustained this season; 2) the projected reduction in string-string installation cycle time possible with independent firm drilling; and, 3) an earlier start of the drilling season made possible through winterization of the drill on the Seasonal Equipment Site planned for next season. A total of 22 strings, 52 surface tanks, and over 1400 DOMs are installed.

860 DOMs were tested at the South Pole this season with a passing rate of 98%. 820 of those DOMs were deployed this season while the rest were stored for next season.

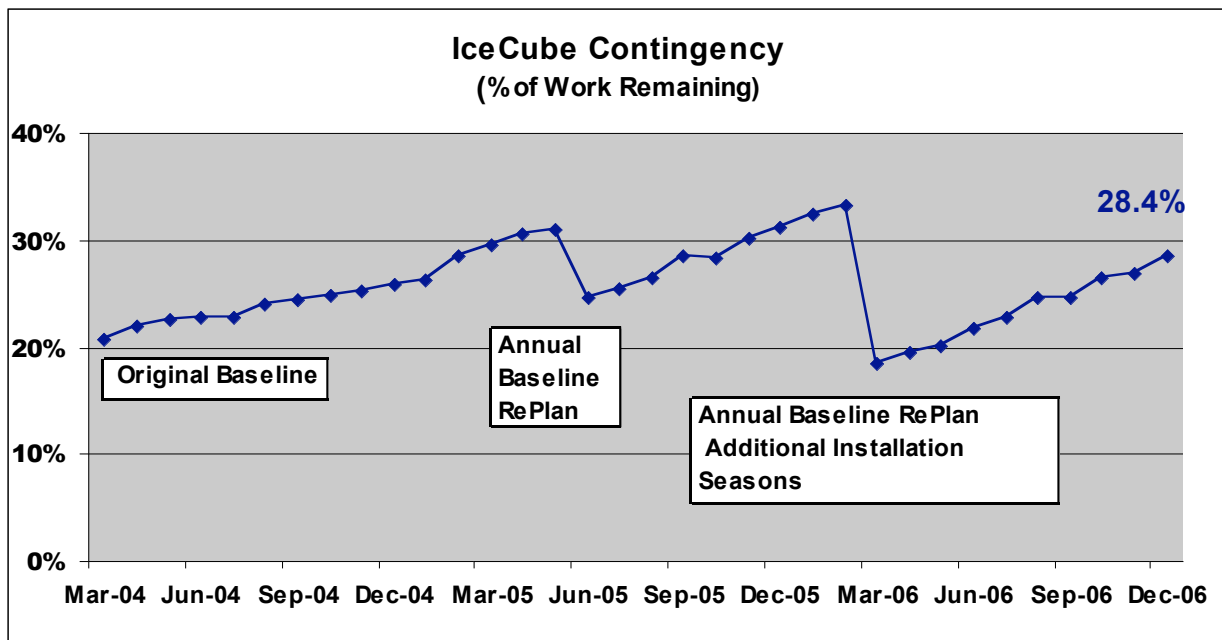
The South Pole data transfer system was successfully upgraded by NSF/RPSC and bulk transmission of string commissioning data over the satellite has been running with the upgraded IceCube data transfer system.



**Cost and Schedule Performance** – The project is 67.6% complete versus the plan of 68.3% complete, as measured using earned value techniques. The earned value measurement includes all tasks completed to date including design, development, procured materials, and the construction of the infrastructure that supports the seasonal installation plan, e.g., the hot water drill, cargo shipments, etc.

IceCube Neutrino Observatory Cost Schedule Status Report Reporting Period Ending: 12/31/2006 <sup>Note 1</sup>													
OBS Structure L2	Cumulative To Date (AY K\$)							At Completion (AY K\$) <sup>Notes</sup>			Complete (%)		
	Budgeted Cost <sup>2</sup>		Actual Cost of Work Performed	Variance		Contingency		Budgeted AY \$s	Latest Revised Estimate	Variance	Sched	Perf	Act Cost
	Work Scheduled	Work Performed		Schedule	Cost	Assigned	% ETC						
Project Support	20,052.0	19,955.7	19,592.7	-96.3	363.0	725.6	7.4%	30,260.4	29,373.3	887.0	66.3%	65.9%	64.7%
Implementation	26,224.3	26,199.3	26,926.6	-25.0	-727.3	7,088.6	42.1%	39,300.5	43,756.5	-4,456.0	66.7%	66.7%	68.5%
Instrumentation	49,504.7	48,999.3	48,819.1	-505.4	180.1	3,972.1	20.3%	68,418.5	68,427.9	-9.4	72.4%	71.6%	71.4%
Data Acquisition	27,586.8	27,373.3	26,770.5	-213.5	602.8	635.9	8.6%	34,129.6	34,129.6	0.0	80.8%	80.2%	78.4%
Data Systems	17,630.4	16,871.9	18,530.7	-758.5	-1,658.8	1,617.0	23.6%	25,381.4	25,381.4	0.0	69.5%	66.5%	73.0%
Detector Comm. & Verification	13,545.1	13,394.7	13,428.8	-150.3	-34.0	939.6	14.4%	19,932.4	19,932.4	0.0	68.0%	67.2%	67.4%
Subtotal	154,543.2	152,794.2	154,068.4	-1,749.1	-1,274.3	14,978.8	22.4%	217,422.8	221,001.1	-3,578.3	71.1%	70.3%	70.9%
RPSC SUPPORT	16,632.6	16,478.6	16,226.6	-153.9	252.0	8,043.5	36.8%	32,817.5	38,104.0	-5,286.5	50.7%	50.2%	49.4%
NSF	656.0	656.0	656.0	0.0	0.0	160.0	26.4%	1,263.0	1,263.0	0.0	51.9%	51.9%	51.9%
Total	171,831.9	169,928.8	170,951.1	-1,903.0	-1,022.3	23,182.3	25.9%	251,503.3	260,368.0	-8,864.8	68.3%	67.6%	68.0%
CONTINGENCY <sup>Notes 3,4</sup>								23,182.3	14,317.5	8,864.8			
IceCube Total <sup>Note 2</sup>	171,831.9	169,928.8	170,951.1	-1,903.0	-1,022.3	23,182.3	25.9%	274,685.5	274,685.5	0.0	68.3%	67.6%	68.0%

Notes: 1 Incorporates approved baseline changes.  
2 Total Budget at Completion includes non-US contributions 2,915 K over the amount in the post Hartill III baseline (\$29,698 K)  
3 Budgeted contingency is: 28.4% of the Budgeted cost of work remaining.  
4 Budgeted contingency is: 25.9% of the Estimated Cost to Complete (ETC)  
5 The latest revised estimate equals either the budgeted cost of work remaining divided by the historical cost performance index, or a currently proposed baseline revision.



**Change Log - IceCube Total Project Budget Baseline (\$K)**

No.	Description	Date Approved	Total Baseline	Allocated Budget	Allocated Budget Change	Contingency Budget	Estimate To Complete (ETC)	Budgeted Cost of Work Remaining	Contingency % of Remaining Work
NA	Status as of Nov 2006		274,686	251,503		23,182	93,517	86,043	26.9%
NA	Status as of Dec 2006		274,686	251,503		23,182	89,417	81,574	28.4%

**High Level Risk Assessment & Potential Future Contingency Adjustments**

Item	Potential Contingency Adjustments	Notes
Data Handling PY5 cost variance will not be fully recovered.	\$900K	Unbudgeted capital expenditures were made this year to increase storage at the pole and upgrade CPU cluster performance.
Spares, additional drillers, potential increased retro and maintenance costs in drilling out years	\$4,500K	This potential change will be addressed as part of the revised plan for construction completion - April 1, 2007.
Budget assumptions concerning the out-year NonUs capital contributions for DOM production and cables are too high	\$1,200K	Portions of the nonUS commitment may have been made through alternative capital contributions without removing the original budget assumptions.
Restore 80-string configuration	\$5,600K	Cost to increase to 80-strings, assuming most probable production yields.
Scope and higher unit pricing will increase the RPSC out-year budget baseline	\$5,250K	This potential change will be addressed as part of the revised plan for construction completion. The completion plan is expected to be approved by April 1, 2007.

In addition to the risk items noted in the table above there is also a potential impact to the construction contingency budget depending on the funding for Maintenance & Operations (M&O). A revised M&O proposal will be submitted on March 1<sup>st</sup> and a formal review of the proposal is planned for March 15-16<sup>th</sup>. If funding is not adequate to cover staff currently planned for M&O activities it will be necessary to use construction contingency to support critical staff needed for the successful completion of the construction project. This will be addressed in a case-by-case basis and in all cases the contingency funds will be used to support construction tasks.

***Drill Operation and String Installation*** – At the completion of the season a total of 13 holes had been drilled with 13 strings deployed. The seasonal equipment site has been compacted and stored for the winter. The enhanced hot water drill and modular deployment structure has been winterized and stored on location to provide for a quicker set-up and earlier start date next season.

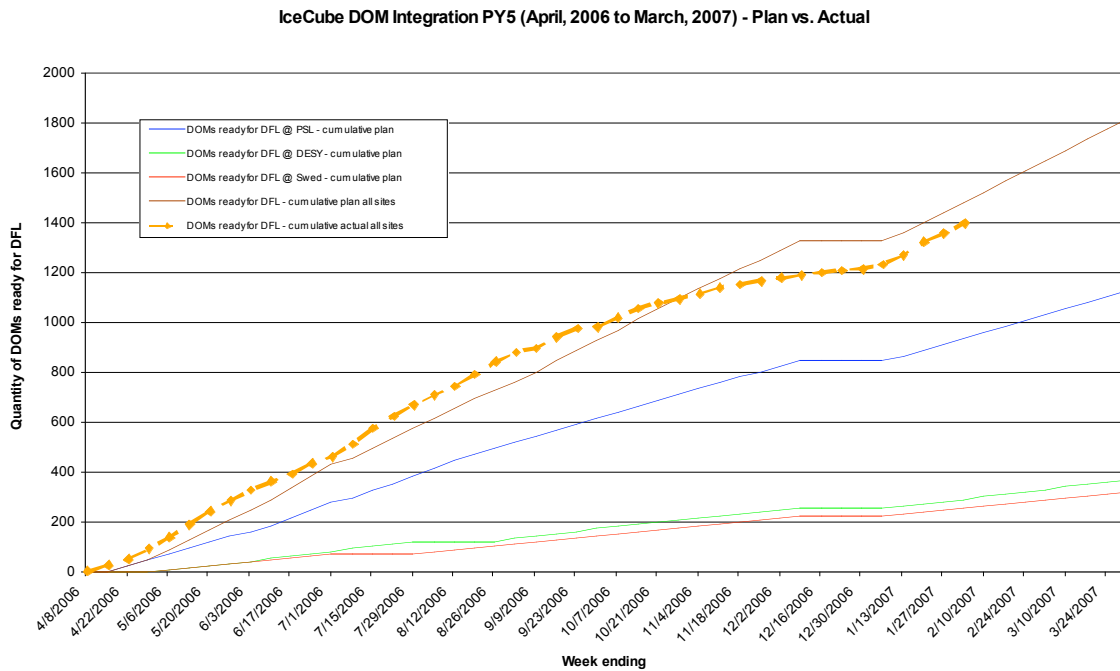
Holes #12, #13, and #14 were drilled using the independent firm drill (IFD). Hole #14 was covered and marked, ready for deep ice drilling next season. Both holes #12 and #13 were of very good quality and worked well for subsequent ice drilling and deployment. The IFD should

be able to drill a firm hole at least every other day. Minor modifications and upgrades are planned for the off-ice season.

A total of seven hose sections were replaced due to leaks or other damage by the end of the season. Spare hose was installed prior to camp teardown to ensure that only hose that meets inspection requirements is in place for the start of next season. Sections of the damaged hose are being shipped back to Madison for inspection, test, and analysis. The hose vendor, IVG, has been contacted and work has started on a plan for replacement hose. IVG engineers are working with IceCube to analyze drill data and hose specimens.

**IceCube Laboratory** – The IceCube Laboratory has been commissioned and a ribbon cutting ceremony was held on January 20<sup>th</sup>. The Temporary IceCube Laboratory has been cleared and decommissioned as of January 19<sup>th</sup>. Construction for the west tower and bridge started in late January and is on schedule to be completed.

**Digital Optical Module and Cable Production Status and Plans** - There are no major issues with instrumentation production. The plans provide instrumentation well in advance of the installation dates and support the use of the least expensive shipping methods. The actual status of DOM integration is provided in the following chart.



**South Pole DOM Testing** – DOM testing at South Pole was completed on 24 January. A total of 860 DOMs were tested in 16 cycles for a pass rate of 98%. Of the 860, 820 were deployed this season. The remaining DOMs have been moved to storage and will be used next season.

**IceTop Installation and Commissioning** – Twenty IceTop tanks were deployed this season. Tanks deployed earlier in the season are about 60% frozen while the later tanks are about 30% frozen. All ten IceTop stations (20 tanks) have been connected to the IceCube Laboratory.

***Detector Commissioning and Verification*** – The calibration and verification data taking plan was executed at Pole with Penn State coordinating this activity from the north. Initial studies indicate that the strings deployed in 2005 and 2006, and re-cabled this season, satisfy basic data verification tests. Likewise, the newly deployed strings that have frozen-in pass basic timing tests. A few easy to fix problems were encountered related to surface software or low-level calibration constants.

The Working Group structure, created to focus collaboration effort by physics analysis topic, is effectively coordinating the design and implementation of numerous online filters. It is also working well as a venue for discussing various issues concerning simulated data and the IceTray software framework.

Online reconstruction modules are now being used actively by the creators of various physics filters to select events for shipment north via satellite. The modules are working as designed.

String 48's close proximity to AMANDA string 4 presented a unique opportunity to take data using the AMANDA surface laser while string 48 was still unfrozen. It is hoped that this data will allow us to reduce the single largest contribution to systematic errors in physics analyses performed to date. Initial studies of the hole-ice data we acquired indicate that the data is of sufficient quality for analysis.

Data for the initial geometry calibration of the newly deployed strings was brought north, and has been analyzed. Initial constants will be released in early February.

Several key personnel arrived at Pole at the end of January to address longstanding AMANDA hardware issues. The plan is to troubleshoot and repair the highest priority problems before station close.

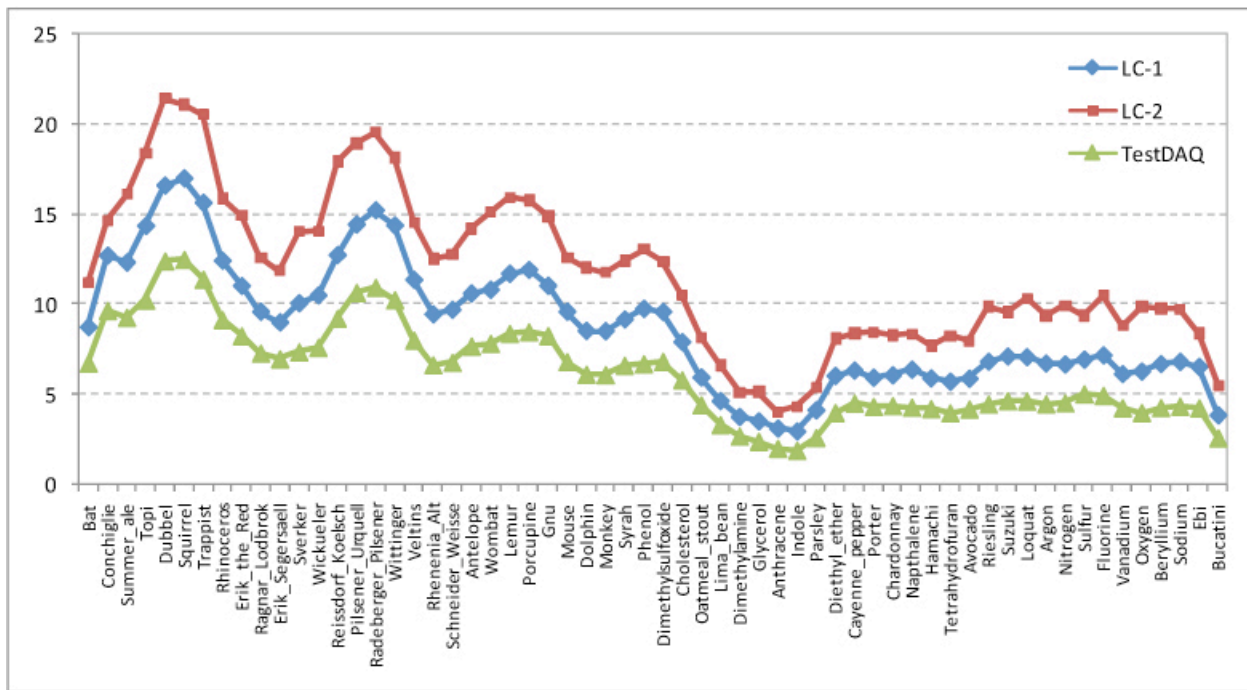
***Data Acquisition System Hardware*** - DOM Main Board production continues to progress smoothly without any major issues. The vendor has met all quality and shipping commitments to date. 513 tested DOM Main Boards have been delivered with an additional 240 MBs/month projected until the purchase order is fully satisfied. LBNL delivered 504 fully tested and inspected MBs on schedule to the DOM integration sites (240 to PSL, 132 to DESY Zeuthen, and 132 to Stockholm).

Internal review of Rev3 DOM Hub final design documentation is complete, and all documents have been released to the project office for a second round of review. The DOM Hub documentation will be ready for the DOM Hub build RFQ by the middle of February. The final purchase order for Single Board Computers for the DOM Hubs has been issued to the selected manufacturing vendor.

***Data Acquisition System Software*** – A new version of DAQ software, pDAQ, has been deployed on the SPS cluster at South Pole and as of 16 February 18 deep-ice strings and all 26 IceTop stations have been integrated into data-taking mode. In addition, the DAQ systems for registration of the hardware and software trigger signals from the AMANDA waveform DAQ

are operational so that IceCube can receive trigger and timing information from the AMANDA detector. The remaining four deep-ice strings are as yet not fully commissioned and therefore have not been included in the pDAQ configuration. DAQ integration activity will be carried out remotely after station close in mid-February.

An early comparison of pDAQ raw hit rates out of the StringHubs to TestDAQ raw hit rates is shown in the following figure:



The figure shows string 21 data taken with the pDAQ StringHub on 2/2/2007 with nearest neighbor LC requirement (blue diamonds), next-to-nearest-neighbor LC (red squares), and TestDAQ data from August 2006 (green triangles). The discrepancy between pDAQ and TestDAQ operating in similar LC configurations is most likely due to the difference in CR muon flux between August and February and to a lesser extent due to the slight differences in pDAQ/TestDAQ LC configuration (+/- 1000 ns window vs +/- 400 ns window). The data from pDAQ reproduces the shape of the ice structure quite well, and additionally, the plot demonstrates for the first time the increase in data rates as a result of configuring the detector for next-to-nearest-neighbor local coincidence.

**Data Systems** - 18 racks of computer equipment, core software systems, and networking for the SPS computing have been installed in the new IceCube Laboratory. All surface cables and patch cables were installed and tested. The lab was commissioned in January, and the temporary counting house (TICL) was decommissioned and the structure handed over to drilling operations.

The South Pole data transfer system was successfully upgraded by Polar Programs and bulk transmission of string commissioning data over the satellite has been running with the upgraded IceCube data transfer system (SPADE). We have seen transfer rates in excess of 40 GBytes/day.

Development of the Joint-Event-Builder (JEB) is continuing. The JEB will join the Icecube and Amanda TWR data streams into the PnF IceTray framework for online filtering of the joined events from the two arrays. Interface and system integration testing is being performed on the SPTS-64 to ensure the online filter and JEB work with experiment control and the new pDAQ.

Simulation production with version 1.9.4 continued, and progress is being made with distributed production of simulation events. Work continues on using GRID computing for simulation production through the GLOW cluster at UW, and planning for increased use of GRID computing is proceeding well. Development of IceSim release 2.0 continues with a slight schedule delay.

There was a major re-design of Experimental Control (EC) requirements and operational modes this month to accommodate changes for the new DAQ and new JEB/PnF systems. Testing has been ongoing at SPTS-64 and first deployments of EC software at Pole went smoothly. The new EC system implemented at the pole in January has responsibility for loading the run configuration data base.

***Quality Assurance and Safety*** – There was one injury to report early in the season. An IceCube driller injured a finger. He was treated and returned to finish the remainder of the drill season. All incidents will be reviewed and incorporated into an action plan to reduce the risk of reoccurrence.

The monthly reports are posted at [IceCube Monthly Reports](#).  
Construction Reports are posted at [IceCube 2006-2007 Weekly Construction Reports](#).

### **Meetings and Events**

Project Advisory Panel/Science Advisory Committee Meeting	March 1-2, 2007
2006/2007 Field Season Lessons-Learned Meeting	March 5, 2007
Season Review and Strategic Planning Meeting w/ NSF and RPSC	March 6, 2007
NSF Review of Revised M&O Plans and Research Program	March 15-16, 2007
IceCube Collaboration Meeting, Lake Geneva, Wisconsin	April 24-28, 2007
NSF Annual Review of the IceCube Project	May 30-31, 2007