

## IceCube Project Monthly Report July 2006

### Accomplishments

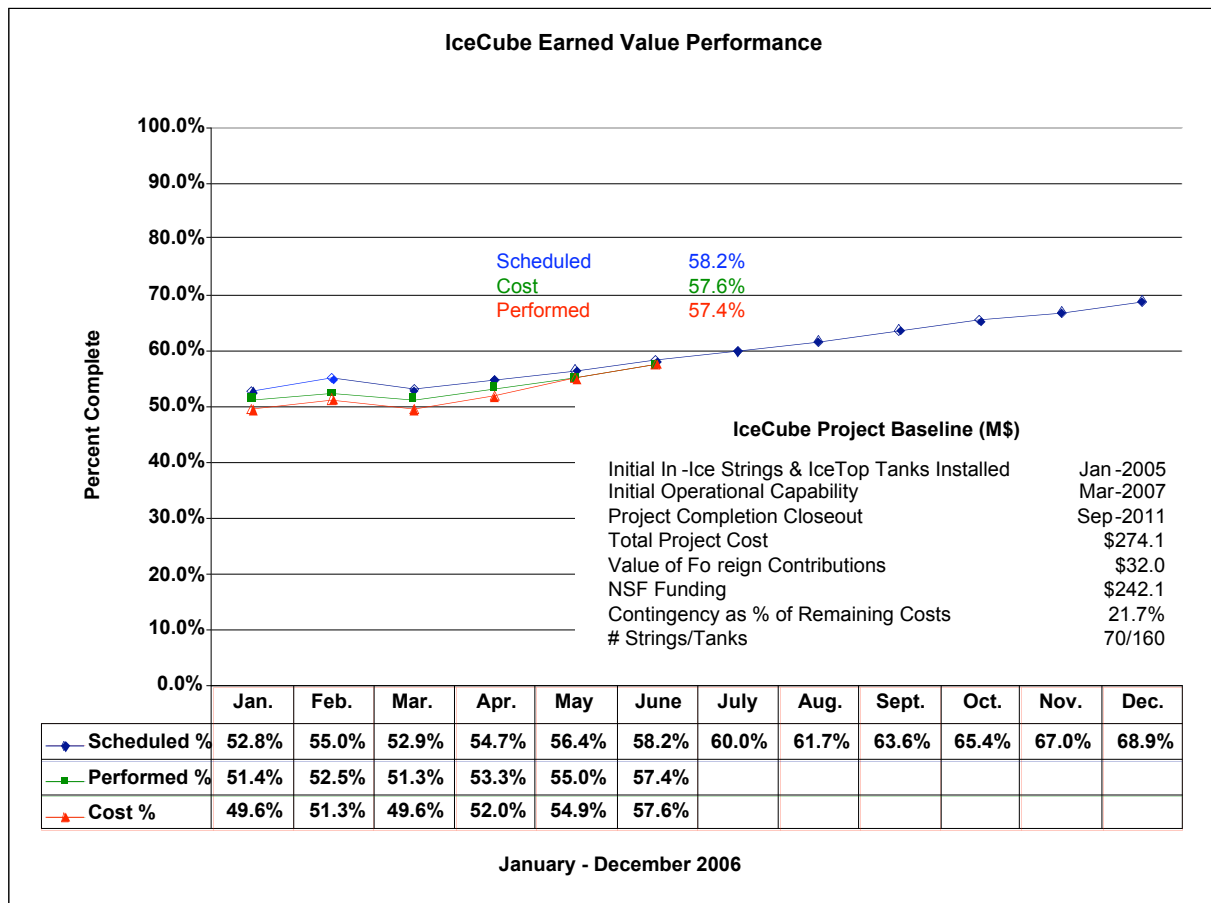
The National Science Foundation completed a review of the IceCube Operations proposal on August 1 – 3, 2006. The review went very well and IceCube is looking forward to receiving the final report.

UW completed a comprehensive training program for the staff that will work as drillers and installers at the South Pole from July 28 – August 11.

The IceCube Data Acquisition System collected 315 million events in July with an overall uptime of 81%, including both unscheduled and scheduled downtime.

The online data filtering process at the South Pole continues to operate with high efficiency and reliability selecting a desired subset of events for transmission over the satellites.

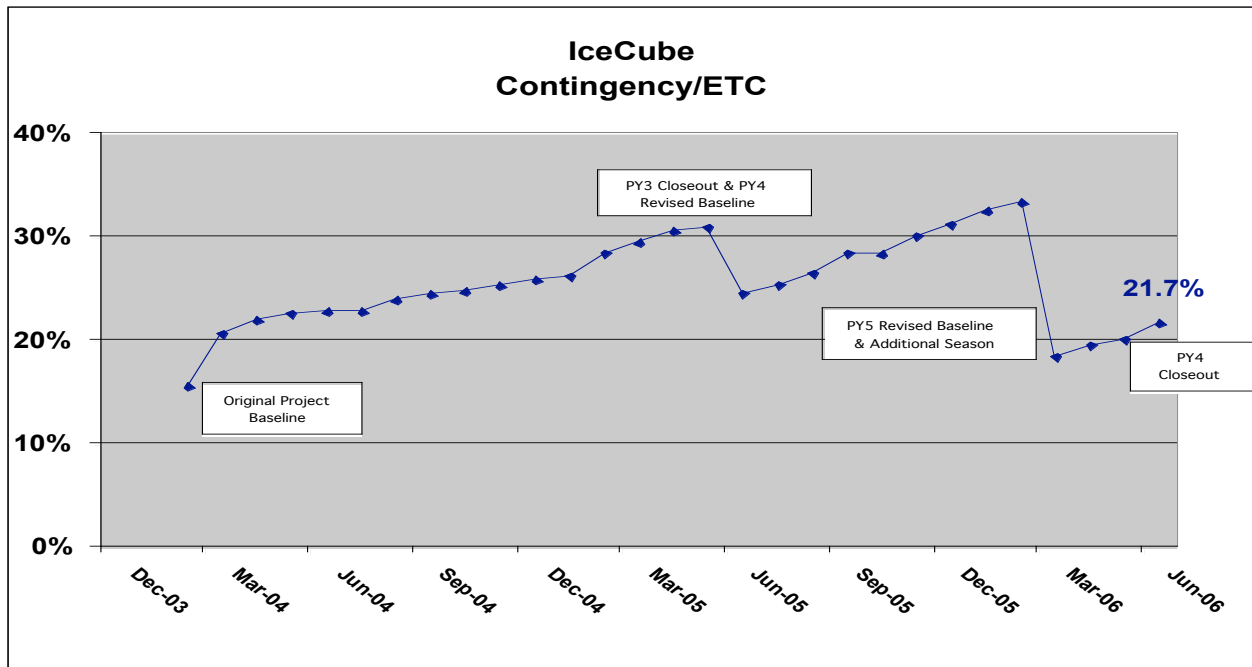
A cumulative total of over four hundred DOMs completed testing with no significant failures.



**Cost and Schedule Performance** – The project is 57.4% complete versus the planned performance of 58.2% 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: 6/30/2006 <small>Note 1</small>													
OBS Structure L2	Cumulative To Date (AY K\$)						At Completion (AY K\$) <small>Note 5</small>			Complete (%)			
	Budgeted Cost <sup>2</sup>		Actual Cost of Work Performed	Variance		Contingency		Budgeted AY \$s	Latest Revised Estimate	Variance	Sched	Perf	Actl Cost
	Work Scheduled	Work Performed		Schedule	Cost	Assigned	% ETC						
PROJECT SUPPORT	18,127.8	18,061.8	17,963.5	-66.0	98.3	1,014.3	8.0%	30,474.2	30,713.7	-239.6	59.5%	59.3%	58.9%
IMPLEMENTATION	22,045.9	22,034.6	22,754.8	-11.3	-720.1	9,592.4	60.2%	37,852.9	38,679.4	-826.5	58.2%	58.2%	60.1%
INSTRUMENTATION	40,064.1	38,988.3	38,829.2	-1,075.8	159.1	1,902.6	6.4%	68,542.2	68,351.7	190.5	58.5%	56.9%	56.7%
DATA ACQUISITION	23,507.9	24,103.3	24,354.6	595.4	-251.3	1,030.9	9.7%	34,498.6	34,969.5	-470.9	68.1%	69.9%	70.6%
DATA SYSTEMS	14,222.8	14,326.8	14,083.9	104.0	242.9	2,154.4	19.0%	25,368.9	25,435.7	-66.8	56.1%	56.5%	55.5%
DETECTOR COMM. & VERIFICATION	10,684.5	10,729.2	10,690.0	44.7	39.2	1,156.3	12.6%	19,933.7	19,868.4	65.4	53.6%	53.8%	53.6%
<b>COLLABORATION SUBTOTAL</b>	<b>128,653.0</b>	<b>128,244.0</b>	<b>128,675.9</b>	<b>-409.0</b>	<b>-431.9</b>	<b>16,851.0</b>	<b>18.9%</b>	<b>216,670.4</b>	<b>218,018.4</b>	<b>-1,348.0</b>	<b>59.4%</b>	<b>59.2%</b>	<b>59.4%</b>
RPSC SUPPORT	16,675.1	15,168.2	15,101.4	-1,506.9	66.8	6,408.1	35.9%	32,781.2	32,971.9	-190.6	50.9%	46.3%	46.1%
NSF	589.5	589.5	589.5	0.0	0.0	144.0	21.4%	1,263.0	1,263.0	0.0	46.7%	46.7%	46.7%
<b>ALLOCATED SUBTOTAL</b>	<b>145,917.5</b>	<b>144,001.6</b>	<b>144,366.8</b>	<b>-1,915.9</b>	<b>-365.2</b>	<b>23,403.0</b>	<b>21.7%</b>	<b>250,714.7</b>	<b>252,253.3</b>	<b>-1,538.6</b>	<b>58.2%</b>	<b>57.4%</b>	<b>57.6%</b>
TOTAL CONTINGENCY <small>Notes 3,4</small>								23,403.0	21,864.4	1,538.6			
<b>IceCube Neutrino Observatory</b> <small>Note 2</small>	<b>145,917.5</b>	<b>144,001.6</b>	<b>144,366.8</b>	<b>-1,915.9</b>	<b>-365.2</b>	<b>23,403.0</b>	<b>21.7%</b>	<b>274,117.7</b>	<b>274,117.7</b>	<b>0.0</b>	<b>58.2%</b>	<b>57.4%</b>	<b>57.6%</b>

Notes: 1 Incorporates approved baseline changes.  
2 Total Budget at Completion includes non-US contributions 2,347 K over the amount in the post Hartill III baseline \$29,698 K  
3 Budgeted contingency is: 21.9% of the Budgeted cost of work remaining.  
4 Budgeted contingency is: 21.7% of the Estimated Cost to Complete (ETC)  
5 The latest revised estimate equals the budgeted cost of work remaining divided by the historical cost performance index.



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

No.	Description	Approved	Total Baseline	Allocated Budget	Change	Contingency Budget	Estimate to Complete (ETC)	Contingency /ETC
	Status as of June 30, 2006		274,118	251,124	0	22,993	107,887	21.3%
CR0058	Reduction in University of California – Berkeley’s Budget for Project Year 5	07/12/06	274,118	250,969	-156	23,149	107,887	21.5%
CR0058	Build 3 DOM test sleds for use at the South Pole	07/12/06	271,118	251,006	37	23,112	107,887	21.4%
CR0064	Reduce Encumbrances for Engineering Services	07/12/06	274,118	250,715	-291	23,403	107,887	21.7%

The tables above show cost performance, contingency trends, and recent contingency allocations. The table entitled, Change Log – IceCube Total Project Budget Baseline (\$K), lists the three changes to the contingency budget approved in July resulting in a \$410k increase in the IceCube contingency budget.

The following table identifies risk items and other potential future adjustments to the IceCube contingency budget. The last item is the budget planned for the last season of drilling, instrumentation, and string installation. If cost experience is negative and the contingency budget becomes a concern it is possible to reduce the scope of the project by reducing the number of strings installed (baseline is 70 strings). The most likely scenario would be to eliminate the final drilling season in 2010/11 along with the instrumentation planned for installation that year. The budget savings would be used to ensure that the previous four installation seasons are successful.

**Risk Assessment & Potential Contingency Adjustments**

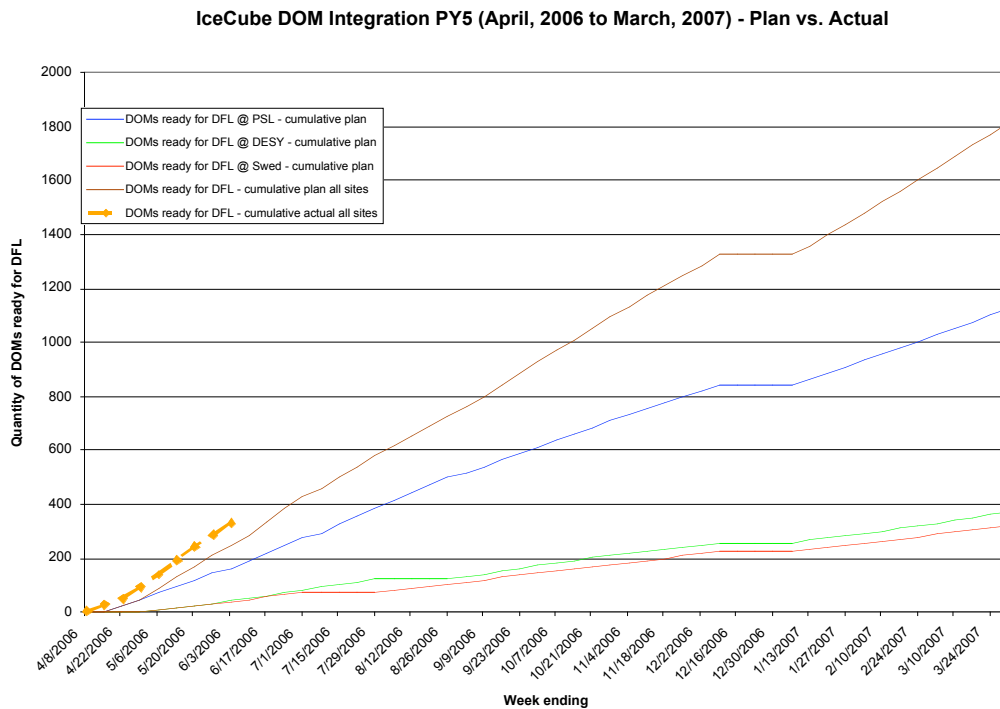
Item	Potential Contingency Adjustments (\$K)	Notes
Additional expenses to improve drill reliability	- \$1,500	Includes Independent Firm Drill, Crescent Improvements, PSL Test Facility
An additional seasonal drillers will be needed to support 24x7 drilling	- \$2,175	Increase the number of seasonal drillers from 6 to 18 for project years 6-8
Scope and pricing increases within the RPSC budget	- \$5,966	RPSC re-baseline variance: \$3,565K; ICL Fire suppress: \$300K, fuel price increase: \$2,100K
Fuel prices increase beyond current baseline estimates	- \$768	Potential for additional increases in the fuel prices beyond those included in the IceCube out-year fuel budget.
Potential savings from the elimination of the final drilling/installation season in 2010/11	+ \$8,227	This cost avoidance excludes potential hardware savings.

**Drill Operation and String Installation** – Construction of the training and test bed simulator continues and was used successfully for portions of the driller and deployment training. A concrete pad for the test tower was poured. Tower materials were ordered and construction will commence in the coming weeks. The simulator will be used for drilling/deployment training as well as testing EHWD components throughout the remainder of the project. Design and construction of an independent firm drill continues and the drill head aluminum parts are 50% complete. Copper windings will begin next week. The sled is constructed and ready and parts are ordered for the water tank. The reel stand is mostly complete. Design and mock-up tests are

complete on a segmented water tank liner and a purchase order was placed with the vendor. All replacement parts arrived and are ready for packing. Drill computers for the test bed are operational and on site. VCR like playback of drill data is complete and was effectively used during driller training. Improvements for error and data logging are complete. A project to incorporate generator monitoring into the EHWD software has begun. Driller/Deployment training was completed on August 11, 2006.

**Logistics** – The packing and crating of supplies that are needed at the South Pole has begun and the first crate is scheduled to be shipped from Madison on August 21<sup>st</sup>. An inventory process was defined and implemented to keep track of items used at the South Pole.

**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.



**DOM Testing** – A total of eight Final Acceptance Testing cycles are complete. Six of the eight cycles were completed at the University of Wisconsin Physical Sciences Laboratory (PSL) and two were completed at DESY-Zeuthen. Currently, three FAT cycles are in progress, two at PSL and one at DESY.

A total of 429 DOMs were tested in the eight FAT cycles. Of the 429 DOMs tested, none have shown any significant failures. Since no major failures have been detected, most of the DOMs with problems should pass upon retesting.

***Detector Commissioning and Verification*** – The verification effort has produced a set of web pages documenting the commissioning and verification of the eight strings deployed this past season. This effort is largely completed.

The monitoring system continues to be used regularly by collaborators and is improved using feedback from monitoring shift-takers. An automated procedure for creating monitoring plots of high level quantities, such as the downward-going muon angular distribution, is functioning, and a meeting will be held at the end of August to determine how to fully integrate this new information with the official monitoring pages. At this meeting, we will also propose what a “good run” is for use in data analysis.

Work on all aspects of TWR integration (in the data stream and in the simulation) continues to make progress. We are hopeful that DAQ will allow us to perform a simple test to see if AMANDA/TWR triggers can be fed to the IceCube Global Trigger and that the whole system can be made to work.

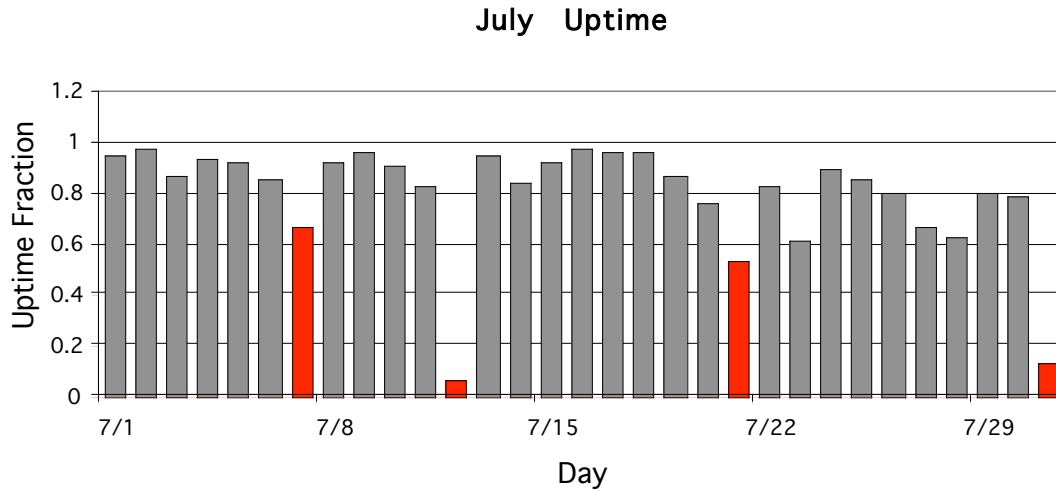
***Data Acquisition System Hardware*** - The primary deliverables for the DAQ hardware group are 1250 DOM Main Board Assemblies, one GPS/Master Clock Distribution system and 35 DOMHub Industrial Computers.

DOM Main Board production continues to progress smoothly. To date, Sanmina-SCI, the Mainboard manufacturer, has delivered 1279 of the DOM Main Board subassemblies to LBNL for final board level testing. 1232 of the DOM Main Board assemblies have been delivered to DOM assembly sites in Wisconsin, Germany, and Sweden. Deliveries are well ahead of schedule and all European shipments are complete. All U.S. shipments are scheduled to be complete by August 21<sup>st</sup>. The materials contract for the building of the remaining DOM Main Boards is in place, and parts procurement has begun.

The final version of the GPS/Master Clock Distribution system, which is used to distribute time codes and system clocks to all of the DOM/Hubs in the IceCube array, is completely assembled and tested. The assembled hardware will be ready for shipment to UW Madison at the start of August. The distribution cables have been successfully screened for timing match. The final tested production units and cables required for the full distribution system will be delivered in early August.

The complete quantity of DOMHub computers have been shipped to the IceCube Project on schedule.

***Data Acquisition System Software*** - The IceCube DAQ collected 315 million events in July giving an overall uptime of 81%, including unscheduled downtime due to acquisition system crashes and scheduled downtimes due to maintenance activities such as software upgrades and calibration and verification work. The summary versus day of the month is shown in the following Figure.



**Figure 1.** Graph of DAQ uptime versus day in July 2006. The red bars indicate maintenance and/or calibration activity.

The South Pole System (SPS) surface DAQ continues to run release 12 of the BADGER branch of the software. However, a new release of the DOM mainboard software was successfully deployed to the DOMs on 7/19 to fix an issue with setting the afterpulse suppression (deadtime) in the scaler monitoring stream which records the unbiased rate of DOM triggers.

The next release of the DAQ software, WEASEL, is still pending the resolution of issues found during testing on the Northern Hemisphere test system, SPTS. This branch includes support for readout of the supernova scaler system (1.6 ms time resolution) and also contains the DOMHub simulation code which the developers have begun using on SPTS in order to simulate the presence of realistic configurations of the detector. Until now it has not been possible to fully load the DAQ system in the SPTS tests. These simulation tools will be key to testing DAQ stability on as yet undeployed string configurations prior to installation.

Work on the future release (codename AARDVARK) has begun. This release contains software re-factoring to redistribute tasks now concentrated in the EventBuilder node to the StringProcessor nodes, which will scale with the number of strings (the EventBuilder node is unique). This architectural change becomes increasingly important for higher data rates and larger numbers of DOMs.

**Data Systems** - Work is continuing on the South Pole Build System (SPBS) at UW for planned shipment to Pole in October. The schedule for the SPBS is on track with the planned breakdown for packaging and shipment to start mid September. The equipment for the 64-bit computing South Pole Test System (SPTS-64) has arrived at UW and assembly has begun. The plan calls for SPTS-64 to be operational before the breakdown of SPBS in September. Currently no delays anticipated.

Installation of computing equipment for the Northern hemisphere Tier 1 Data Center at UW continues. The latest equipment includes 2 racks with 64 HP processing boxes each with two

dual-core AMD 64-bit processors. Installation and commissioning of this CPU upgrade is near completion, pending some power distribution upgrades.

Online filtering of data at Pole to select events for transmission continues with high efficiency and reliability since June 1 with no major problems. Continued enhancements to the online and offline database tools for IceTray were delivered this last month.

The IceTray online/offline software is now in beta testing on the 5<sup>th</sup> supported platform (MAC OS X on Intel processors). Developer release and continuous build system is available.

The data transmitted over satellite and ingested into the data warehouse has been reliably running and automatically processed by the L0 process. The L0 process has been enhanced with automated monitoring histograms that are posted on the web for detector monitoring using the filtered data set as it arrives in the North. Beta testing continues on an automated L1 reconstruction in the UW data center. The L1 process includes more advanced muon fitting using the LLH muon fitter and filtering out an enriched muon neutrino dataset. Plans have been developed to integrate the offline production processing into the tool set used for distributed production of monte carlo.

***Quality Assurance and Safety*** – Approximately 484 non-conforming material (NCM) reports have been written regarding failures or issues with verification of DOMs, test equipment, DOM components and production articles. 90% of NCMs reported have been resolved. Documentation for the IceCube Laboratory is currently being generated and will be completed by the end of summer.

Safety training for the drilling/deployment team was completed. Function specific safety training was integrated into the formal Drilling/Deployment Training sessions. OSHA specific training was delivered. In addition, customized training for the drill site was incorporated by discussing the related hazards during each functional season.

The monthly reports are posted at [IceCube Monthly Reports](#).

### **Meetings and Events**

International Oversight and Finance Group Meeting - DESY	September 11, 2006
Season Planning Confirmation Meeting – RPSC	September 12, 2006
Safety Table-Top Meeting – RPSC	September 22-23, 2006
IceCube Collaboration Meeting – DESY	October 6-10, 2006
DAQ & Experiment Control Deliverables Meeting – UW	October 18-19, 2006