

IceCube Project Monthly Report September 2006

Accomplishments

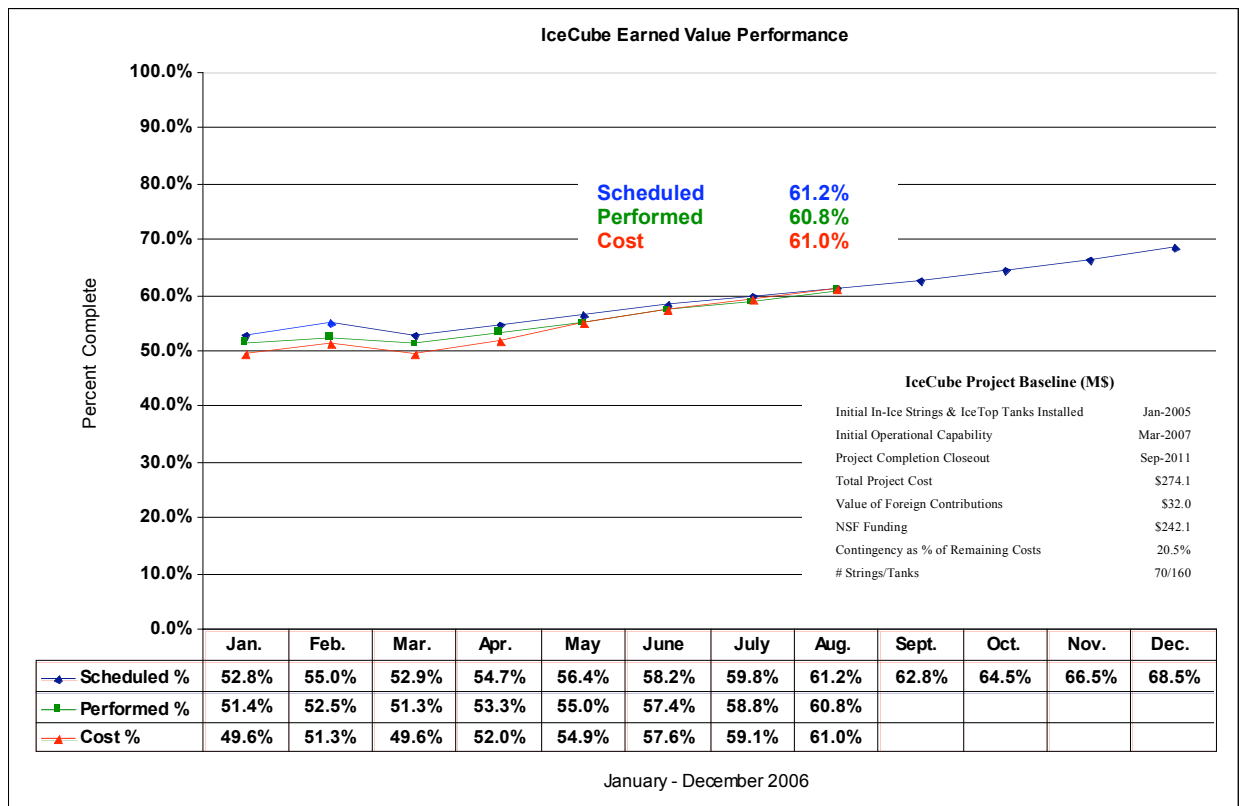
A series of final readiness reviews were completed in preparation for the upcoming construction season at the South Pole. These reviews covered drilling, installation, counting house activities and Raytheon Polar Services Company support. Personnel will begin traveling to the South Pole starting near the end of October.

Digital Optical Module production and testing continues on schedule. The production run of 1300 Digital Optical Module Main Boards is 100% complete.

Installation of additional data storage capacity for the main (Tier 0) data warehouse and computing equipment for the Tier 1 data center at UW continues on schedule.

Significant progress was made incorporating the AMANDA Transient Waveform Recorder (TWR) data into the IceCube framework.

IceCube held a collaboration meeting at DESY-Zeuthen from October 5-10, 2006.



Cost and Schedule Performance – The project is 60.8% complete versus the plan of 61.2% 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.

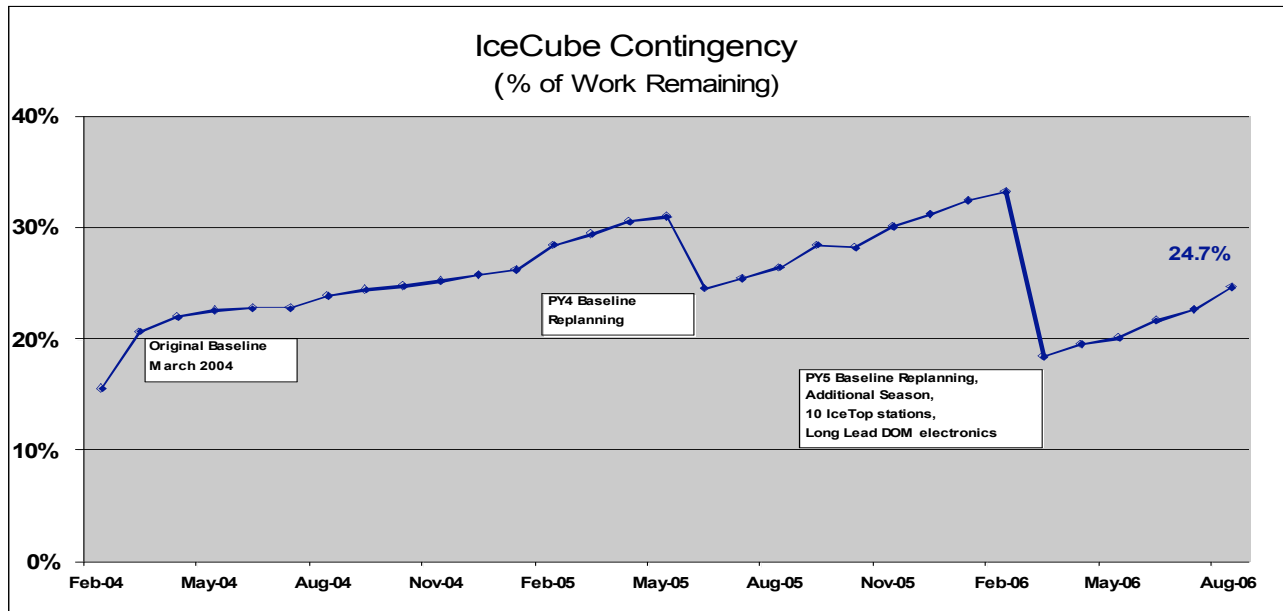
IceCube Neutrino Observatory Cost Schedule Status Report Reporting Period Ending: 8/31/2006 ^{Note 1}													
OBS Structure L2	Cumulative To Date (AY K\$)							At Completion (AY K\$) ^{Note 5}			Complete (%)		
	Budgeted Cost ²		Actual Cost of Work Performed	Variance		Contingency		Budgeted AY \$s	Latest Revised Estimate	Variance	Sched	Perf	Actl Cost
	Work Scheduled	Work Performed		Schedule	Cost	Assigned	% ETC						
PROJECT SUPPORT	18,854.0	18,731.7	18,541.7	-122.4	190.0	932.2	8.5%	30,474.2	29,512.1	962.0	61.9%	61.5%	60.8%
IMPLEMENTATION	22,529.7	22,795.4	24,035.3	265.7	-1,240.0	10,711.1	54.3%	37,852.9	43,753.3	-5,900.4	59.5%	60.2%	63.5%
INSTRUMENTATION	42,037.7	41,769.5	41,467.1	-268.2	302.4	1,682.2	6.3%	68,426.6	68,304.6	122.0	61.4%	61.0%	60.6%
DATA ACQUISITION	25,290.0	25,143.7	25,229.1	-146.3	-85.4	926.4	10.6%	33,998.9	33,998.9	0.0	74.4%	74.0%	74.2%
DATA SYSTEMS	15,325.8	15,177.0	15,787.9	-148.8	-610.9	2,078.1	21.7%	25,368.9	25,368.9	0.0	60.4%	59.8%	62.2%
DETECTOR COMM. & VERIFICATION	11,633.2	11,687.8	11,669.2	54.6	18.6	1,076.2	13.0%	19,962.4	19,962.4	0.0	58.3%	58.5%	58.5%
COLLABORATION SUBTOTAL	135,670.4	135,305.1	136,730.3	-365.4	-1,425.2	17,406.1	20.7%	216,083.9	220,900.3	-4,816.3	62.8%	62.6%	63.3%
RPSC SUPPORT	16,868.3	16,325.6	15,331.2	-542.7	994.4	6,750.1	29.5%	33,053.4	38,179.0	-5,125.6	51.0%	49.4%	46.4%
NSF	611.6	611.6	611.6	0.0	0.0	94.3	14.5%	1,263.0	1,263.0	0.0	48.4%	48.4%	48.4%
ALLOCATED SUBTOTAL	153,150.4	152,242.3	152,673.2	-908.1	-430.8	24,250.5	22.5%	250,400.3	260,342.2	-9,941.9	61.2%	60.8%	61.0%
TOTAL CONTINGENCY ^{Note 3,4}								24,250.5	14,308.5	9,941.9			
IceCube Neutrino Observatory ^{Note 2}	153,150.4	152,242.3	152,673.2	-908.1	-430.8	24,250.5	22.5%	274,650.8	274,650.8	0.0	61.2%	60.8%	61.0%

Notes: 1 Incorporates approved baseline changes.
2 Total Budget at Completion includes non-US contributions 2,880 K over the amount in the post Hartill III baseline \$29,698 K
3 Budgeted contingency is: 24.7% of the Budgeted cost of work remaining.
4 Budgeted contingency is: 22.5% 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.

The schedule variance for the IceCube collaboration activities (excludes RPSC and NSF support activities) at the end of August is negative \$365.4K. There is no dominant factor contributing to the variance and each of the individual WBS Level 2 variances is not insignificant.

The cost variance for IceCube collaboration activities at the end of August is negative \$1,425K. This variance is dominated by the cost variance in Implementation (drilling, logistics, and installation), negative \$1,240K. The implementation variance is mainly due to the increase in expenditures in 2006 to enhance the reliability of the enhanced hot water drill. A formal baseline change request covering this additional scope was approved in September and therefore the cost variance in Implementation will be eliminated in the next monthly report and the total cost variance for the project will be significantly reduced.

There have been four baseline changes since the last report (see the IceCube Change Log below). These changes result in a net increase to the contingency budget of \$847K. In addition, the budgeted cost of work remaining was reduced by \$5.076M. The contingency budget relative to the work remaining is now 24.7%. Subsequent to approval of CR0068, IceCube Laboratory (ICL) fire suppression, a revised approach was selected that reduces the cost to \$75K. A change request is being processed to return the excess \$197K to contingency.



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

No.	Description	Approved	Total Baseline	Allocated Budget	Change to Budget	Contingency Budget	Estimate to Complete (ETC)	Contingency %Remaining Work
NA	Status as of July 2006		274,118	250,715	0	23,403	103,234	22.7%
CR65	DAQ Cart for String Testing	08/23/06	274,118	250,731	16	23,387	108,000	23.7%
CR66	Additional Monitoring Effort	09/06/06	274,118	250,743	12	23,374	108,012	23.7%
CR68	ICL Fire Suppression System	09/06/06	274,118	251,016	272	23,102	108,284	23.4%
CR69	Instrumentation Adjustments a) parts for fewer (70) strings (-\$1,647k) b) tanks/cables pricing changes (+\$499k)	09/20/06	274,118	249,867	-1,148	24,250	107,136	24.8%
NA	Recognition of additional non-U.S. support	09/20/06	274,651	250,400	533	24,250	107,669	24.7%

Risk Assessment & Potential Contingency Adjustments

Item	Potential Contingency Adjustments (\$K)	Notes
PY5 Implementation budget inadequate to complete drill enhancements	\$1,444	Adjusted down from \$1,626K to remove redundant labor
Accelerated project support staffing reductions	-\$213	Reallocate to contingency
Spares, increased number of drillers (6 to 18) increased retro and maintenance costs will drive-up implementation out-year budgets	\$4,456	Will be captured during PY6 detailed planning
Reduce scope of ICL fire suppression	-\$197	Reallocate to contingency
Scope and pricing increases will drive the RPSC budget baseline revision upward	\$5,126	RPSC re-baseline rev5b: \$2,951K, Fuel prices: \$2,100K
Additional base fuel price increase	\$768	Assign contingency to mitigate risk of out-year fuel budget less than NSF out-year projection
Cost if 5 additional drilling/deployment seasons are not enough to deploy 70 strings	\$3,710	Assign contingency for nearly half of an additional drilling season beyond 2010/2011
Draws on contingency due to slow ramp up in operations support	??	Working to reduce the funding requirements for operations

Drill Operation and String Installation – A detailed internal Readiness Review was held at RPSC and concluded on October 3rd. The topics that were reviewed included the status of personnel hiring & PQ, repair work and enhancements, software, schedule, procedures, drilling plan, and cargo & logistics. Several minor actions and items to be followed-up were captured. Overall implementation is prepared for the season.

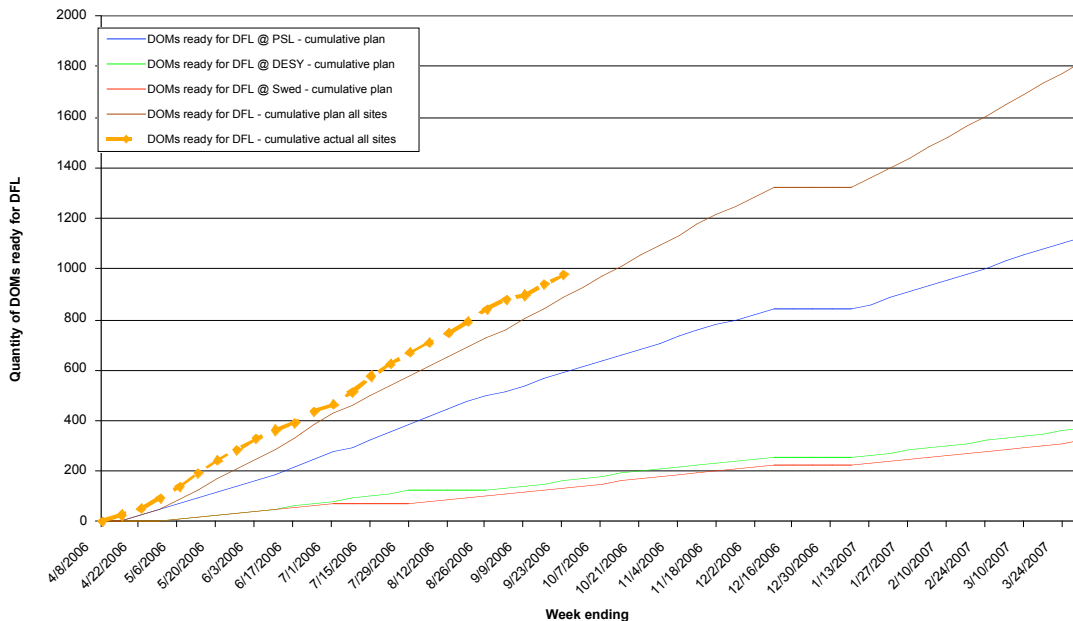
As additional drill head was built, tested and shipped on October 11th. The firm drill tower/sled and mechanics will be ready to ship by November 10th; this includes the main sled, hose reel, motor and brake, hose guide, water tank and plumbing. This schedule will allow for testing at the South Pole this season.

Construction of the Training/Test Bed Simulator is nearly complete. A few remaining components are on hold to allow labor to focus on shipping the drill cargo. Portions of the test bed are continuing to be used to test deployment equipment and hose. Tower fabrication is ongoing. The simulator will be used for drilling/deployment activity training as well as testing EHWD components throughout the remainder of the project.

Logistics – Cargo shipments to the South Pole continue. Approximately 90,000 lbs. of cargo has been shipped. Approximately 20,000 lbs. are items for the IceCube Laboratory. Inventory continues to be entered into the inventory software system, HardCat. A receiving/inventory Standard Operating Procedure for the South Pole will be available in the coming weeks for review.

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.

IceCube DOM Integration PY5 (April, 2006 to March, 2007) - Plan vs. Actual



DOM Testing – There have been a total of 14 Final Acceptance Testing (FAT) cycles completed at the three worldwide production sites. Eleven of the 14 FAT cycles were completed at the University of Wisconsin Physical Sciences Laboratory and three were completed at DESY-Zeuthen. Currently, two FAT cycles are in progress, one at the University of Wisconsin and one at DESY.

A total of 751 DOMs were tested in the 14 FAT cycles. None of the 751 DOMs tested had any major failures and the failed DOMs should ultimately pass upon retesting.

Detector Commissioning and Verification – Verification results are being incorporated into the monitoring. Work towards establishing basic criteria for deciding which runs are “good” for data analysis has begun.

A good deal of planning for the upcoming season has been completed for verification, calibration and AMANDA/IceCube integration. Most of the minimum goals that have been set for the South Pole Season should be met.

The commissioning and verification groups are making requests for special data runs, analyzing the resulting data, and generally pushing the detector configuration parameters in the direction needed to obtain the best physics data. The groups recently obtained six hours of test data in which the RealDAQ system reads out a DOM fed with AMANDA-generated clock signals. This data is valuable for AMANDA/IceCube time synchronization studies. This data is being analyzed. We have also requested a similar amount of data in which the RealDAQ system reads out a second DOM fed with AMANDA trigger signals as well. This data is critical for understanding how well we can establish an “inner core” detector surrounded by a veto ring. The “inner core” concept was endorsed by the Science Advisory Committee in the 2006 review.

The first gain calibration was completed and a newly-hired LBNL postdoc will take on responsibility for this effort.

The AMANDA/IceCube has made considerable strides in incorporating the AMANDA TWR data into the IceCube framework. Joint TWR/IceCube events have been reconstructed and look good. Crosstalk on AMANDA cables appears to be simpler to eliminate with the TWR system than under the old muonDAQ system.

Data Acquisition System Hardware - The primary deliverables for the DAQ hardware group are DOM Main Board assemblies, a GPS/Master Clock distribution system and DOMHub industrial computers.

DOM Main Board production continues to progress smoothly. The production run of 1300 DOM Mains Boards is 100% complete. 1282 deployable Main Boards were delivered to DOM Integration sites. The production run of 2500 Main Boards, enough to build between 70 and 74 strings, is progressing on schedule. All components are due to arrive by mid-October, and delivery of Main Boards to LBNL for final test and QA should occur by mid-November. Main Board shipments to Integration sites should start up again by the beginning of December.

Delivery of all components of the final version of the GPS/Master Clock distribution system, used to distribute time codes and system clocks to all of the DOM/Hubs in the IceCube array, is complete. All of the DOMHub computers have been shipped to the IceCube Project on schedule for this year.

Data Acquisition System Software - The IceCube DAQ collected 310 million events in August. The summary of events collected per day during the month of September 2006 is shown in the following figure:

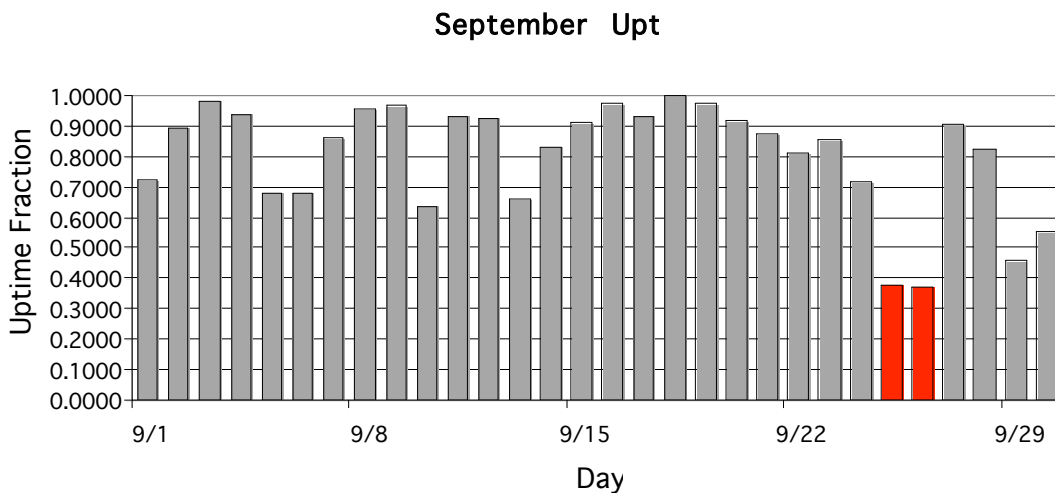


Figure 1. Graph of DAQ uptime fraction versus day in September 2006

The supernova-enabled DAQ release, code-named ‘WEASEL,’ was deployed to South Pole on 9/20 and the array has been taking high-resolution supernova data from this date. At this time the data is not proceeding through the online supernova trigger but is being recorded to tape at the rate of approximately 300 kB/sec. The online trigger, already connected to the SNEWS network monitoring the AMANDA array, will be upgraded in the coming months to continuously monitor the IceCube supernova stream and report significant noise rate increases that are the signal of a passing supernova neutrino shockwave. Currently the IceCube extensions have been developed, but it is undergoing evaluation using fragments of the pre-recorded real data now coming from South Pole.

On the northern hemisphere testing systems, development continues on increasing the fidelity of the array simulation package. The new 64-bit build system did see a full deployment of the DAQ software with 23 simulated strings providing data to the system; unfortunately this state was achieved only days before the build system needed to be torn down for shipment to South Pole and so the testing in this configuration was limited. More development and testing needs to be done on the 64-bit test system after it arrives and when constructed in October.

Data Systems - Overall progress on Data Systems remains good with no major delays or cost variances.

The South Pole Build System (SPBS) planned for installation in the new counting house (ICL) was tested at the University of Wisconsin, disassembled, and shipped to the South Pole after

system testing. The SPBS installation at the South Pole this year represents the nearly completed ICL computing infrastructure for readout, online filtering, data handling and control for the IceCube detector. This is the most significant milestone to date for the data handling system.

The equipment for the 64-bit computing South Pole Test System (SPTS-64) completed the final stages of assembly and final software installation and testing is nearly complete. The SPTS-64 will be handed to system developers sometime in mid October. The conversion to 64-bit computing was originally planned for operations but will be completed as part of construction.

Installation of computing equipment for the Northern hemisphere Tier 1 Data Center and upgraded storage capacity for the Tier 0 Data Warehouse at UW continues on schedule. Work on South Pole IT security and expected satellite transfer rates continues in cooperation with RPSC and the NSF.

Online filtering of data at the South 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 last month. Upgraded distribution and build tool for the IceTray online/offline software went through final testing. This upgraded system allows easier software builds for new operating systems and easier installation for users. The new system is a major step on the way for the development of a “single click icon” installation of offline software/event viewer binaries for non-expert users. Two experiments (Daya Bay neutrino reactor experiment and the proposed HAWC gamma-ray telescope) have contacted us about access to the IceTray framework for evaluation as an analysis framework for their experiments. We have granted both requests access to the software and documentation.

Significant progress has been made on the Joint-Event-Builder (JEB), which 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. This is major milestone in the integration of the Amanda detector into IceCube and will allow us to turn off several legacy systems on Amanda to save power at South Pole and to make optimal use of the available satellite bandwidth. This work is being done along with the Amanda integration work.

The data transmitted over satellite and ingested into the data warehouse continues to be running reliably and automatically processed by the L0 filter. Beta testing continues on an automated L1 reconstruction filter in the UW data center. The L1 filter process includes more advanced muon fitting using the LLH muon fitter and filtering out an enriched muon neutrino dataset. Work continues to integrate the offline production processing into the tool set used for distributed production of monte carlo. Significant progress has been made here in the last month and final planning for implementing the system into regular production is nearly complete.

As an example of the complete end-to-end functionality of the DOMs to the offline reconstruction, the first “un-blinding” for a physics analysis occurred last month. Regular good data taking began June 1, 2006, and we now have an atmospheric neutrino analysis based on data over the satellite in its final stages before the winter season is complete. The first thesis on IceCube is being done on this data with the expected graduation in December.

Simulation production with version 1.9.2 continues at a steady pace and is being used for physics analysis. The next production releases are versions 1.9.4 and 1.9.4a are in progress and should be released in October and November respectively. Version 1.9.4 adds better modeling of the trigger and DOMs. Version 1.9.4a adds AMANDA TWR simulation into the IceSim monte carlo and will include all the functionality for version 2.0.0. After code reviews and adding more unit test to 1.9.4a we will release version 2.0, which will be a major new release for doing physics analysis with next years integrated Icecube/Amanda detector.

Quality Assurance and Safety – Approximately 90% of non-conforming materials (NCM) issues associated with DOM production were resolved. Corrective and preventative plans have routinely been implemented to greatly reduce and/or eliminate the potential for further recurrence.

First Aid and CPR training for University of Wisconsin – Madison employees deploying to the South Pole was completed at the IceCube office on September 26th and September 29th. The First Aid segment focused on the environment at the South Pole with sections done on frostbite and altitude sickness.

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

Meetings and Events

Forecast for Start of Drilling for the 2006/2007 Season	December 5, 2006
Forecast for End of Drilling for the 2006/2007 Season	January 30, 2007
Project Advisory Panel/Science Advisory Committee	March 2007
IceCube Collaboration Meeting, Lake Geneva, Wisconsin	April 24-28, 2007
NSF Annual Review of the IceCube Project (tentative)	May 2007