

IceCube Project Monthly Report June 2006

Accomplishments

The IceCube Analysis Group held a meeting at Penn State University from June 21-25, 2006.

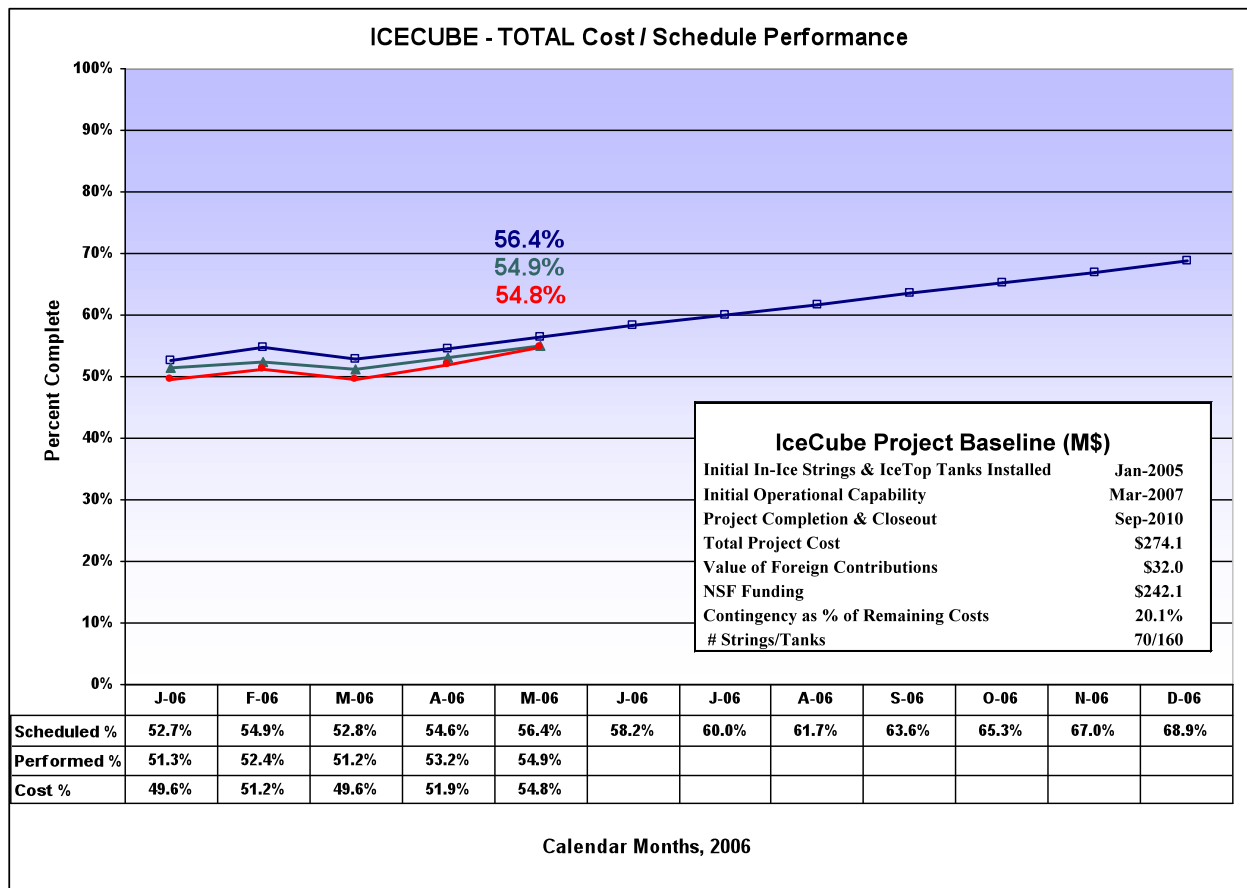
The IceCube Simulation Group met at Penn State University from June 26-29, 2006.

Driller/Deployment training will be held at the University of Wisconsin – Madison Physical Sciences Laboratory from July 24 – August 4, 2006.

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.

Northern Hemisphere UW Tier 1 Data warehouse is functioning well and ingesting IceCube 9-string data into the warehouse as it is received over the satellite at an average rate of ~6.5 GB/day.

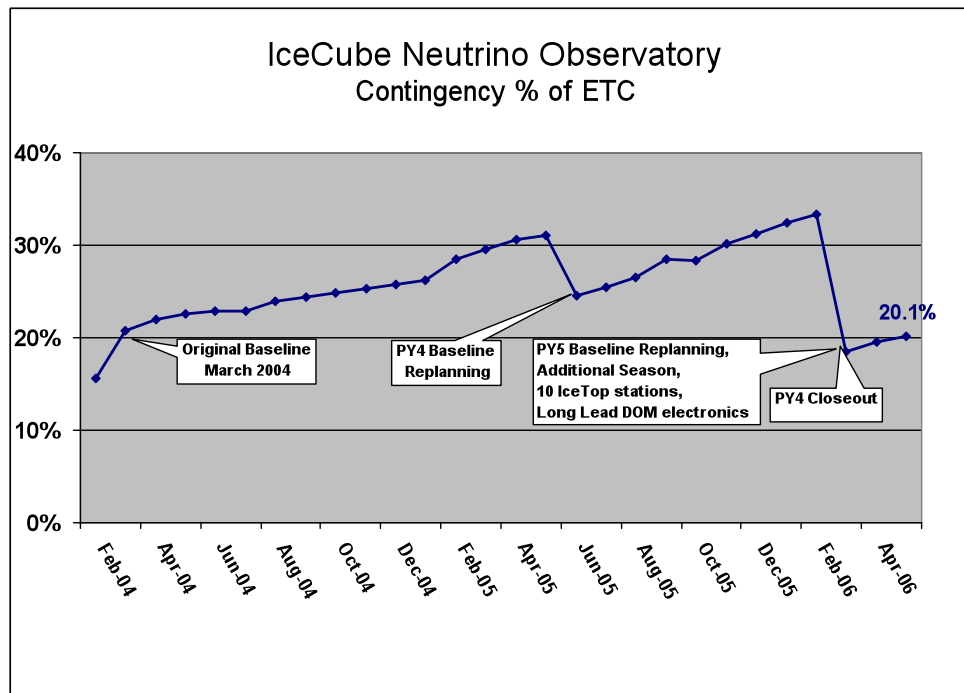
The DAQ collected 309 million events in June with an integrated livetime over the month of approximately 80%.



Cost and Schedule Performance – The project is 54.9% complete versus the planned performance of 56.4% 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: 5/31/2006 ¹														
OBS Structure L2	Cumulative To Date (AY K\$)							At Completion (AY K\$)				Complete (%)		
	Budgeted Cost ²		Actual Cost of Work Performed	Variance		Contingency		Budgeted AY \$s	Latest Revised Estimate	LRE with Pending Changes	Variance w/ Pending Changes	Sched	Perf	Actl Cost
	Work Scheduled	Work Performed		Schedule	Cost	Assigned	% ETC							
PROJECT SUPPORT	17,951.0	17,748.0	17,627.6	-203.0	120.4	1,096.3	8.2%	30,765.2	30,996.4	30,996.4	-231.2	58.3%	57.7%	57.3%
IMPLEMENTATION	21,809.5	21,635.9	21,999.1	-173.6	-363.2	7,602.9	45.7%	37,852.9	38,626.9	41,801.9	-3,949.0	57.6%	57.2%	58.1%
INSTRUMENTATION	37,920.3	37,014.4	36,679.2	-905.9	335.2	1,993.1	6.4%	68,548.8	67,746.7	67,746.7	802.1	55.3%	54.0%	53.5%
DATA ACQUISITION	22,820.8	22,625.8	22,478.9	-195.0	147.0	1,082.5	9.2%	34,498.6	34,228.0	34,228.0	270.6	66.1%	65.6%	65.2%
DATA SYSTEMS	13,619.3	13,579.1	13,572.5	-40.1	6.6	2,380.3	19.2%	25,368.9	25,992.3	25,992.3	-623.4	53.7%	53.5%	53.5%
DETECTOR COMM. & VERIFICATION	10,222.9	10,229.8	10,150.6	6.9	79.2	1,206.7	12.4%	20,045.9	19,845.3	19,845.3	200.5	51.0%	51.0%	50.6%
COLLABORATION SUBTOTAL	124,343.7	122,833.1	122,507.9	-1,510.6	325.2	15,361.8	16.2%	217,080.2	217,435.6	220,610.6	-3,530.4	57.3%	56.6%	56.4%
RPSC SUPPORT	16,595.6	14,497.7	14,649.9	-2,097.9	-152.2	7,590.7	40.2%	32,781.2	33,554.0	40,372.0	-7,590.7	50.6%	44.2%	44.7%
NSF	578.4	578.4	578.4	0.0	0.0	81.4	11.9%	1,263.0	1,263.0	1,263.0	0.0	45.8%	45.8%	45.8%
ALLOCATED SUBTOTAL	141,517.7	137,909.1	137,736.1	-3,608.6	173.0	23,033.9	20.1%	251,124.5	252,252.6	262,245.6	-11,121.1	56.4%	54.9%	54.8%
Total Contingency								22,993.2	21,865.1	11,872.1	11,121.1			
IceCube Neutrino Observatory ²	141,517.7	137,909.1	137,736.1	-3,608.6	173.0	23,033.9	20.1%	274,117.7	274,117.7	274,117.7	0.0	56.4%	54.9%	54.8%

- Notes: 1 Incorporates approved baseline changes.
 2 Total Budget at Completion includes non-US contributor 2,347 K over the amount in the post Harill III baseline of: \$29,698 K
 3 Budgeted contingency is: 20.3% of the Budgeted cost of work remaining.
 4 Budgeted contingency is: 20.1% of the Estimated Cost to Complete (ETC)
 5 Contingency is assigned to each WBS L-2 element based on the ETC, a bottom-up risk assessment model, management judgement, and cost constraints.
 6 With the following pending changes, the projected contingency @ completion will be: 9.5% of the Estimated Cost to Complete (ETC)
- | | |
|--------------------------------------|-------------|
| RPSC Baseline Revision | \$3,590,728 |
| Fuel Price Increase | \$3,500,000 |
| PY5 Drill Enhancements increase | \$1,000,000 |
| Increased Drilling staff for Pys 6-8 | \$2,175,000 |



The latest revised estimates were modified to reflect the anticipated changes resulting from the Raytheon Polar Services baseline revision, fuel price increases and Implementation budget increases. The cumulative schedule variance at the end of May is negative \$3.6 million. \$2 million is due to the delay in Raytheon Polar Services completing the IceCube Laboratory. \$1 million is from the lagging receipts in Instrumentation and Implementation. DAQ software development remains slightly behind schedule.

A risk assessment and contingency assignment is presented at a summary level in the following table:

Contingency Assignment Summary						
WBS Activity	Assigned Contingency Percentage	Estimate to Complete (ETC)	Model Contingency Assessment (\$)	Assigned Contingency Amount (\$)	Management Contingency Assessment (\$)	Contingency Adjusted ETC (\$)
Project Support	8.2%	\$13,368,827	\$1,113,838	\$1,096,338	\$1,113,838	\$14,465,165
Implementation	45.7%	\$16,627,785	\$3,619,881	\$7,602,881	\$10,211,194	\$24,230,667
Instrumentation	6.5%	\$30,656,019	\$2,409,658	\$1,993,087	\$2,009,658	\$32,649,106
Data Acquisition	8.9%	\$12,160,535	\$1,182,513	\$1,082,513	\$1,082,513	\$13,243,048
Data Systems	18.8%	\$12,419,814	\$2,339,623	\$2,339,623	\$2,339,623	\$14,759,437
Commissioning & Verification	12.4%	\$9,694,719	\$1,206,659	\$1,206,659	\$1,206,659	\$10,901,378
Polar Support Services	40.2%	\$18,904,105	\$3,789,498	\$7,590,730	\$9,500,979	\$26,494,835
National Science Foundation	11.9%	\$684,669	\$41,080	\$81,407	\$160,000	\$766,076
IceCube Total	20.1%	\$114,516,473	\$15,702,749	\$22,993,238	\$27,624,464	\$137,509,711
Current Contingency Budget:				\$22,993,238		

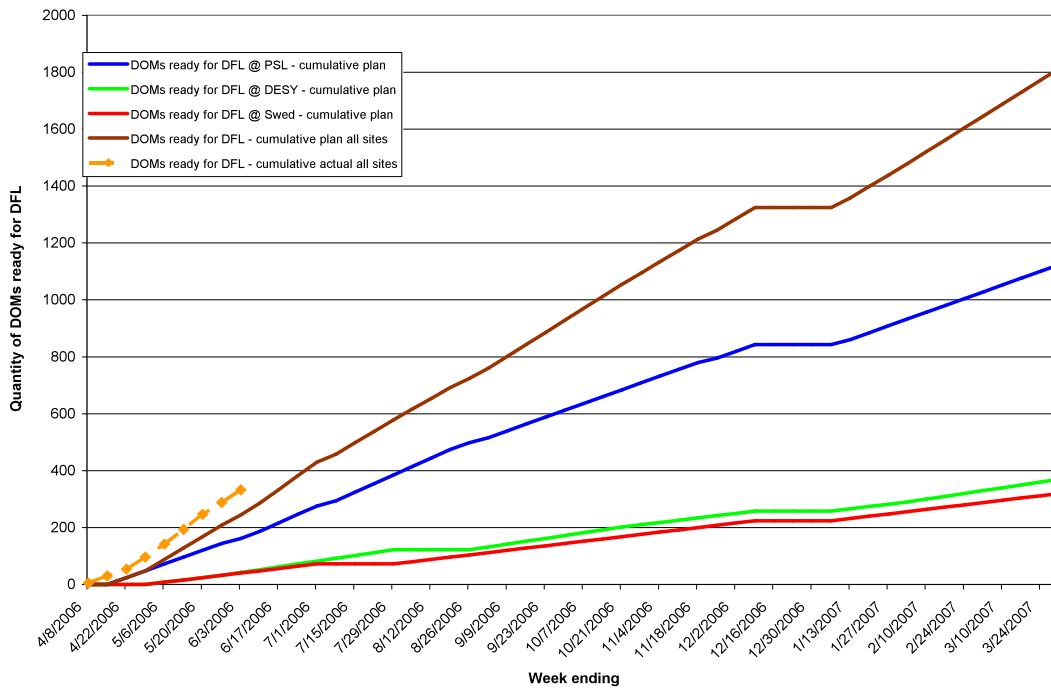
Drill Operation and String Installation – An off-ice (summer) schedule has been completed and is being used to track and status tasks. The on-ice Integrated Master Schedule is underway and being worked on this week with Raytheon Polar Services in Madison. The construction of the Training/Test Bed Simulator is underway at the University of Wisconsin Physical Sciences Laboratory. The tower and concrete pad orders have been placed and component sheds have been completed. The simulator will be used for drilling and deploying activity training as well as Enhanced Hot Water Drill components for this year and consequent years. Tank and drill designs for the Independent Firm Drill are underway. Sled and platform materials are currently on order. The electrical and mechanical designs of the Firm Drill are in its final stages. A design has been completed and mock tests performed on a segmented water tank liner. This is the chosen solution for repairing the 10,000 gallon water tanks. The Y-drill is being under going pressure tests. The testing of the Y-drill should be completed in the next week. Replacement hardware parts have been ordered for the South Pole and for the test-bed. Requirements for UI changes are being gathered. Several members of the Implementation Team attended a two day DuPont safety course. Planning for the Driller/Deployment training in late July, early August is near completion.

Logistics – IceCube is currently working on improving the tracking and inventory of items at the South Pole. An inventory software program has been selected and will be acquired by the end of the July. A detailed inventory process is being devised and will be implemented sometime in August.

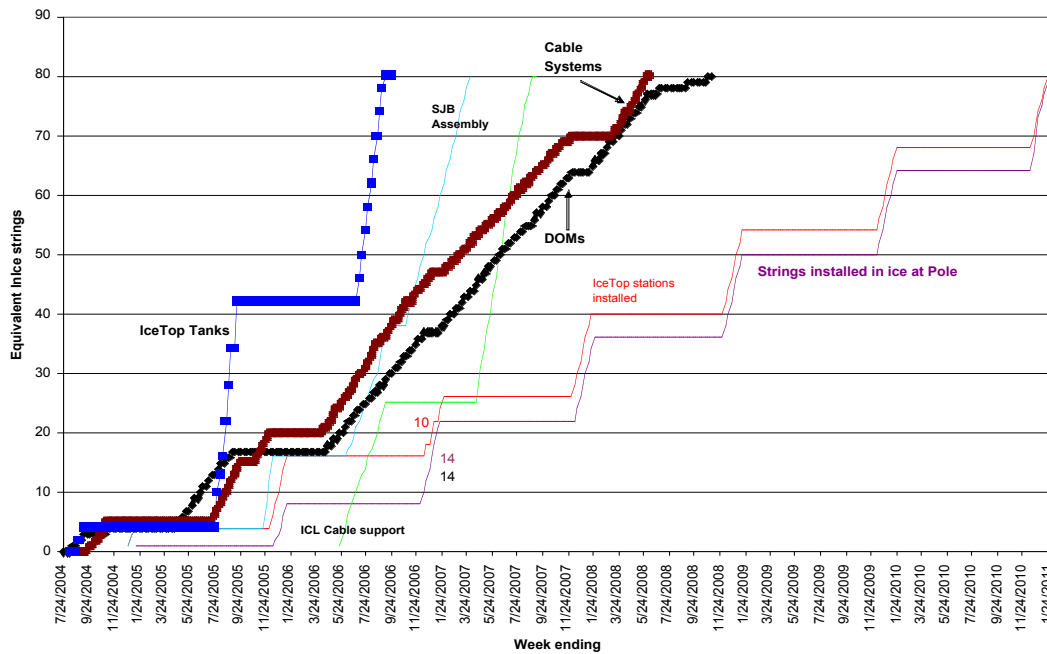
Currently there are 83 people that are on the Physical Qualification (PQ) roster for the Pole. Five more people will be added to the PQ roster in the coming week. Approximately 13 standard shipping crates have been built and are ready for packing drill cargo at University of Wisconsin Physical Sciences Laboratory. The drill crates should be ready to ship on August 21, 2006. The DAQ equipment crate design has been approved and one crate has been built and is ready for packing.

Digital Optical Module and Cable Production Status and Plans - The plan for DOM production for 2006 is provided in the chart below along with the plan for DOM, cable, and tank production plan for 2004 – 2008. 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.

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



Instrumentation Production CY2004 - CY2008 for 80 strings installed



DOM Testing at UW-Madison – Two of the three modular dark freezer laboratories (MDFL) have run four Final Acceptance Testing (FAT) cycles and a fifth FAT cycle is currently under way. FAT cycles have been running. The third MDFL is under going commissioning and should be running by the end of July. Until recently, all DOM production in the U.S. was carried out using a single dark freezer laboratory. IceCube is in need of expanded DOM testing capability due to the large number of DOMs that will be needed in the next and subsequent seasons.

A total of 230 DOMs have been tested in four FAT cycles. Of the 230 DOMs tested, 29 had minor failures. These DOMs will be evaluated and retested at a later date. Since there have been no major failures most of the DOMs should pass upon retesting.

Detector Commissioning and Verification – The verification group continues to collect data from Pole and has set up a complete system for analyzing the data on the computers at the pole, and then shipping only summary information to the north. This enables us to work with extremely large datasets that are too large to fit over the satellite bandwidth. Without this system, we would otherwise have to wait until November 2007 to look at this data. Verification data taking is expected to be completed next month.

The calibration effort has begun Stage 3 geometry calibration using downward-going muons. The first gain calibration has been partially completed and compares favorably to the existing laboratory measurements. Further measurements of the optical properties of the bulk ice are being collected at Pole and analyzed in the North, to determine the details of photon propagation for use in simulation and reconstruction software.

The monitoring system is being used regularly by collaborators. An automated procedure for creating monitoring plots of high level quantities, such as the downward-going muon angular distribution, was successfully installed and is in use. Initially these plots are loosely coupled to the existing monitoring page, with further integration planned over the next few months. The results from this monitoring will also be used to generate a list of good runs for use in physics analysis.

Analysis of the AMANDA TWR data using the IceCube software is underway at several institutions. A software solution has been found for a timing glitch caused by triggers arriving too close to system clock ticks, the last of the low-level issues identified during detailed study of the 2005 data set. There has been significant progress on identification and cleaning of cross talk and other electronic artifacts in the TWR data. Filtering of the 2005 data set is in preparation, with processing for production of several physics streams (muons, cascades, GRBs, etc.) scheduled to begin in August. Verification of the AMANDA-IceCube timing synchronization system has shown that the system works properly, allowing data from the two systems to be aligned within a few nanoseconds (the intrinsic resolution of the two systems). An IceSim-based TWR simulation is ready, and will be integrated with recent developments on the main IceSim development branch. The design details of the online data merging system are being finalized, in preparation for implementation and pre-deployment testing in the next few months.

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.

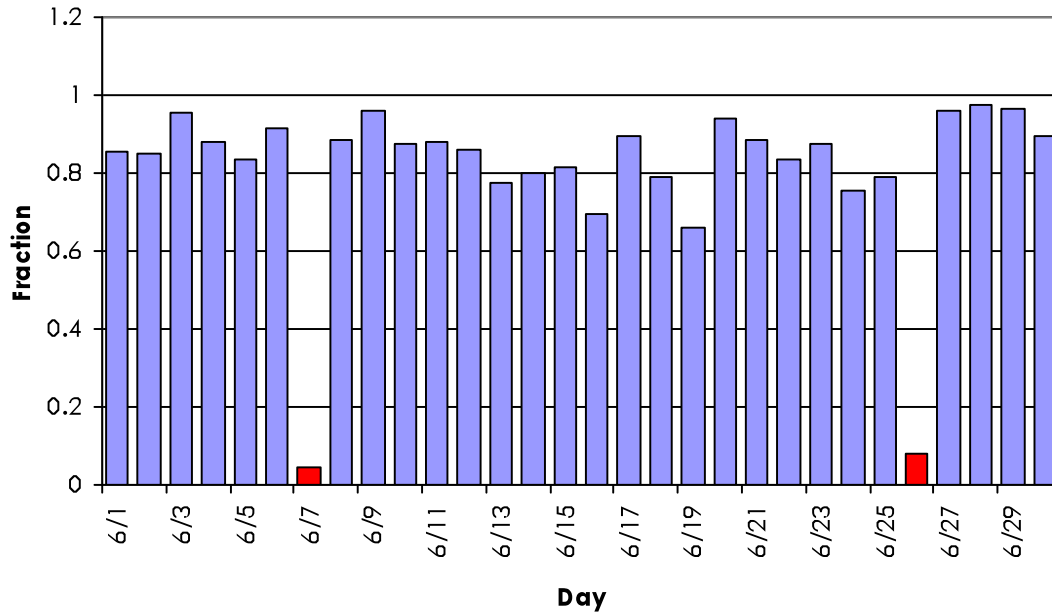
DOM Main Board production continues to progress smoothly. To date, Sanmina-SCI, the Mainboard manufacturer, has delivered 1186 of the DOM Main Board subassemblies to LBNL for final board level testing. 1113 of the DOM Main Board assemblies have been delivered to DOM assembly sites in Wisconsin, Germany, 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 1st.

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 in the last stages of fabrication. The completion of PC Board loading has been delayed due to a delivery of bad blank PC Boards. The plating on the boards was contaminated and the components did not adhere properly. The result of the bad batch of PC boards is a delay to the delivery schedule of 3 weeks. The distribution cables have been delivered and will be tested for phase match. The length of some of the cables may require adjustment to meet the critical timing specification. The final tested production units and cables required for the full distribution system will be delivered by the end of July.

The complete quantity of DOMHub computers was delivered to LBNL in June. LBNL shipped 10 complete DOMHubs by the end of June and all remaining DOMHub units will be shipped by July 14th.

Data Acquisition System Software - The DAQ collected 309 million events in June with an integrated livetime over the month of approximately 80% including scheduled interruptions for software upgrades, detector calibrations, and verification data taking. The graph of uptime versus day in June is plotted in the following figure:

IceCube DAQ Uptime Fraction - June 2006



The red bars indicate that the detector had been taken out of normal operating mode for that day to perform maintenance or verification activities.

The last release of the BADGER branch of DAQ software, tagged as ‘BADGER-12’ was deployed to South Pole on June 6th and has not yet been replaced. It is planned that IceCube will run with this software base for approximately 1 more month as the next release of the software, code-named ‘WEASEL’ undergoes tests on the northern hemisphere testing system. ‘WEASEL’ adds the important feature of the supernova monitoring system readout. Currently the DAQ does not support fully a high-resolution readout in the event of a galactic supernova. Concurrent to this release, the DAQ development team has decided to move forward with plans to upgrade the DAQ to the ‘A+’ architecture.

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

Work is continuing on the South Pole Build System (SPBS) at UW for planned shipment to Pole in October. The SPBS is the computing system to be installed at the IceCube Counting House (ICL) this season at pole, and consists of approximately 17 racks with associated computer systems, networking infrastructure, cabling and power distribution. The build, shipment and installation of the SPBS this season in the ICL is a major project milestone. We remain on schedule with the SPBS. Major equipment purchases for the South Pole system have been

placed. The first DOM Hubs have arrived at UW from LBNL and the system continues to be assembled as equipment arrives.

Installation of computing equipment for the Northern hemisphere Tier 1 Data Center at UW continues. Northern Hemisphere UW Tier 1 Data warehouse is functioning well and ingesting IceCube 9-string data into the warehouse as it is received over the satellite at an average rate of ~6.5 GB/day.

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 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. Also, in the last month a EHE event filter has been added to the L1 process to strip out the highest energy events for the EHE physics working group.

The first large-scale production runs of IceSim Monte Carlo have begun in earnest at UW using IceSim V01-09-02. Comparisons of data and IceSim monte carlo progressing well with the predicted trigger rate within about 10% of the actual trigger rate. ewere run in large numbers for downgoing muons. Distributed production of monte carlo using IceSim V01-09-02 has begun at several institutions.

Progress in experiment control continues with improvements in configuration infrastructure and detector monitoring web pages. We have set on a date in late august to have a workshop for defining final deliverables from Experiment Control.

Quality Assurance & Safety – Approximately 435 non-conforming material (NCM) reports have been written regarding failures or issues with verification of DOM's, test equipment, DOM components and production articles. Approximately 90% of the NCMs have been closed. The NCM process is being worked on to help speed up the analyses, which should increase the closure rate over coming months. Corrective and preventative plans are routinely implemented to greatly reduce and/or eliminate the potential for recurrence of these problems.

A Hazard Analysis for the IceCube Laboratory is scheduled to be done later this summer as soon as the preliminary design documents are completed. 87% of the Hazard Analyses have been reviewed and revised based upon the design/process changes and from input from the recent South Pole Season. The remainder will be completed in the next week in preparation of Driller/Deployment Training at the end of the month.

Line supervisory safety training was completed for Deputy Shift leads, as well as a few others, as part of the new Safety Team at the South Pole. The training commenced on June 29 and was completed on June 30, 2006. In an effort to shift the safety responsibility from one person to the responsibility of everyone, the team underwent a series of behavior based safety training sessions that emphasized team-building. The course was tailored towards safety on a construction site at the South Pole. Currently, a safety program is being designed for the Driller/Deployment Training.

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

Meetings and Events

Drilling and Deployment Training – Madison	July 24-August 4, 2006
NSF Review of IceCube Operations Plans – Madison	August 1-2, 2006
International Oversight and Finance Group Meeting - DESY	September 11, 2006
Season Confirmation Meeting – RPSC	September 12, 2006
Safety Table-Top Meeting – RPSC	September 13, 2006
IceCube Collaboration Meeting – DESY	October 6-10, 2006