

IceCube Project Monthly Report August 2006

Accomplishments

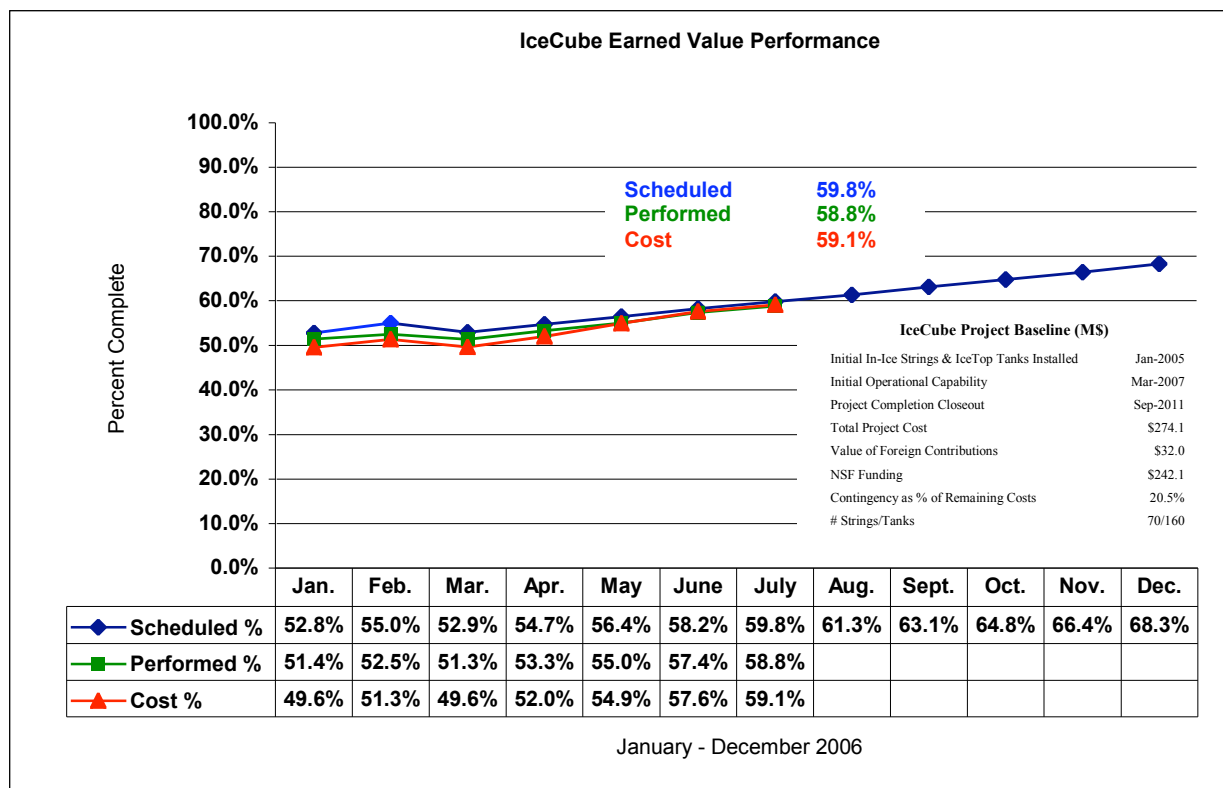
The IceCube International Oversight and Finance Group (IOFG) met on September 11, 2006 at the DESY-Zeuthen laboratory to discuss financing of IceCube operations beginning in 2007.

Shipments of equipment to the South Pole commenced with over 35,000 lb shipped so far.

A plan was prepared for using string 48 to get a better understanding of the ice properties. This string will be located in the center of the AMANDA array.

A cumulative total of over 450 DOMs completed final acceptance testing with no significant failures.

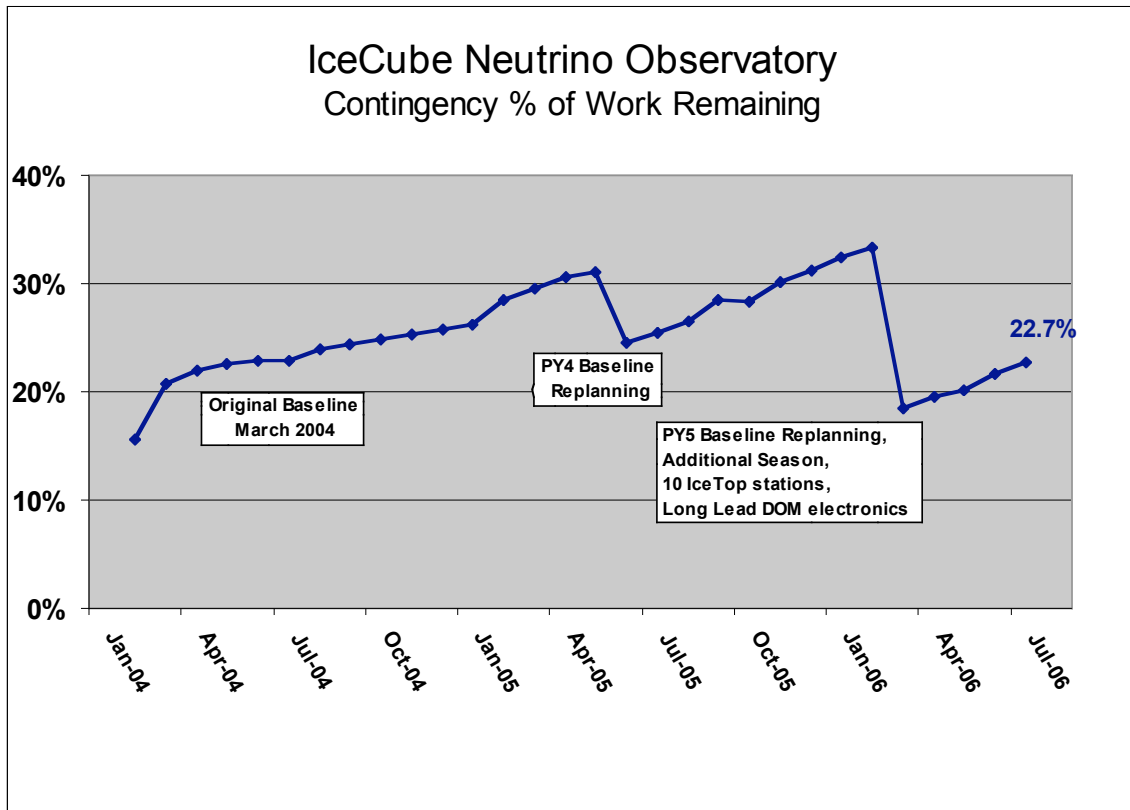
Completed a detailed schedule for installing 12-14 strings in December and January.



Cost and Schedule Performance – The project is 58.8% complete versus the planned performance of 59.8% 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: 7/31/2006 ^{Note 1}													
OBS Structure L2	Cumulative To Date (AY K\$)							At Completion (AY K\$) ^{Notes}			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	18,495.7	18,365.9	18,285.0	-129.8	80.9	984.6	8.3%	30,474.2	30,147.4	326.7	60.7%	60.3%	60.0%
IMPLEMENTATION	22,280.8	22,432.3	23,257.9	151.6	-825.5	9,214.7	44.5%	37,852.9	43,979.9	-6,127.0	58.9%	59.3%	61.4%
INSTRUMENTATION	40,982.2	40,136.2	39,913.3	-846.0	222.9	1,806.0	6.5%	68,542.2	67,893.6	648.6	59.8%	58.6%	58.2%
DATA ACQUISITION	24,748.5	24,721.7	24,776.7	-26.8	-55.0	981.3	10.6%	34,498.6	33,998.9	499.7	71.7%	71.7%	71.8%
DATA SYSTEMS	14,780.8	14,674.0	14,973.1	-106.8	-299.1	2,148.3	20.7%	25,368.9	25,368.9	0.0	58.3%	57.8%	59.0%
DETECTOR COMM. & VERIFICATION	11,174.2	11,217.3	11,208.2	43.1	9.1	1,116.7	12.8%	19,933.7	19,933.7	0.0	56.1%	56.3%	56.2%
COLLABORATION SUBTOTAL	132,462.2	131,547.5	132,414.2	-914.7	-866.8	16,251.5	18.3%	216,670.4	221,322.3	-4,651.9	61.1%	60.7%	61.1%
RPSC SUPPORT	16,751.3	15,332.8	15,271.6	-1,418.5	61.3	7,099.4	30.9%	32,781.2	38,215.1	-5,433.9	51.1%	46.8%	46.6%
NSF	600.5	600.5	600.5	0.0	0.0	52.1	7.9%	1,263.0	1,263.0	0.0	47.5%	47.5%	47.5%
ALLOCATED SUBTOTAL	149,814.0	147,480.8	148,286.4	-2,333.2	-805.5	23,403.0	20.8%	250,714.7	260,800.5	-10,085.8	59.8%	58.8%	59.1%
TOTAL CONTINGENCY ^{Notes 3,4}								23,403.0	13,317.3	10,085.8			
IceCube Neutrino Observatory ^{Note 2}	149,814.0	147,480.8	148,286.4	-2,333.2	-805.5	23,403.0	20.8%	274,117.7	274,117.7	0.0	59.8%	58.8%	59.1%

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: 22.7% of the Budgeted cost of work remaining.
4 Budgeted contingency is: 20.8% 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	Approved	Total Baseline	Allocated Budget	Change	Contingency Budget	Estimate to Complete (ETC)	Contingency /ETC
0064	Reduced Engineering Budget	07/12/06	274,118	250,715	-291	23,403	107,887	21.7%
Jul-06	July 2006		274,118	250,715	0	23,403	103,234	22.7%

The cost variance for all activities, excluding RPSC and NSF, at the end of June was -\$867K and was dominated by a variance of -\$826 thousand in Implementation. This variance reflects moving ahead with approved procurement/engineering activities to enhance the reliability of the hot water drill prior to processing of the formal baseline change proposal (BCP). This BCP was approved in early September, adding \$1.670 million to the PY5 budget for implementation. As a result, this cost variance will be significantly lower next month.

There was one baseline change since the last report as noted in the table above and the budget for work remaining has been reduced by \$4.65M reflecting the value of work performed in July. Contingency/Work Remaining now stands at 22.7%.

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 in 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 and labor for the current project year.	- \$1,670	Includes independent firm drill, tower crescent improvements, PSL test facilities, etc.
Potential for additional seasonal drillers to support 24x7 drilling	- \$4,456	Increase the number of seasonal drillers from 6 to 18 for project years 6-8
Scope and cost estimate increases within the RPSC budget category	- \$5,434	RPSC re-baseline variance: \$3,259K; ICL Fire suppress: \$75K, fuel price increase: \$2,100K
Fuel prices increase beyond current baseline estimates	- \$768	Potential for additional increases beyond those included in the IceCube out-year fuel budget.
Potential draws on construction contingency to cover staff that were planned to transition to operations activities	???	Operations funding is likely to be less than required.
Reduce commitment to long lead items from the current plan that keeps the option open for 80 strings to 70+ strings	+ \$1,150	This potential change will increase the contingency budget.
Potential Project Office staffing reduction	+ \$213	Staffing ramp down in systems engineering and other project support.
Potential savings from the elimination of the final drilling/installation season in 2010/11	+ \$8,040	This cost avoidance excludes potential hardware savings.

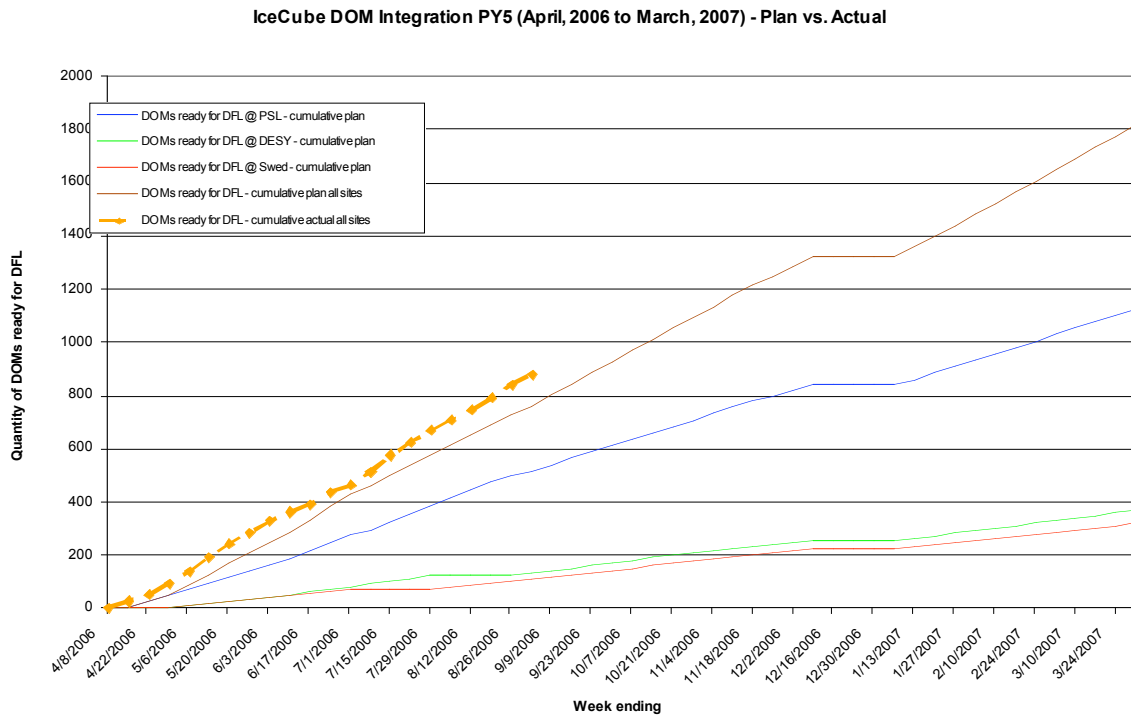
Drill Operation and String Installation _ Construction of the training and test bed simulator is essentially complete. The few remaining components are on hold in deference to preparing shipments of drill cargo. Portions of the test bed are continuing to be used to test HPP motors, pumps, deployment equipment, hose, etc. A concrete pad for the test tower was poured and a

safety fence erected and tower fabrication is underway. The simulator will be used for drilling/deployment activity training as well as testing EHWD components throughout the remainder of the project. Procurement of the Independent Firm Drill is nearing completion. The drill head aluminum parts are fabricated and the copper windings are complete. The sled is constructed and ready. Parts were ordered for the supply tank and the reel stand and spool is mostly complete. Fabrication of the new water tank liner sections is complete and welding and installation methods are being tested prior to packaging and shipping in mid September. A welder has been contracted to deploy to the South Pole to perform and oversee the relining project. A project to incorporate generator monitoring with EHWD software is underway.

The annual RPSC/UW Planning Wrap-Up meeting was concluded in Denver on September 12 – 13. A detailed support and schedule review was performed, with no major conflicts discovered. A joint tabletop emergency response drill/simulation was also part of this meeting.

Logistics – Two shipments to the South Pole were made on August 21 and September 6. Another shipment will be made in the coming days. A total of 35,000 lbs of cargo, consisting of the drill equipment was shipped on schedule.

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 nine Final Acceptance Testing (FAT) cycles are complete. Seven of the nine cycles were completed at the University of Wisconsin Physical Sciences Laboratory

(PSL) and two were completed at DESY-Zeuthen. Currently, two FAT cycles are in progress, one at PSL and one at DESY.

A total of 458 DOMs were tested in the nine FAT cycles. Of the 458 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 – A meeting held at Berkeley at the end of August was very fruitful. The discussion centered on incorporating verification results into the monitoring system in an automatic way, and on establishing basic criteria for deciding which runs are “good” for data analysis. We anticipate fully incorporating the verification results into the monitoring system by September, and producing a proposal for establishing a good run list on the same time scale.

We continue to collect some data from Pole for calibration purposes. Most recently, we requested and obtained modifications to the scripts that run TestDAQ so that finer control of the DOM flasher board LEDs would be possible. This will be used for studies of the ice properties with the new strings.

Stage 3 geometry calibration using downward-going muons now has a new graduate student from Sweden working on the task.

The first gain calibration was completed. The LBNL postdoc who did this work has transferred his knowledge and the task will continue to be the responsibility of LBNL.

Detailed plans have been drafted for using string 48 this coming season to get a more complete understanding of the hole ice and will be circulated to the appropriate parties in September.

In early September the DAQ system will be used to test whether AMANDA/TWR triggers can be fed to the IceCube Global Trigger and that the whole system can operate reliably. Success in this test is vital if we want to acquire data this year that allows us to analyze AMANDA events with the surrounding IceCube strings as a veto. We will certainly be able to do this in 2007.

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 Main Board manufacturer, has delivered 1300 of 1300 DOM Main Board subassemblies to LBNL for final board level testing. To date, 1278 DOM Main Board assemblies were delivered to DOM assembly sites in Wisconsin, Germany, and Sweden. The materials contract for the build of the remaining DOM Main Boards is in place, and parts procurement is scheduled to be complete by October.

Delivery of all components of 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, to support the In-Ice detector strings and the IceTop detector is complete.

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

Data Acquisition System Software - The IceCube DAQ collected 294 million events in August. The summary of events collected versus day of the month is shown in the following figure. The low uptime during the first two weeks of the month was traced to DAQ stalls caused by an interaction of the DAQ software with a system auditing process – both contending for limited CPU, memory, and network bandwidth resources. The audits were ceased on 8/17 with a corresponding increase in uptime.

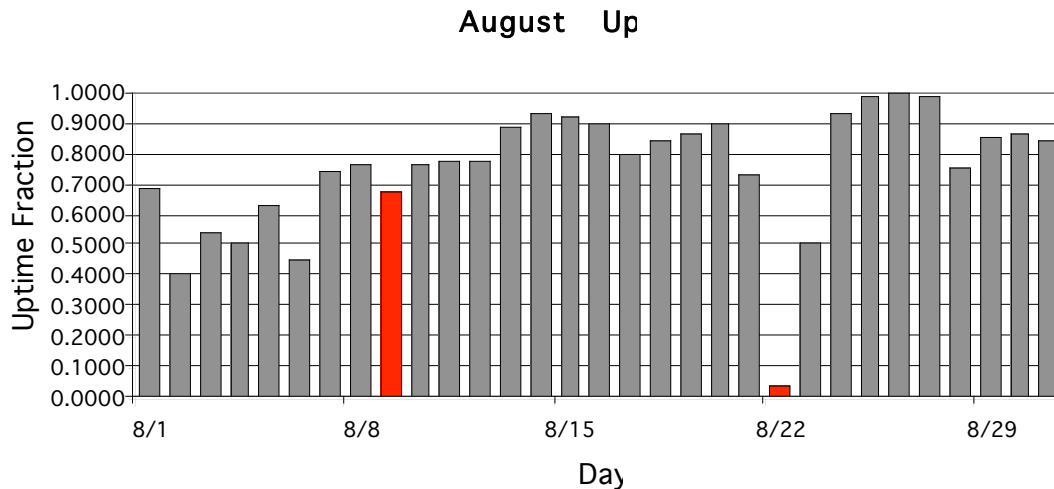


Figure 1. Graph of DAQ uptime versus day in August 2006. The red bars indicate maintenance and/or calibration activity.

The next software release – code-named ‘WEASEL’ – was deployed and run on the South Pole System (SPS) on 8/29 and 8/30 as part of the DAQ S/W final qualification procedure. The tests of 8/29 without the downstream software successfully completed. However, when the downstream data consumers were enabled on 8/30, the DAQ failed to complete the qualification due to application stalls. The software was rewound to BADGER version 12-01 and more tests of WEASEL with simulated strings on the South Pole Test System were scheduled in order to attempt to understand the resource contention problem. The simulation functionality has increased – currently the load presented by 8 strings are being simulated at SPTS.

The South Pole Build System (SPBS) was made available to DAQ development during August. This system comprises the 32 new DOMHub computers delivered in July and more than a dozen 64-bit server-class computers which will host the DAQ trigger processes during the upcoming season. The DAQ software was ported and tested on the new server architecture. This will continue throughout September until the system is broken down for shipment to South Pole.

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

Work is continuing on the South Pole Build System (SPBS) at UW for planned shipment to Pole next month. The schedule for the SPBS is on track with the planned breakdown for packaging and shipment to start next week. The equipment for the 64 bit computing South Pole Test System (SPTS-64) has arrived at UW and assembly is finished and final software installation and testing is in the final stages. The plan called for SPTS-64 to be operational before the breakdown of SPBS and this schedule will be met.

Installation of computing equipment for the Northern hemisphere Tier 1 Data Center at UW continues. Completed installation and commissioning of 2 racks with 64 HP processing boxes each with two dual-core AMD 64-bit processors. Tier 0 Data Warehouse has been upgraded with additional disk storage.

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 running on the 6th supported platform (MAC OS X on Intel processors). In final stage of development for “single click icon” installation of offline software/event viewer on Mac OS X.

The data transmitted over satellite and ingested into the data warehouse continues to be 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. Work continues to integrate the offline production processing into the tool set used for distributed production of monte carlo.

Production of Monte Carlo going well with large data sets of cosmic ray muons (background) and neutrinos being used for atmospheric neutrino analysis. In addition, data sets of coincident double-muon background events have been produced.

As a high-level demonstration and test of end-to-end functionality and status of monte carlo, online filtering and detector performance the Atmospheric muon neutrino analysis makes a good example. Regular filtering and data taking with the nine-string detector (IC9) began on June 1, 2006 (Only 3 months after deployment). After examining data and monet carlo for 1 month of data we are now preparing to “un-blind” all the data for atmospheric neutrino analysis, which we plan to publish this winter as a demonstration of the detector performance. This quick turn-around from first deployment to filtering data for satellite transmission to physics results with monte carlo comparison is the most impressive demonstration of the overall status of the detector I could imagine at this early stage in the project, and real demonstration that we are now entering a phase of true operations.

Progress in experiment control continues with improvements in configuration infrastructure and detector monitoring web pages. The workshop for defining final deliverables from DAQ and Experiment Control is scheduled for Sept 25-26 at UW-Madison.

Quality Assurance and Safety – A safety design review was completed for the welding tasks planned for the next season. The new water tank liners will be welded within a confined space requiring a permit. The process and hazards analysis were completed by UW and submitted to RPSC for concurrence. RPSC determined that IceCube should issue its own permits for the welding and confined space entry. IceCube, along with RPSC are working together to make this process happen safely and correctly.

Approximately 90% of NCMs reported are resolved. Documentation for the IceCube Laboratory was completed including the Cable Installation Procedure, Evacuation and Muster Procedure, and Hazards Analysis.

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

Meetings and Events

Safety Table-Top Meeting – RPSC	September 22-23, 2006
IceCube Collaboration Meeting – DESY	October 6-10, 2006
DAQ & Experiment Control Deliverables Meeting – UW	September 25-26, 2006
UW-Internal South Pole Readiness Review	September 27, 2006