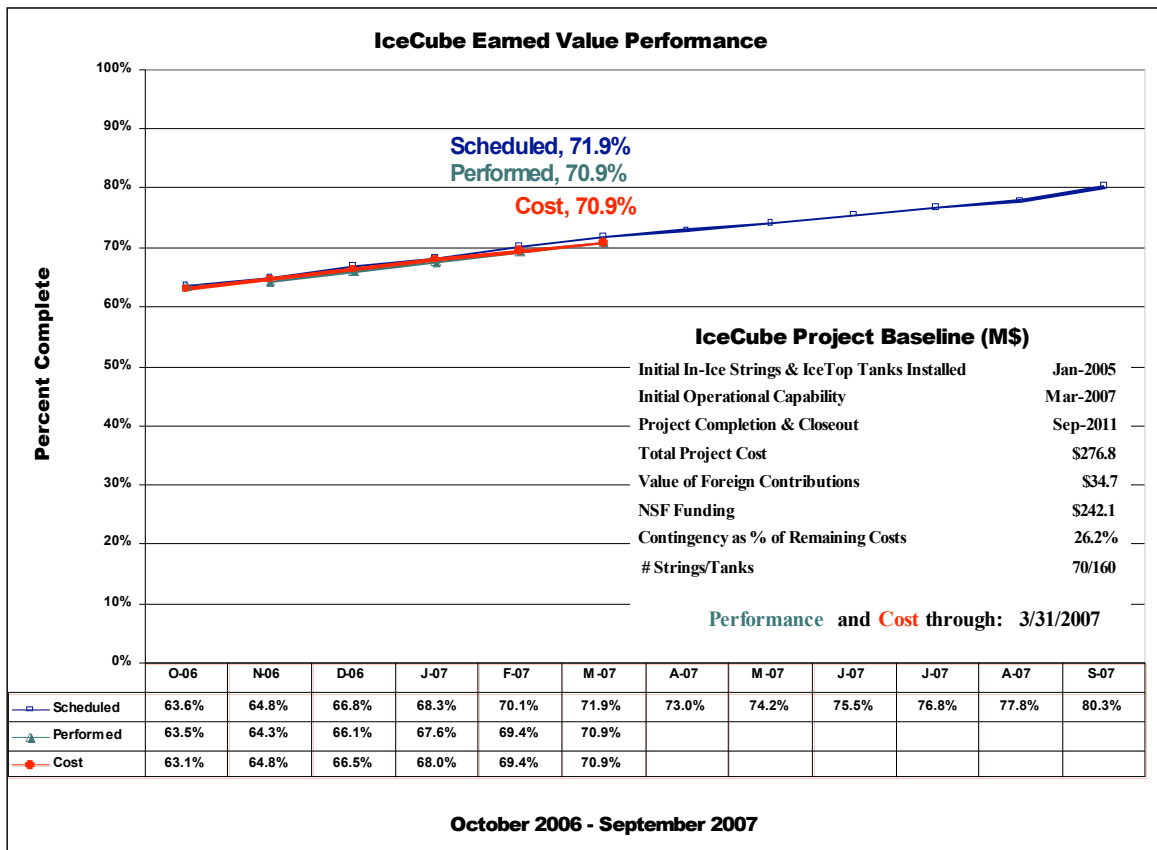


IceCube Project Monthly Report April 2007

Accomplishments

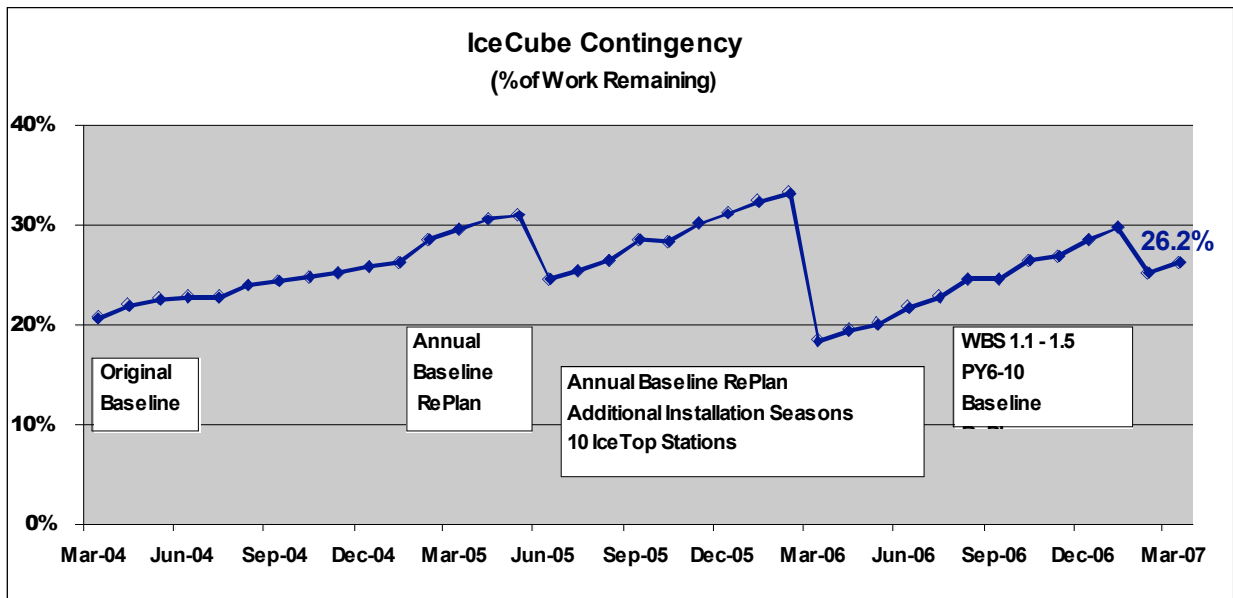
- The annual detailed planning meeting between Raytheon and IceCube was held in early April.
- A review of the drill hose was held in mid-April to evaluate hose failures, root causes, test plans, design, and procurement strategies.
- The Drill Advisory Committee met in Madison, Wisconsin on April 18 to review the 06/07 drill season, off-ice activities, and 07/08 plans. Particular attention was devoted to hose failures, software modifications, and staffing plans. Recommendations and findings by the committee will be made in a final report to the project office in mid-May.
- During the month of April 269 DOMs were produced with all sites contributing to this total.
- The AMANDA array was integrated into the production Data Acquisition System.
- The Spring 2007 IceCube Collaboration Meeting was held in Lake Geneva, Wisconsin, April 24 through April 28.



Cost and Schedule Performance – The project is 70.9% complete versus the plan of 71.9% 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: 3/31/2007 ^{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
	Scheduled	Performed		Schedule	Cost	Assigned	% ETC						
Project Support	20,932.5	20,874.7	20,313.3	-57.8	561.4	367.4	5.3%	28,743.4	27,253.6	1,489.8	72.8%	72.6%	70.7%
Implementation	27,326.6	27,326.6	28,596.8	0.0	-1,270.2	3,649.7	19.9%	42,965.0	46,920.8	-3,955.8	63.6%	63.6%	66.6%
Instrumentation	55,040.6	53,755.5	52,391.7	-1,285.1	1,363.8	1,128.1	6.3%	70,162.7	70,162.7	0.0	78.4%	76.6%	74.7%
Data Acquisition	29,286.7	29,205.9	29,109.8	-80.8	96.1	270.3	7.0%	33,181.7	32,945.0	236.8	88.3%	88.0%	87.7%
Data Systems	19,297.7	18,610.2	19,799.7	-687.5	-1,189.5	315.6	4.2%	25,835.6	27,335.6	-1,500.0	74.7%	72.0%	76.6%
Detector Comm. & Verification	14,966.5	14,740.1	14,771.6	-226.4	-31.5	675.7	9.1%	22,228.4	22,228.4	0.0	67.3%	66.3%	66.5%
Subtotal	166,850.7	164,513.1	164,982.9	-2,337.6	-469.9	6,406.7	10.4%	223,116.9	226,846.2	-3,729.3	74.8%	73.7%	73.9%
RPSC SUPPORT	17,258.4	17,193.3	16,556.4	-65.1	636.8	1,630.1	8.7%	32,817.5	35,339.9	-2,522.4	52.6%	52.4%	50.5%
NSF	689.3	689.3	689.3	0.0	0.0	34.4	6.0%	1,263.0	1,263.0	0.0	54.6%	54.6%	54.6%
Total	184,798.4	182,395.7	182,228.7	-2,402.7	167.0	8,071.2	9.9%	257,197.4	263,449.1	-6,251.7	71.9%	70.9%	70.9%
CONTINGENCY ^{Notes 3,4}								19,603.2	13,351.5	6,251.7			
IceCube Total ^{Note 2}	184,798.4	182,395.7	182,228.7	-2,402.7	167.0	8,071.2	9.9%	276,800.6	276,800.6	0.0	71.9%	70.9%	70.9%

Notes: 1 Incorporates approved baseline changes.
2 Total Budget at Completion includes non-US contributions 5,030 K over the amount in the post Hartill III baseline of: \$29,698 K
3 Budgeted contingency is: 26.2% of the Budgeted cost of work remaining.
4 Budgeted contingency is: 24.2% of the Estimated Cost to Complete (ETC)
5 All latest revised estimates reflect March 2007 risk assessment. RPSC/LRE also reflects projected rebaseline from PY6-10 detailed planning.
6 Contingency is assigned to each L-2 element based on the ETC, a bottom-up risk assessment model, management judgement, and cost constraints.



3/31/2007

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

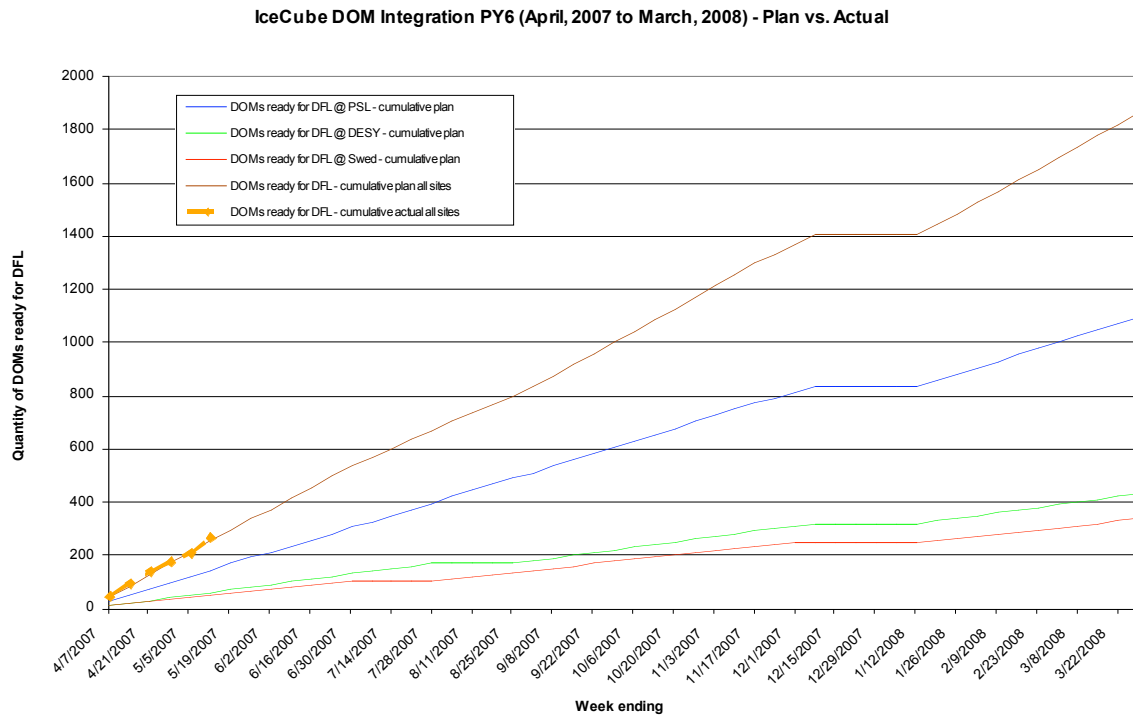
No.	Description	Date Approved	Total Baseline	Allocated Budget	Allocated Budget Change	Contingency Budget	Estimate To Complete (ETC)	Budgeted Cost of Work Remaining	Contingency % of Remaining Work
NA	Status as of Feb 2007		277,100	257,188		19,912	84,073	78,671	25.3%
CR89	CR 0089 Move PY6 effort in Simulation from UW to SUBR	03/22/07	277,100	257,179	-9	19,921			
CR93	CR 0093 Moving HV budget from Non-US to US	03/28/07	276,801	257,197	18	19,603	80,023	74,802	26.2%

Risk Assessment & Potential Contingency Adjustments		
Item	Potential Contingency Adjustments	Notes
Assign contingency to mitigate technical, cost and schedule risks associated with the defined scope of work.	\$8,071K	Risk model applied at WBS-Level 4 to assess appropriate contingency as a percent of the cost of work remaining.
Potential unbudgeted cost at end of project to retro IceCube equipment/materials from South Pole	\$1,500K	This number represents a worst case scenario.
Estimated 1.6 Baseline Change from PY6 -10 Planning.	\$2,522K	Increase work scope and higher fuel prices will increase the RPSC out - year budget baseline.
Additional Pre -operations activities including engineering runs and data verification efforts.	\$1,179K	Assign 100 % of \$1179K to mitigate the risk that initial M&O funding will be less and/or later than planned over first three years.
Restore 80 -string configuration	\$5,578K	Assign 100 % of \$5578.1K needed to increase endstate configuration to 80-strings. (based on conservative yield assumptions and planned support for 70 strings)
Fuel Price Increases	\$752K	Fully fund fuel at \$3.47/gal for remainder of project

Drill Operation and String Installation – A detailed planning meeting was held in early April between Raytheon and IceCube. Support requirements, and the development of detailed plans and schedules were started at this time. A staffing plan and schedule has been completed with individuals identified for deployment. Driller and deployment training is scheduled for late July/early August.

A review of the drill hose was held to troubleshoot the failures that were encountered with the main hose. The root cause of failure has been identified as winter storage technique and the associated ambient temperature. Enough hose has been ordered to completely replace the existing hose and changes are being made to address the storage issue next season. The new hose is less dense than what is currently used and has been specifically developed by IVG to meet IceCube requirements. Modifications to end fittings and lay up are also being considered as part of the plan to reduce failures. Several tests are planned for new and existing hose to verify new hose integrity.

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 Performance - The installation and the subsequent freeze-in process with temporary pressures up to more than 400 bar is demanding on the string hardware. The DOM survival rates are very high. Of the 1424 optical sensors deployed to date, only 16 (1.1%) are not usable, and another 18 (1.3%) have shown minor issues, some of which are expected to be resolved. Over 97% of all the DOMs are commissioned with full functionality and are in operation. Only two sensors failed after they were frozen in and commissioned. A total of 1000 DOM years of integrated operation has been accumulated as of May 2007.

Detector Commissioning and Verification – We have performed a number of high-level verification tests on some data taken in March. These tests verified the proper functioning of the detector and the integrity of the data via the following high-level parameters: Adjacent DOM timing, DOM timing residuals (from cosmic-ray muon events), DOM occupancy, Multi-string timing, Local coincidence, and IceTop-InIce timing.

A proposal for defining a “good run” was made at the collaboration meeting. The software that will allow us to have a flexible system for generating such a list — a system that allows for both a standardized definition of a good run as well as more individualized ones — is not hard to implement in the existing framework.

A large fraction of the benchmarking data has been taken. The taping issue was resolved by providing the C&V group with additional disk space. These disks will also store other C&V datasets used to verify detector performance, running code at the South Pole on local CPUs and disks, and only shipping small summary (ROOT) files north.

Progress continues with the integration of high level verification data into the monitoring system. We are confident we will have a fully functional and highly useful system in place for monitoring both low-level and high-level detector performance before data taking officially starts.

The hole ice data analysis is progressing. Plots were shown at the collaboration meeting that clearly indicate an effect due to the hole ice. This was not unexpected. It mainly increases our confidence that we will be able to use this specialized dataset to better our understanding of this important optical parameter.

Several issues related to communications between IceCube and AMANDA caused problems this month, leading to some instability in the DAQ during the current test phase. Some of these problems were related to GPS timing. Problems were found on both the AMANDA and IceCube sides of the respective code bases. The problems have been resolved at this time and we are ready to take coincident AMANDA-IceCube data when official data taking commences.

Data Acquisition System Hardware - The remaining primary deliverables for the DAQ hardware for this project year are DOM Main Board Assemblies, and final design documentation for the DOM Hub Industrial Computers.

DOM Main Board production continues to progress smoothly and without any major issues. The vendor has been able to meet all of their quality and shipping commitments to date. The assembly and test vendor has delivered 1815 tested DOM Main Boards and will deliver a minimum of 240 MBs/month from now until they reach the purchase order quantity. LBNL has delivered 1548 fully tested and inspected MBs, on schedule, to the DOM integration sites, 948 to PSL, 360 to DESY Zeuthen, and 240 to Stockholm.

The Rev3 DOM Hub design documentation is 100% complete, and all documents have been released to UW. The engineers at UW have started the RFQ process to select the vendor that will build the remaining DOMHubs. LBNL has accumulated a stock of DOMHub spare parts

from past years of production. These parts will be shipped to UW over the next 2 months for use in refurbishing Rev2 and building Rev3 DOMHubs.

Data Acquisition System Software - From April 1, 2007 to May 13, 2007 the production DAQ (pDAQ) system logged 1.07 billions events to tape in 1264 separate data run files. At the beginning of this period the trigger was set to fire on a coincidence of 20 DOMs in five μ sec. Currently we have lowered this trigger threshold to eight DOMs in five μ sec and are taking data at a combined rate from IceCube and AMANDA (see the next paragraph) slightly in excess of 600 Hz. The stability of the pDAQ has dramatically improved since the introduction of the new memory management system in late March. The IceCube array has been taking data at approximately 75% uptime since the beginning of April and most of the downtime has been due to either scheduled maintenance or hardware problems. When pDAQ is running on stable hardware without operator intervention, the down time is less than 1%, due principally to the cycle time in between data taking runs which have for the moment been limited to eight hours because of design issues with the monitoring system.

The AMANDA array was also integrated into the IceCube data acquisition system: pDAQ can receive software messages over the network from the AMANDA data acquisition system (AMANDA TWR) which precipitates a read out of any triggered IceCube DOMs within a specified time window around the AMANDA trigger.

The introduction of full support of waveform compression is the principal outstanding item which must be included in pDAQ for nominal data taking in 2007. Currently the various DAQ systems have readout the DOMs in a verbose format, which could dramatically exceed the maximum data rate to tape of 300 GB per day. This last hurdle is expected to be surpassed within the next few weeks.

Data Systems - The South Pole Systems in the ICL continue operation. There is continued satellite transmission of engineering data and pre-scaled minbias data for DAQ and JEB/PnF filter studies in preparation for planned physics data taking scheduled to start in May. Data rates on the satellite are in excess of 20 GB/day. We are continuing our recovery effort in the ICL after the temperature overheating episode. All online systems have recovered and are operating. There is still some rebuild work that needs to be done on the core software distribution machine. There is continued operation, maintenance and upgrades to the UW data center and data warehouse to keep pace with incoming engineering data from IC-22.

The final JEB/PnF version, which merges TWR and IceCube data online in real time is in testing at the UW South Pole Test System (SPTS), using engineering test data from pole, and is scheduled to be deployed at South Pole in the coming weeks. Interfaces and system integration with P-DAQ, TWR-DAQ, experiment control, and Spade at the South Pole continues. New releases of IceTray analysis framework continue. Work continues for the online filter reconstruction IceTray code, which is in testing on engineering data and Monte Carlo data, to set final cut parameters to meet satellite bandwidth requirements and keep high efficiency for neutrino events. Planned deployment at Pole is mid May.

Simulation production with the release of production version V01-09-07 continued in April. Simulation is moving towards a release of IceSim version 2.0, which will include a full feature set and improved storage of detailed Monte Carlo information in the IceTray data class framework. Version 2.0 is now scheduled for released in early June.

The experiment control system is running at Pole and coordinating all subsystem configuration start/stop and status information for all IceCube subsystems (i.e. p-daq, JEB/PnF/Spade/TWR-daq). The final feature set and improved ease of use for operators is continuing.

Quality Assurance and Safety – There are no significant issues to report.

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

Meetings and Events

NSF Annual Review of the IceCube Project

May 30-31, 2007