IceCube Project Monthly Report - June 2010

Accomplishments

- Detector uptime was 99.0% in June, the first full month of taking data using the 79-string configuration.

- Planning for the annual Driller/Installer training program is complete. The training will be held in Madison from July 26 through August 6.

- An optimized volume trigger included in the most recent Data Acquisition software release is successfully running on the UW-Madison South Pole Test System.

- Planning is underway for the April 26-29, 2011 collaboration meeting in Madison. This meeting will provide an opportunity to recognize the successful completion of IceCube construction. Concurrent with the meeting will be a particle astrophysics meeting (April 29-30) and an ice drilling technology meeting (April 27-28).

Cost and Schedule Performance – The project is 96.4% complete. Remaining contingency is $5.1 million. The NSF IceCube MREFC funding of $242.1 million remains unchanged since the project baseline was established in 2004.
The cost variance at the end of May 2010 was $1,424k. This favorable cost variance is mostly due to Raytheon Polar Service Corporation and New York Air National Guard FY10 on-ice fuel and labor cost savings.

**Contingency Status and Plans** – No change requests were implemented during the past month.
IceCube is conducting reviews of the various MREFC subsystems to ensure completeness and readiness for reliable operations. The action item lists resulting from these reviews continue to generate the need for additional resources, e.g., programming support, computing hardware purchases, documentation effort, etc. The cost is considered in the risk assessment process.

### Risk Assessment & Potential Contingency Adjustments

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate (S$K)</th>
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<tbody>
<tr>
<td>1. Potentially Cost Exposure for the Approved Scope of Work based on Level 3 Technical, Cost and Schedule Risk Assessment.</td>
<td>$1,155K</td>
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<tr>
<td>WBS 1.1 Project Support</td>
<td>Engineering Support and management closeout activities in PY10. $125K</td>
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<td>WBS 1.2 Implementation</td>
<td>Additional UW &amp; PSL Labor to replace and refurbish drill hardware. On-Ice safety staffing. $560K</td>
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<td>WBS 1.3 Instrumentation</td>
<td>Additional packing and shipping. $30K</td>
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<td>WBS 1.4 Data Systems</td>
<td>Simulation software programming and documentation. $50K</td>
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<td>WBS 1.5 Comm. &amp; Verification</td>
<td>Final calibration algorithm development. $25K</td>
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<td>WBS 1.6 RPSC and ANG</td>
<td>RPSC revised rates and additional On-Ice support. $300K</td>
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<td>WBS 1.8 NSF</td>
<td>Additional reviews and oversight. $15K</td>
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<td>WBS 1.9 Pre Operations</td>
<td>Disk Storage, CPU and Network hardware replacement. $50K</td>
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<td>2. Computing Infrastructure and Software Development.</td>
<td>$1,560K</td>
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<td>South Pole Systems and South Pole Test Systems</td>
<td>FY10/FY11 comprehensive upgrades, replacing old servers, tape drives, and media. $650K</td>
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<td>UW Data Center and Data Warehouse</td>
<td>Project Years 9 and 10 upgrades. $450K</td>
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<tr>
<td>DAQ Software Development</td>
<td>IceCube Live and Data Acquisition software. $85K</td>
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<tr>
<td>Simulations Programs</td>
<td>Simulation Programs software development and Verification through full operations. $75K</td>
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<tr>
<td>Offline Data Processing</td>
<td>Improve and stabilize the automation and operation of Offline Data Processing. $75K</td>
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<tr>
<td>Distributed Computing Infrastructure</td>
<td>Support for Simulation Production and Data Processing at distributed sites. $150K</td>
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<tr>
<td>Computing Network</td>
<td>Network hardware and software upgrades. $75K</td>
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<td>3. Pre-operations labor to meet core pre-operational requirements through Sep. 2010.</td>
<td>$350K</td>
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<td>4. Estimated cost to retro IceCube equipment/materials from the South Pole at the end of the project.</td>
<td>$1,050K</td>
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<td>5. Potential labor cost to retain experienced personnel in the final year of construction to ensure that the final season will be a success.</td>
<td>$150K</td>
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<td>6. Develop software for special simulations by Southern University, additional calibration support from UC-Berkeley, and computing hardware for UC-Irvine to participate in distributed simulation production.</td>
<td>$150K</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$4,415K</strong></td>
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Available Contingency as of May 31, 2010

Drill Operation and Installation – All South Pole equipment remains in storage, with IceCube winter-overs monitoring the Drill Control Center, the Tower Operations module, the main hose reel, and the Season Equipment Site. There have been no issues with South Pole storage.

Off-Ice Activities:
- A detailed planning meeting was held in Denver with Raytheon Polar Services Corporation regarding storing and dismantling the Enhanced Hot Water Drill (EHWD).
- All driller and installer positions are filled, including recruitment of eight alternates.
- Scheduling for the annual Driller/Installer training program is complete. Training will be held in Madison, Wisconsin July 26 through August 6.
- The University of Wisconsin-Madison Physical Science Laboratory (PSL) test bed is setup and ready for training to begin in July.
- Repairs and disposition of retrograde equipment and salvage from last season is complete.
- Replacement and spare part procurements continue.
- The Enhanced Hot Water Trencher is being reconfigured and repaired for the coming season.
- Decommissioning plans for the PSL test-bed/training facility are in development and the work will begin after driller/installer training.
- Retrograde crate fabrication is underway, and materials for bracing and shipping Mobile Drilling Structures and equipment are procured.
- The EHWD documentation project continues with video editing and diagram updates underway, and a file hierarchy developed – estimated 35% complete.
- Special Device projects continue to be coordinated and monitored.

Detector Commissioning and Verification – No major problems were found in the data, and verification is running well.

This month database experts recognized and fixed flasher runs that were not providing data to the I3OMDB database. As was mentioned last month, Commissioning and Verification was integrated into the new version of Processing and Filtering software. Two modules were problematic and have been fixed.

Calibration and Monitoring – Collaboration partners at Uppsala University have been investigating Mie Scattering in order to understand photon propagation in the ice methodology. Results pertaining to the use of the “HG phase function” are being investigated by simulation.

Data Acquisition Hardware & Software – The Data Acquisition (DAQ) uptime for June was 99.2%. No new DAQ releases were made in June.

DAQ efforts for June included an in-depth look at the volume trigger that appeared in the most recent software release and a detailed audit of hits in the DAQ to pinpoint data loss.
A series of tests were made to examine the DAQ interruptions that occurred when the volume trigger was enabled in 79-string configuration data runs. As a result, an optimized version of the volume trigger was developed and is successfully running on the UW-Madison South Pole Test System. Testing on the South Pole System is planned for July.

A detailed audit of hits in the DAQ revealed a minor data loss when the Digital Optical Module (DOM) mainboard buffer suffered an overflow condition. Two bugs were identified as leading to this condition. The first bug was traced to the DOM monitoring system and resulted in approximately 0.004% data loss. It was resolved. The second bug, also a 0.004% data loss, was fixed in the DOM mainboard code and is scheduled for release on the detector in early July.

Detector Up-Time: 99.0%
IceCube (in-ice) clean runs Up-Time: 93.24%
Unscheduled Downtime: 0.10%

Definition of the terms:
“Detector Up-Time” is the percentage of the time period for which the pDAQ data acquisition was acquiring data and delivering at least 500Hz of event rate. This uptime measure therefore includes periods in which the detector was taking data with a partial detector enabled or with light contamination from calibration sources.

“Clean run Up-Time(s)” is the percentage of the time period considered to have pristine data (standard hardware and software configurations) with the full nominal detector enabled, not contaminated with light from calibration sources and for which no serious alerts were generated by the monitoring, verification or other. The criteria applied are not algorithmic but rather represent the Run Coordinator’s overall impression of the quality (including uniformity) of the runs/data.
June was the first full month of data taking with the new 79-string configuration and an impressive total uptime of 99.0% was achieved. One DOMhub was excluded from data taking due to hardware failures. Total unscheduled downtime was kept to a minimal 0.1%, and the clean up-time was reduced to 93.2% while the DOMhub was being repaired.

Software updates were installed for online filtering, monitoring, and the supernova subsystems. These updates did not interrupt the overall data taking. Monitoring information for several runs was lost due to two failed disk drives and a bug in the monitoring. The recovery process was labor intensive and the monitoring bug has been resolved.

**Data Handling** – South Pole Systems began the 79-string physics operation on May 31, 2010. June was the first full month of 79-string data collection. The figure below shows the filtered physics data in green, dominating the daily satellite data transfer rates (MBytes/day) throughout the month.

![TDRSS Transfers Starting 01 Jun 2010 For 30 Days](https://via.placeholder.com/150)

Maintenance and upgrade of the data handling system is planned for the next austral summer. Tests are already being run on the South Pole Test System in Madison, Wisconsin.

**Online & Offline Filtering, Software & Database** - The online filtering system for 79-string data continues smoothly with daily transmission to the data warehouse at UW-Madison within bandwidth guidelines. Work continues on fine-tuning Processing and Filtering software performance, improving monitoring and communications with IceCube Live, and completing documentation.

The Level 2 offline production processing of 59-string data is nearly complete. Preparations continue for a unified Level 3 offline processing on the data in the warehouse. This is the first
run with a unified Level 3, which will reduce dataset sizes and provide different datasets for physics working groups. Preliminary work continues in preparing the Level 2 offline processing for 79-string data.

**Simulation** – Simulation production for the month of June exceeded the data goals required for physics analysis. Simulation data for 59-string through 86-string data is currently being produced with a software release from April 2010. All 59-string simulation data are processed through the same protocol applied to experimental data from the detector, and are fully compatible with experimental data.

The production of simulation benchmark datasets with an 86-string configuration is being generated for physics sensitivity studies but will serve several purposes. The datasets will allow working groups to study the current 79-string detector configuration, including the complete Deep Core low energy sub-array. In addition, they will also be used to study the online data filtering algorithm on the complete detector configuration next year. Both background and signal datasets are being generated with minimal trigger condition in order to warrant the general purpose of these benchmark datasets.

**2011 IceCube Inauguration Plans** – Planning is underway for multiple events to celebrate detector completion in 2011. Drilling and string installation is scheduled to finish in December of 2010, and all holes will be frozen and ready for final commissioning in January 2011.

IceCube staff and the University of Wisconsin-Madison Communications are developing a media plan to promote news of IceCube completion. In addition, several events are scheduled around the IceCube Collaboration meeting April 26-29, 2011, including an inaugural dinner on Thursday, April 28, 2011. During the week of the collaboration meeting, IceCube will host meetings focusing on future drilling technologies and particle astrophysics. Both meetings will provide overviews of their respective fields and invited speakers will cover key topics.

The future drilling technology meeting on April 27 & 28, 2011 is intended to cover a wide subject matter; topics include glaciology, ice coring, rapid access drilling, ice sheet dynamics, and experiments that use ice drilling, such as expanding the dark matter search at the South Pole and radio or satellite based experiments. The intention is to create connections among disciplines that use ice drilling and to use the expertise of IceCube drilling personnel.

The particle astrophysics meeting on April 29 & 30, 2011 features experts covering major activities in the field. Topics include cosmic rays, gamma rays, dark matter, gravitational waves, cosmology, and accelerator and non-accelerator neutrinos.

**Education and Outreach** – While IceCube institutions around the world are accepting summer students from local high schools and undergrad programs, outreach activities to connect with the general public continue with hands on ice-drilling activities for kids and families in Madison.
In addition, a native Spanish speaker and collaboration member prepared and delivered a presentation to 50 high school students in Guadalajara, Jalisco, Mexico. The presentation will be added to the IceCube outreach collection and be made available for the collaboration.

El estado actual de IceCube

- 79 cables desplegados hasta la fecha
- configuración final de 5160 Modulos en 86 cables entre 1.4 y 2.4 km de profundidad
- detecta ~100 neutrones y $1.7 \times 10^8$ muones per day
- umbral de 10 GeV
- resolución angular de 0.4~1 grados

A slide from the June outreach presentation to high school students in Guadalajara, Mexico.

Quality Assurance and Safety – Preparations continue for Driller/Installer training that begins the final week of July. The training schedule currently covers basic electricity, rigging, welding, fire extinguisher use, and CPR/AED.

Additional Occupational Safety and Health Administration training in Fall Protection, Lock-Out/Tag-Out, and Blood Bourne Pathogens were established.

Upcoming IceCube Meetings and Events
Driller/Installer Training, Madison, WI July 26-August 6, 2010
IceCube Collaboration Meeting, Brussels, Belgium September 20-23, 2010

Acronym List
EHWD Enhanced Hot Water Drill
PSL Physical Sciences Laboratory
DAQ Data Acquisition
DOM     Digital Optical Module