Accomplishments

- The Integrated Master Schedule and Master Site Plans for drilling and cabling this season are complete.
- A Planning Wrap-up meeting was held in Denver with RPSC on September 9-10 to confirm all support and logistics plans are understood and complete.
- A South Pole Readiness Review was held at UW Sept 16th. Equipment status, personnel plans, and schedules were reviewed. The review concluded that all equipment, plans, and personnel are ready for the upcoming season.
- During the month of September, 23 Digital Optical Module (DOM) Hubs were refurbished at UW and shipped to the South Pole.
- This September the IceCube Data Acquisition System operated with 99.1% uptime and collected approximately 5 billion physics events at an average rate of 1900 events per second.
Cost and Schedule Performance – The project is 93.1% complete. Remaining contingency is $7.1 million. There has been no change to the NSF MREFC funding requirements of $242.1 million since the project performance baseline was established in February 2004.

The Schedule Variance at the end of August 2009 was -$34k, primarily due to late delivery of surface cables in Instrumentation. The cost variance at the end of August 2009 was $1,844k. This favorable variance is principally due to FY09 labor and on-ice support costs for Raytheon Polar Services Corporation and the Air National Guard being lower than planned. In addition, the driller training costs were less than the baseline budget.

The final schedule for string installation is 18 strings in December 2009 – January 2010 and 9 strings in the final season, December 2010 – January 2011. A total of 19 strings were installed last season.

Resources are in place for the successful completion of the MREFC project in FY2011.
### IceCube Total Project Budget Baseline - Quarterly Change Log ($K)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Date Approved</th>
<th>Total Baseline</th>
<th>Allocated Budget</th>
<th>Allocated Budget Change</th>
<th>Contingency Budget</th>
<th>Budgeted Cost of Work Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>Status as of May 2009</td>
<td></td>
<td>275,503</td>
<td>268,056</td>
<td>0</td>
<td>7,447</td>
<td>21,392</td>
</tr>
<tr>
<td>CR149</td>
<td>UA Graduate Student</td>
<td>07/13/09</td>
<td>275,503</td>
<td>268,095</td>
<td>39</td>
<td>7,408</td>
<td>20,069</td>
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<tr>
<td>CR150</td>
<td>Rebaseline RPSC FY2010</td>
<td>07/13/09</td>
<td>275,503</td>
<td>267,808</td>
<td>-287</td>
<td>7,696</td>
<td>20,069</td>
</tr>
<tr>
<td>CR151</td>
<td>Add Equipment to Pre-Ops</td>
<td>07/27/09</td>
<td>275,503</td>
<td>267,908</td>
<td>100</td>
<td>7,596</td>
<td>20,069</td>
</tr>
<tr>
<td>NA</td>
<td>Status as of June 2009</td>
<td></td>
<td>275,503</td>
<td>267,908</td>
<td>0</td>
<td>7,596</td>
<td>20,069</td>
</tr>
<tr>
<td>NA</td>
<td>Status as of July 2009</td>
<td></td>
<td>275,503</td>
<td>267,908</td>
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<td>19,036</td>
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<tr>
<td>CR154</td>
<td>ICL Rooftop Access</td>
<td>09/29/09</td>
<td>275,503</td>
<td>267,908</td>
<td>0</td>
<td>7,596</td>
<td></td>
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<tr>
<td>CR155</td>
<td>Data Storage Expansion</td>
<td>09/30/09</td>
<td>275,503</td>
<td>268,371</td>
<td>464</td>
<td>7,132</td>
<td></td>
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<tr>
<td>CR156</td>
<td>Computing @ Southern U.</td>
<td>09/28/09</td>
<td>275,503</td>
<td>268,409</td>
<td>37</td>
<td>7,095</td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>Status as of August 2009</td>
<td></td>
<td>275,503</td>
<td>268,409</td>
<td>0</td>
<td>7,095</td>
<td>18,541</td>
</tr>
</tbody>
</table>

**Contingency Status and Plans** — Three change requests were implemented in the past month: IC0154 IceCube Lab Rooftop Access, IC0155 Data Storage Expansion, and IC0156 Distributed Computing support for the Southern University – Baton Rouge. The available Contingency is now $7,095M.

### Risk Assessment & Potential Contingency Adjustments

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate ($K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Contingency potentially required for technical, cost and schedule risks associated with the approved scope of work. Risk assessments are made at WBS-Level 4 to determine the value of the risk exposure as a percent of the cost of work remaining.</td>
<td>$1,605</td>
</tr>
<tr>
<td>2. Pre-Operations costs for additional capacity to the data storage and network systems both at the South Pole and in the North, and for extending software development efforts.</td>
<td>$2,100</td>
</tr>
<tr>
<td>3. RPSC Estimated FY09 Closeout (-$700K) and moving the support for one string from FY09 to FY11 (+$250K)</td>
<td>-$450</td>
</tr>
<tr>
<td>4. Remaining cost of instrumentation required for an 86-string detector, 80 strings from the original proposal plus the six DeepCore strings financed by European partners.</td>
<td>$500</td>
</tr>
<tr>
<td>5. RPSC estimate of base cost to support the installation of six strings during the 2010/11 drilling season. The current RPSC baseline already includes support for 80 strings.</td>
<td>$1,340</td>
</tr>
<tr>
<td>6. The cost to retro IceCube equipment/materials from the South Pole at the end of the project in FY2012. This is a conservative estimate based on Rev. 8 of the RPSC budget.</td>
<td>$1,050</td>
</tr>
<tr>
<td>7. Potential cost to retain experienced key personnel in the final season to ensure the success of the last drilling and installation season.</td>
<td>$500</td>
</tr>
<tr>
<td>8. Potential additional Fuel Cost exposure during the last season of drilling (FY2011)</td>
<td>$450</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$7,095</strong></td>
</tr>
</tbody>
</table>

**Available Contingency as of Aug 31, 2009**

$7,095
Drill Operation and Installation – Hose Heat System monitoring continues without issue. Similarly, Do Not Freeze Modules power/heat monitoring continues with no issues to report. Recent images from South Pole reveal moderate snow drifting at the Seasonal Equipment Site, equivalent to previous years.

Off-Ice Drilling Activities:

• Staffing: All 30 driller positions are filled (w/8 alternates). As of the end of September all but four were physically qualified (PQ’d).
• The shift roster is set with deployment dates linked to flights and activities. Drill crew will begin arriving at South Pole Nov 4th.
• The Integrated Master Schedule and Master Site Plans are complete – both reflecting a 20-hole plan, w/19 surface cable trenches, and 14 IceTop stations.
• An Enhanced Hot Water Trencher system was fabricated, assembled, and shipped for trenching surface cables from holes to IceCube Laboratory.
• A new surface hose handling fork-fence was fabricated and shipped. This will relieve tension stresses put on the hose during hole-to-hole relocation.
• A sonar system was procured, tested, and shipped; this will improve RodWell development and management over the season.
• A Planning Wrap-up meeting was held in Denver with RPSC on the 9-10th to confirm all support and logistics plans are understood and set.
• A Readiness Review was held Sept 16th. Equipment status, personnel plans, and schedules were reviewed. Implementation is ready for the season.
• A final shipment of repaired/replacement equipment was shipped onward to South Pole.
• The EHWD User Manual (Turn-Over Package) continues; video script sequences are 80% outlined; drawings and documentation collection is ongoing. Related activities for South Pole are identified and planned.
• Procedure review/revisions continued through September (90% complete). New procedures are being written for 2 new systems.
• Hazard Analysis reviews are 100% complete. New HA’s are being written for two new systems.

Off-Ice Installation Activities:

• Staffing: The four primary deployer positions are filled with two of the four already PQ’d.
• The last shipment of Deployment gear left for the Pole during the month.
• The Readiness Review on the 16th confirmed that deployment is ready for the season. All equipment shipped, staffing plans are in place, and the hazard analysis updated.
• The installation team will begin to arrive at the Pole around November 23rd.
• A list of Special Devices is developed. Weekly status meetings confirm most of these sub-projects will meet ship dates and be ready for installation at NPX.

Detector Commissioning and Verification - Verification continues to run smoothly. Discussions are ongoing within UW concerning integration of Verification with “IceCube Live.” Similarly, we are working with Maryland concerning modifications of Verification.
scripts to accommodate the new operating mode for the Processing and Filtering compute farm at Pole.

Code is being put into place to remove short gaps in the data that result from minor problems such as individual dropped DOMs. This code will run on the IceCube 59 string configuration data during “Level2” processing in the north. This is a minor effect but will improve the overall quality of the data labeled as belonging to the “good run list.”

Work is progressing on the inclusion of tests of waveforms into the standard processing. Martin Wolf (Heidelberg) has undertaken this task.

**Calibration and Monitoring** - Flasher runs continue to be taken, with minimal impact on data taking activities. Most recently, these runs were taken to aid in the study of ice properties.

Discussions concerning flashing the Standard Candle laser in IceCube 59 string configuration for calibration purposes are underway.

**Data Acquisition Hardware & Software** – During the month of September, 23 Digital Optical Module (DOM) Hubs were refurbished at UW and shipped to the South Pole, where they will serve as readout computers for strings to be deployed in the 2009-2010 season. IceCube system engineering is working with Data Acquisition (DAQ) engineers at Lawrence Berkeley National Laboratory and DESY to identify a new and/or supplemental master clock GPS unit for IceCube.

This September the IceCube DAQ operated with 99.1% uptime and collected approximately 5 billion physics events at an average rate of 1900 events per second. Unscheduled downtime was due to two principle factors: run cycling, which introduces 270 seconds of downtime per day (0.3% of the day), and hardware failures - mostly hub crashes which accounted for 0.4% of the downtime.

On the development end, the next DAQ release code, called El Farlito, has not been issued. A release candidate will appear in early October. The DAQ group has taken the opportunity provided by the delay to include a few unplanned features in addition to the major driving feature of shrinking the size of the DAQ on-disk data format. Newly introduced features include:

- Enhancements to the software deployment system to allow greater flexibility in configuring run-time options such as development computers, South Pole test system, and the South Pole system production data taking system.
- Better reporting of the DAQ event rate based on event timestamps; this will reduce unphysical fluctuations displayed in the real-time graphs of IceCube Live.
- Quick switching of flasher board parameters during complex, extended calibration runs without powering off and on flasher boards.
Finally, the DAQ group has received the trigger requests for the run to begin April 2010 with the strings deployed this polar season. We are working with various individuals in the science working groups to accommodate these requests.

September was the most smooth and trouble-free data taking month so far this year. The overall detector uptime was 99.1% and the clean in-ice uptime was 97.3%. The few normal occurrences of equipment/systems malfunctions (e.g DOM readout cards giving bad data, hub crashing, or hanging) were promptly alerted by the automatic systems and swiftly corrected by Winterover intervention.

A new version of the JEB code was deployed to address an issue discovered in the feature extraction of hits as used in the cascade filter. All other filters for physics remained unchanged.

**Performance Metrics:**
Detector Up-Time: 99.1%
IceCube (in-ice) clean runs Up-Time: 97.3%
Unscheduled Downtime: 0.2%

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.

**Data Handling** - South Pole systems in the IceCube Lab began 59-string configuration on May 20th and it has been running smoothly since then. The figure below shows the daily satellite data transfer rates in gigabytes for this month.
Planning for South Pole systems upgrades to handle the additional strings and data rate in 2009-2010 installation season is proceeding on schedule. Planning also continues for the annual upgrades to the data warehouse to accommodate the 59 string data and simulation storage needs.

**Online & Offline Filtering, Software & Database** - The online filtering system for the 59-string run, which began in May, continues smoothly. Daily satellite transmission of filtered data to UW is shown in the figure above.

Design work, debugging, and testing of the final online filter software infrastructure continued in September. Final testing with an implementation of the DAQ final design for the raw data payload system, which appears to reduce the data size to 40% of the raw format, is completed. Final verification of data integrity is being performed in the north. The final online filter software will include more detailed monitoring and higher integration with the IceCube Live experiment control system. The deployment of this final PnF online software system is scheduled for late November. This will be a major milestone for the online software system, with the remaining MREFC work reduced to ongoing integration with new strings in the remaining season, tweaking for performance and final documentation the remaining deliverables.

Development of IceTray version 3, with support for collaborative sharing of the core software with the KM3Net and ANTARES collaborations, is complete with the fourth and final release candidate. This release candidate is used by the collaboration with the official release coming in mid October. This is the final major version release for IceTray.
as part of the MREFC, with documentation and small changes for performance enhancements and minor upgrades for improved usability the remaining deliverables.

**Simulation** - Simulation production is ongoing producing background and signal samples for 22 string, 40 string, and 59 string data sets. The simulation production system uses a ticketing system and smart distribution of job queues coordinates to distribute Monte Carlo production throughout the collaboration in an automated way. Below is a summary for the last month of the IceCube Monte Carlo production sites. The average number of cpu actively processing Monte Carlo was 756.

![Simulation chart](image)

**Education and Outreach** – In exploring new ways to show people what IceCube is, we developed a 3-D model of the detector developed using Google SketchUp. This model is available on the IceCube website. With this file and the free application, users can zoom in to view an individual DOM and zoom out to view the whole array including the IceCube Lab and IceTop tanks. The Knowles Science Teaching Fellows who visited the IceCube project this summer were alerted to this model and webpage traffic is steady. Below are only three views of an infinite number that can be generated with the array file. The application can also generate animations. Several are available to the public in a variety of formats.
Quality Assurance and Safety – Efforts to identify gaps in IceCube documentation are underway, and review and revision of the Drilling and Deployment Procedures used at the South Pole is ongoing. As part of the documentation enhancements, we are securing digital copies of all IceCube drawings produced by the UW Physicals Sciences Laboratory. These drawings are being organized in the IceCube Docushare directories.

As previously reported, all Enhanced Hot Water Drill Hazards Analyses are complete. Additional Hazards Analyses are being performed Raytheon Polar Services Corporation and IceCube. Raytheon will analyze the operation of generators at the drill camp, and IceCube is focusing on the Enhanced Hot Water Trencher at the Pole.

The SafeStart On-Line Program is available to all individuals deploying to the South Pole this season. The on-line course consists of the same five modules that many of the drillers already received. The training modules are a great SafeStart Refresher for all those going to Pole.

M&O Planning - A revised budget was submitted to NSF for Maintenance & Operations for the period from FY2011 – FY2015. The budget was reduced by roughly ten percent relative from the original budget and is responsive to recommendations from the NSF panel reviews and subsequent guidance from the NSF and the International Oversight and Finance Group.

Meetings and Events
NSF IOFG Meeting and Revised M&O Budget Review November 2-3, 2009

Monthly reports are posted at IceCube Monthly Reports.