IceCube Project Monthly Report – August 2009

Accomplishments

- Driller and string installation personnel completed safety and system training in early August.
- A shipment to Port Hueneme of repaired drilling equipment, spare parts, and replacements departed UW on August 27. All shipments continue on schedule.
- Testing and verification of the latest Data Acquisition software release began this month.
- Overall detector uptime for the month of August was excellent at 98.6 percent.
- A seasonal IceCube safety officer was hired and received training and orientation to personnel, systems, and procedures.

Cost and Schedule Performance – The project is 92.9% complete. Remaining contingency is $7.6 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 cost variance at the end of July 2009 was $1,713k. This favorable variance is principally due to lower than planned FY09 labor and on-ice support costs for RPSC and the Air National Guard.

**Contingency Status and Plans** — There was no change to contingency in the month of July 2009.

### Change Log - IceCube Total Project Budget Baseline ($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 April 2009</td>
<td></td>
<td>275,293</td>
<td>267,808</td>
<td></td>
<td>7,486</td>
<td>25,432</td>
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<tr>
<td>CR144</td>
<td>US Institutions - 5 Surface-to-DOM cables</td>
<td>05/13/09</td>
<td>275,293</td>
<td>268,456</td>
<td>648</td>
<td>6,838</td>
<td></td>
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<td>CR144</td>
<td>Non-US Institutions - Instrumentation for 100 DOMs</td>
<td>05/13/09</td>
<td>275,503</td>
<td>268,666</td>
<td>210</td>
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<td>CR148</td>
<td>RPSC FY08 Closeout</td>
<td>07/07/09</td>
<td>275,503</td>
<td>268,056</td>
<td>-609</td>
<td>7,447</td>
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</tr>
<tr>
<td>NA</td>
<td>Status as of May 2009</td>
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<td>275,503</td>
<td>268,056</td>
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<td>7,447</td>
<td>21,392</td>
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<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>
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<td>CR150</td>
<td>Rebaseline 1.6 FY10 budget</td>
<td>07/13/09</td>
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<td>267,808</td>
<td>-287</td>
<td>7,696</td>
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<tr>
<td>CR151</td>
<td>Add Capital Equipment to 1.9.4</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>
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<td>NA</td>
<td>Status as of June 2009</td>
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<td>267,908</td>
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<td>7,596</td>
<td>19,036</td>
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<tr>
<td>NA</td>
<td>Status as of July 2009</td>
<td></td>
<td>275,503</td>
<td>267,908</td>
<td></td>
<td>7,596</td>
<td>19,036</td>
</tr>
</tbody>
</table>

Notes: 1. Incorporates approved baseline changes.
2. Total Budget at Completion includes $3,732 K non-US contributions over the amount in the post Hartill III baseline.
3. Budgeted contingency is: 39.5% of the Budgeted cost of work remaining.
4. The BAC (Budget At Completion) reflects FY09 detailed Baseline Review.
5. Contingency is assigned based on the Remaining Work, a bottom-up risk assessment, management judgement, and cost
### 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>$1,690K</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>$2,000K</td>
</tr>
<tr>
<td>3. RPSC Estimated FY09 Closeout (-$700K) and moving the support for one string from FY09 to FY11 (+$250K)</td>
<td>-$450K</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>$500K</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>$1,340K</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>$1,050K</td>
</tr>
<tr>
<td>7. Potential cost to retain experienced key personnel in PY9 to ensure the success of the last drilling and installation season.</td>
<td>$700K</td>
</tr>
<tr>
<td>8. Potential additional Fuel Cost exposure during the last season of drilling (FY2011)</td>
<td>$450K</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$7,280K</strong></td>
</tr>
</tbody>
</table>

**Available Contingency as of Jul 31, 2009** $7,596K

**Drill Operation and Installation** – In early August, hose heat monitoring discovered a power failure caused by improper wiring. Raytheon Polar Services Corporation (RPSC) is rectifying this issue. Monitoring Do Not Freeze (DNF) equipment, including Drill Control Center and the Tower Operating Structures continues without issue. Images received from the South Pole reveal that drifting at the season equipment site is lower than in previous years.

Off-Ice Drilling Activities:

- **Staffing:** All seasonal driller positions are filled (w/8 alternates). Shift roster is set with deployment dates matched to flight and on-ice schedules.
- **Integrated Master Schedule and Site Plans** reflecting 20-hole plan w/cable trench paths, and 14 IceTop Pits are complete.
- **Driller safety/systems training** concluded in early August.
- **The planning wrap-up meeting** with Raytheon is scheduled for Sept 9-10 in Denver.
- **Enhanced hot water trencher assembly continues,** a new Standard Operating Procedure (SOP) and Hazard Analysis (HA) are being developed.
- **RodWell development and management equipment (sonar) system** is assembled and being tested at PSL, planned ship date is Set 17.
- **Another shipment of repaired equipment, spares, and replacement parts** left PSL for Port Hueneme on Aug. 27.
- **Independent Firn Drill (IFD) upgrade and repair parts** were shipped.
• Fabrication of a burner test chamber has begun, this will help determine heater reliability and improve efficiency
• A replacement gear box for the main hose reel was procured
• Automated fuel filler and electrical upgrade equipment were shipped
• EHWD User Manual (Turn-Over Pkg) continues; video script sequences are being 60% outlined; drawing and documentation collection is on-going. Activities at South Pole are identified
• Hazard Analysis review/revisions for all existing processes are complete.
• Procedure (SOP’s) review/revisions are 80% complete
• Procurements and Repairs to EHWD equipment continues

Off-Ice Installation Activities:
• Staffing: All deployer/Pressure/Temperature (PTS) positions are filled, shift leads are established (w/3 alternates).
• All equipment, replacement, and spare parts are procured and prepared for shipment
• A Special Device list is developed, weekly status meetings continue to assist SOP development and plans are maturing

Detector Commissioning and Verification – Verification continues to run smoothly, using manually generated templates. The group reviews plots as they are generated, checking for discrepancies and following up with hardware experts regarding anomalies. Other personnel are starting to investigate a global rewrite of Verification’s control scripts, both to simplify the current system and to adapt to the new way that the PnF system will be processing data (now it processes data in many-event sequences, one sequence per processor in the PnF cluster, starting next data taking season it will process data one event per processor; the latter system will simplify Verification processing considerably).

Initial work has begun to include tests of waveforms into the standard processing. Heidelberg and PSU are collaborating on this task.

Calibration and Monitoring – A long flasher run was completed and is being analyzed for use in studying ice properties. At the same time, the simulation of flashers is being debugged to rid it of an unphysical timing error. This error appears as light traveling too fast in ice.

Considerable effort is being expended on understanding the “stretched ice” model, testing it against data for a variety of possible data samples. The stretched ice model artificially expands the vertical size of regions with known shorter scattering lengths.

Data Acquisition Hardware & Software – For the past month, the software group has been focused on the new DAQ release, which will include support for the reduced payload format. Since this is a major change to the IceCube data format, we are proceeding very methodically in the verification and test phase. We expect the release to occur before the end of September. The reduced payload data format is a new data format that should, without loss of information, cut the volume of data stored on tape/disk by as much as 60 percent.

There has also been a recent reprioritization from the project to resolve some long-standing issues related to acquisition of data. Due to the extremely large amount of data involved,
IceCube flasher calibration light sources have typically pushed the DAQ to the limit. Although the current priority is the payload reformat task, some work is being done to optimize the trigger system for greater data throughput.

**IceCube Maintenance and Operations**

![IceCube Detector Operation for Aug 2009](image)

Detector Up-Time: 98.6%
IceCube (in-ice) clean runs Up-Time: 96.3%
Unscheduled Downtime: 0.3%

**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.

August was a very smooth and trouble-free month for acquiring data. The overall detector uptime was 98.6% and the clean in-ice uptime was 96.3%.

There were various attempts at flasher runs for ice properties and for physics modeling of cascades. From the DAQ and configurations standpoint, there were quite a few hurdles to overcome in order to take these flasher runs. Toward the end of the month, we found that the Cluster Trigger was a major reason for the observed problems and it was removed to take a pilot sample of the flasher data. More work on this area is still needed and planned.

An attempt to load a new version of the DOM main board software/firmware was aborted because the release showed more dropped DOMs during the softboot.

On August 5, a crash of the Live control system caused an unusually long run. No data was lost. On Aug 7, a network switch problem caused 2 hours of downtime when an entire rack of hubs
became unreachable. On August 8, a new Live release was deployed that improved the system reliability. A power outage on Aug 13 caused a 15 minute downtime and was quickly mitigated by Winterover action. On August 31 the first successful flasher runs were taken after improving the configurations and the temporary removal of the Cluster Trigger.

**Data Handling** - South Pole systems in the ICL began IC-59 physics operation on May 20th and continued smoothly through August. The figure below shows the daily satellite data transfer rates for this month.

![TDRSS Transfers Starting 01 Aug 2009 For 30 Days](chart.png)

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 IC-59 data and simulation storage needs.

**Online & Offline Filtering, Software & Database** - The online filtering system for the IC-59 run, which began in May, continues smoothly with daily satellite transmission of filtered data to the northern data warehouse at UW as logged in the figure above.

Design work, debugging and testing of the final online filter software infrastructure continued in August. Final testing awaits an implementation of the DAQ final design for the raw data payload system, which appears to reduce the data size to 40% of the current DAQ raw format. This will enable a final system (DAQ and Online filter) to be deployed that will handle the full data rate of the completed detector.

Development of the IceTray version 3 continues, with support for collaborative sharing of the core software with the KM3Net and ANTARES collaborations, which have adopted the use of IceTray for the analysis framework.
**Simulation** - Simulation production is ongoing producing background and signal samples for IC-22, IC-40 and IC-59 data sets. The simulation production system coordinates distributed monte carlo production throughout the collaboration in an automated way using a ticketing system and smart distribution of job queues.

**Education and Outreach** – During August, undergraduate students from the UW River Falls (UWRF) program sponsored by the NSF Office of International Programs and Knowles Science Teaching Fellows (KSTFs) continued their IceCube experience by working at the UW Physical Sciences Lab (PSL). Casey O'Hara, the KSTF traveling to the South Pole with IceCube this year, participated in Instrumentation Deployment Training at PSL on August 4-5. O'Hara was joined by five other KSTFs and several undergraduate students.

UWRF students Michael Fitzl and Forest Kirschbaum spent the summer working on ice bubble cameras in Sweden with Per Olof Huth, Stockholm University, and Allan Hallgren, Uppsala University. The student support was provided by an NSF supplemental grant from the Office of International programs. UW-Madison provided one month of summer salary for Jim Madsen and research support for Tareq AbuZayyad and Alessio Tamburro who worked with the students.

Paul Evenson, University of Delaware, and Jim Madsen, UWRF, obtained funding from the NSF Office of Polar Programs to calibrate an IceTop tank on the Oden Icebreaker that sails from Sweden to Argentina to Antarctica and back to Argentina. The ship leaves Sweden on November 20, 2009 with Drew Anderson, who is replaced by Samantha Jakel in Argentina who sails to Antarctica and is replaced there by Kyle Jero.
**M&O Program Planning** – The University of Wisconsin and the IceCube Collaboration were encouraged by the positive reviews (M&O Panel and NSF Annual Review Panel) of the IceCube M&O proposal, in particular the general conclusion that the overall level of effort (FTE’s) requested is appropriate. The additional guidance from the NSF and the IceCube International Oversight and Finance Group (IOFG) is being pursued. This guidance supports three overarching goals: 1) reduce the “Core” M&O funding requirements by shifting core work to the IceCube collaborating institutions, i.e., increase “Service Work”; 2) increase the percentage contribution to M&O activities by non-U.S. funding agencies and collaborating institutions; and, 3) reduce the out-year M&O funding requirements relative to current requirements by assuming more stable operations in the future. Progress towards these goals would reduce the NSF funding required for Core M&O tasks.

The biggest challenge is the increase in Non-U.S. support relative to the NSF, calculated at 25:75 in the original proposal. We are now at 30:70 in the revised budget plan or 33:67 once faculty salaries supported by the U.S. universities are removed. The upcoming collaboration meeting in September will provide an opportunity to continue to revise our M&O plans and further develop the MoUs that codify the institutional commitments. We are sharing information on progress with the NSF and our collaborators that were identified as the IOFG points of contact for the Swedish, Belgian, and German funding agencies.

**Quality Assurance and Safety** – Brad Whelchel, Safety Representative for the IceCube Project at the Pole, arrived for training during the second week of Driller Training. In addition to SafeStart Training, he was exposed to Driller/Deployer Training and CPR/FA, and received orientation in his responsibilities at the Pole. Brad and Mike Zernick, IceCube Safety Manager, will serve as the safety leads for IceCube this coming season with Mike early in the season and Brad for the duration.

90% of all safety equipment ordered for the upcoming season will ship out to Pole this month.

Safety posters for the drill camp are being created and updated. These posters are largely flowcharts developed from written procedures, presenting instructions and safety information graphically for quick viewing on the job.

Six new posters will be completed this month. The topics are:
- Weight Stack Assembly
- Tower Operations Site (TOS)/Tower Relocation
- TOS Pre-Drill Set-Up
- Updated Hose Inspection Criteria
- Hose Section Replacement
- Hose Reel Move Procedure

**Meetings and Events**

M&O Planning Meeting at UW-Madison

Season Planning Meeting at Raytheon

Collaboration Meeting at Humboldt University

Joint Software Meeting with Antares/KM3Net

Potential NSF On-Site M&O Review

September 2-3, 2009

September 9-10, 2009

September 21–25, 2009

September 25 – 27, 2009

1st wk in November 2009
Monthly reports are posted at IceCube Monthly Reports.