Internal Report LBNL-5473

IceCube Project

LBNL-Internal Vetting Review,

Dec. 10 - 11, 2003

Final Report

Chris Bebek, Earl Cornell, Rod Keller, Spencer Klein, Jay Marx, Peter Nugent, Rajinder Singh, Nancy Slater, Craig Tull, and Sergio Zimmermann

Berkeley Lab, Jan. 30, 2004
With addition of Mar. 15, 2004

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Executive Summary

An Internal Vetting Review of the LBNL part of the IceCube Project was held on Dec. 10 –11, 2003. The LBNL project is embedded in a multilateral collaboration under the leadership of the University of Wisconsin. This vetting review was exclusively concerned with the LBNL part of the overall project; the purpose was to discover potential managerial or technical problems for the project and help upper LBNL management assess its viability.

The charge to the review committee included nine topics, most of them containing several specific questions with emphasis on managerial aspects of the project. In addition, the committee chairman asked project management to address a tenth topic which, strictly speaking, was not part of the formal charge to the committee.

The review included plenary presentations by project management and staff on the first day and four subcommittee breakout reviews in a free format that included questions and answers and a few formal presentations. All subcommittees met for a short common session on the second day to discuss hardware/software integration issues.

Five observers represented the University of Wisconsin and took part in the public sessions, occasionally giving their direct input to the proceedings.

The general assessment of the review is that the LBNL subproject of IceCube is technically in a reasonable shape, with some shortcomings in the areas of hardware fabrication schedule, software specifications, detailed requirement definitions, and reliability assessment that should be straightforward to amend. The relationship between the University of Wisconsin and Berkeley Lab is effective, and there is a lot of goodwill on both sides.

On the managerial side some deficiencies were noted, regarding the current state of the contingency analysis, integrated schedules and cost profiles for the duration of the main project, LBNL staffing plans, and detailed requirements for LBNL deliverables. There is reasonable hope that many of these issues will be resolved in the short term through interaction with the overall project, but at this point in time a number of formal agreements have to be put in place. Without them, the LBNL part of the project is in danger of not succeeding.

The most conspicuous issues have resulted in seven action items listed at the end of this report. In the opinion of the review committee, all these action items have to be resolved, some of them very soon, before ultimate success can reasonably be expected.

Review Committee

Rod Keller (chair)

Chris Bebek	Data Acquisition Hardware
Earl Cornell	Data Acquisition Software
Spencer Klein	Data Acquisition Hardware (chair)
Jay Marx	Management, cost, schedule
Peter Nugent	Software Architecture
R. P. Singh (deputy chair)	Data Acquisition Software (chair)
Nancy Slater	Management, cost, schedule (chair)
Craig Tull	Software Architecture (chair)
Sergio Zimmermann	Data Acquisition Hardware

Ex-officio

Kem Robinson

Jim Siegrist

James Symons

Subcommittees:

1. DAQ HW—Bebek, **Klein** (chair), Zimmermann
2. DAQ SW—Cornell, **Singh** (chair)
3. Software Architecture—Nugent, **Tull** (chair)
4. Management, cost, schedule—**Slater** (chair), Marx

Charge to the Review Committee

The IceCube Vetting Review Committee should consider all relevant aspects of the project's management, project plan, technical approach and status, cost estimate, resources, schedule and risk and, in doing so, advise as to whether the LBNL IceCube Project is likely to successfully provide the agreed upon deliverables to the overall IceCube Project within the agreed upon budget and schedule.

The committee should identify any project areas that may be incomplete for a given phase in the project and any area of significant risk for the project reaching its objectives. The committee should also review and evaluate the technical status of the project and advise on any concerns or significant technical risks.

Specific questions that the committee should answer (and that should frame the content of the information provided by the project to the reviewers) include the following:

1. Does the project have an effective organizational structure? Are the project roles and responsibilities well defined and understood by those who carry the responsibilities? Are tasks, responsibilities, and authority properly delegated?

2. Are the cost and schedule for the project well understood and are they consistent with the overall funding and schedule of the overall IceCube project? Does the management of the overall IceCube project support the LBNL cost and schedule? Is an appropriate funding profile for LBNL in the overall IceCube plan?

3. Is the schedule comprehensive and verifiable? Are schedule milestones clearly identified, and are the milestones frequent enough to gauge progress? Does the schedule specify relationships, critical paths, slack paths, and resources in appropriate detail for a project of this size? Are adequate resources planned and identified as needed to support the schedule?

4. Is the project plan appropriate, is it an effective tool to guide the project to completion and is it being used effectively by the project leadership? Does the project plan include relevant portions, appropriate to a project of this size, such as the Statement of Work (SOW), Work Breakdown Structure (WBS), Risk Management Plan, and the Budget and Schedule Estimates?

5. Are the technical requirements well understood and documented? Does the baseline design meet the project's objectives? Has adequate R&D been completed in a timely manner to support the construction goals of the project?

6. Is the level of technical progress appropriate for this stage of the project? Are there any potential technical showstoppers or major uncertainties? Are there adequate resources (people, funds, infrastructure) to support the technical goals?

7. Does the IceCube Project and/or NSF expect LBNL to provide facilities, special test equipment, and/or resources that are not part of the project's cost baseline?

8. Is there an appropriate written agreement, or MOU or other document that fully described both LBNL's commitments to IceCube and the resources provided both from IceCube and from LBNL that are needed to meet these commitments?

9. Is there a QA plan that is realistic and appropriate for a project of this scale?

Introduction

An Internal Vetting Review of the LBNL part of the IceCube Project was held on Dec. 10 –11, 2003. The LBNL project is embedded in a multilateral collaboration under the leadership of the University of Wisconsin (**UW**), Madison, WI. This vetting review was exclusively concerned with the LBNL part of the overall project, and unless stated otherwise, **the name 'IceCube' or the expression 'project' without qualifier are being used in this report to refer to the LBNL effort only.**

The charge to the review committee included nine topics, most of them containing several specific questions. In addition, the committee chairman asked the presenters to address a tenth topic:

10. How is success of the LBNL part of the project defined and what is the exit strategy (acceptance criteria and staff roll-off)?

The main purpose of this vetting review was to help the project avoid pitfalls in the managerial or technical areas and help upper LBNL management assess its viability and prospects for success.

Presentations were given by LBNL-IceCube management and staff in a plenary session on the first day and in breakout sessions and one more plenary session during the morning of the second day. The review agenda is given in the Appendix, below. Five observers from the University of Wisconsin, representing the main IceCube Project management, attended the public parts of the review and in some occasions gave direct input. The review committee thankfully acknowledges their contributions which were very helpful in clarifying some collaboration issues.

The formal presentations were backed up by handout material given to the committee at the beginning of the review. Two electronic files distributed earlier to the reviewers described LBNL's role in the main project and the LBNL effort in more breadth, and pointers to more, web-based, information had been communicated earlier on as well.

The review committee wants to specifically thank R. Stokstad, B. Edwards, and R. P. Singh (deputy committee chair) for preparing agenda, documentation, and meeting rooms, and providing catering. We would like to acknowledge the prompt reaction to the committee's requests such as for detailed information on specific issues, an acronym glossary, et cetera.

A substantial effort went into the presentations and preparation of backup material for the breakout sessions.

A general impression was that the collaboration between University of Wisconsin and Berkeley Lab is effective and there are a lot of good work and goodwill on both sides.

Findings

9+1 Review Charge Topics

1. Organizational Structure

Does the project have an effective organizational structure?

Overall, the organizational structure is adequate for the present stage of the project but dual lines of authority between UW & LBNL do exist. The dual lines appear between the Level 2 Lead at UW and the LBNL Project Office. The LBNL Project Director and Project Manager will have direct reporting responsibilities to their counterparts at Wisconsin. The LBNL Level 3 managers have reporting responsibilities to the LBNL Project Manager and the Level 2 manager. All staff below the Level 3 manager has reporting responsibilities to the Level 3 manager. Thus far the dual lines of authority do not appear to be a problem, and the IceCube management indicates that it plans to integrate the LBNL project manger into the overall project organization.

Are the project roles and responsibilities well defined and understood by those who carry the responsibilities?

Generally yes. There is an LBNL IceCube Management Roles document that defines the roles and responsibilities of the Level 3 through Project Director roles. This document is a supplement to the LBNL IceCube Organizational Chart. Each of the team members interviewed in this review seemed to understand their overall responsibilities.

Are tasks, responsibilities, and authority properly delegated?

Overall yes, but there is a potential problem with hardware design in the area of DOM-Hub management. The Level 3 managers create the schedule for the tasks that they are responsible for, and they delegate the tasks throughout the project team (including delegations to non-LBNL people).

2. Cost and Schedule

Are the cost and schedule for the project well understood and are they consistent with the overall funding and schedule of the overall IceCube project?

Not at this time. A complete project estimate-to-complete (ETC) is being created; so the overall project budget is under revision and review at this time. The cost estimates are generated by LBNL and based on proposed costs as well as historical values, and the numbers are reasonably consistent with the overall funding plan. The cost estimate will be updated to include appropriate amounts of contingency funding. The final estimated budget would then be sent to Wisconsin

for review and sign-off. This cost estimate will be presented to the NSF review committee of the main project in February.

The schedule is based on internal LBNL task management; there are 4 separate schedules that are internally consistent (DAC Hardware, DAC Software, Software Architecture, and Integration and Testing). **However, the LBNL schedules were not yet fully integrated into the overall project schedul**e that is being maintained by Wisconsin at the time of the review. It is the objective for the main project to fully integrate the schedules so that there is one master project schedule for the project. The vision is to update the master schedule monthly with updates from all of the collaborators. The master schedule will be resource-loaded each year. **In several areas that regard LBNL efforts, including responsibility for DOMMBs, the schedules are very tight.**

Does the management of the overall IceCube project support the LBNL cost and schedule?

Not explicitly at this time, although the intention is there. The revised ETC will be negotiated to mutual satisfaction. A firm plan should be in place by mid-January for the project meeting with NSF in February.

Is an appropriate funding profile for LBNL in the overall IceCube plan?

Yes in principle, but subject to approval by UW management. The funding profile was defined in the proposal that LBNL submitted in the early stages of the project. The funding requests and budgets are re-submitted annually, but the annual budget requests are aligned with the initial funding request.

3. Schedule and milestones

Is the schedule comprehensive and verifiable?

No. The quality of the schedule is that it is variable. Major deliverables such as the DOM-MB and DAQ Software have detailed schedules; other areas, however, do not at this time. **See recommendations for details.**

Are schedule milestones clearly identified, and are the milestones frequent enough to gauge progress?

Only for one year where the milestones are defined and used to assess progress. **Alignment with IceCube milestones is missing except for hardware.**

Does the schedule specify relationships, critical paths, slack paths, and resources in appropriate detail for a project of this size?

No. A complete integrated pert- or gant-chart type schedule was not provided to the review committee. Also, in some areas more details are required than verbally presented to the committee, to effectively manage the tasks.

Are adequate resources planned and identified as needed to support the schedule?

No. A complete schedule was not provided to the review committee. There is no formal staffing plan in place, either, even though a need for several additional staff members was flagged, and the position requirements are clearly defined at this time. The schedule delays in the hardware and engineering aspects of the project have been due to insufficient staffing. **See recommendations.**

4. Project Planning

Is the project plan appropriate, is it an effective tool to guide the project to completion and is it being used effectively by the project leadership?

No. An integrated project plan needs to be developed. Some parts of such a plan exist, such as a Statement-of-Work (SOW) for the current year, but not for the whole LBNL project. WBS, a risk management plan, and budget and schedules for the current year exist.

Does the project plan include relevant portions, appropriate to a project of this size, such as the Statement of Work (SOW), Work Breakdown Structure (WBS), Risk Management Plan, and the Budget and Schedule Estimates?

Not yet. There is an SOW, to be updated annually. But there does not exist a project plan for the full life of the project that has been fully reviewed and approved by the Overall IceCube management. The WBS is sufficiently comprehensive. An LBNL risk management plan exists. Budget and schedule are in the process of update at the project level.

5. Technical Requirements

Are the technical requirements well understood and documented? Does the baseline design meet the project's objectives? Has adequate R&D been completed in a timely manner to support the construction goals of the project?

Progress has been made in this area; however, **signed-off requirement documents are urgently needed.**

6. Actual Progress and Resources

Is the level of technical progress appropriate for this stage of the project? Are there any potential technical showstoppers or major uncertainties? Are there adequate resources (people, funds, infrastructure) to support the technical goals?

Progress is good overall, but prototype hardware fabrication has fallen behind due to resource constraints. Several personnel have been added recently. There

is concern about when sufficient numbers of DOMs, etc., (with the final version of the firmware) will be available for testing software.

7. Requirements outside established baseline

Do the Overall IceCube Project and/or NSF expect LBNL to provide facilities, special test equipment, and/or resources that are not part of the project's cost baseline?

No.

8. Written Agreements

Is there an appropriate written agreement, or MOU or other document that fully describes both LBNL's commitments to IceCube and the resources provided both from IceCube and from LBNL that are needed to meet these commitments?

Essentially yes. There is a **Draft Memorandum of Understanding** with Wisconsin close to final approval and already **approved by LBNL's cognizant division directors,** and this document sets the framework for the responsibilities of the two organizations. There is a Statement of Work for the current year, and future annual subcontracts will be negotiated with Wisconsin. The details of the subcontract take priority over the MOU.

9. QA Plan

Is there a QA plan that is realistic and appropriate for a project of this scale?

A lot of QA related activities are taking place. The LBNL QA Plan was the first QA plan approved by IceCube. Regarding software, there is not yet an agreed-upon QA procedure. There is no plan to track bugs, but rather to find and fix bugs as they are found. The plan is to do frequent builds and to use various tools to do rule checking etc.

10. Success and Project Closeout

How is success of the LBNL part of the project defined and what is the exit strategy (acceptance criteria and staff roll-off)?

The LBNL group anticipates long-term involvement in the neutrino science program which –if it happens– would eliminate needs for a detailed roll-off plan. In the hardware area of the project, success is defined as shipping the hardware meeting the requirement on schedule. The software success is harder to define because there will be on-going software support over the lifecycle of the project.

Selected Specific Findings

Management

The project team chose two main vendors with long-standing relationships with LBNL for the delivery of some of the hardware, thus reducing the risk of single-point failure. The project needs to **make sure that the vendors are aware of their delivery schedules** – communication with the vendors is essential.

The main project has two annual **project meetings** with all of the collaborators – one meeting is held in Europe and one meeting is held in the US. Plenary sessions with presentations are followed by workshops with task-specific discussions. This allows the entire group to interact and open lines of communication.

LBNL reports costs to Wisconsin according to WBS number. This allows each group to track the actual costs of the WBS tasks, and this setup lends itself to implementing an Earned Value Management System.

The LBNL finance person has a single point of contact with Wisconsin, and this relationship enables effective communication of subcontract and financial issues.

The DocuShare website is an excellent system for sharing project documents and making announcements. Minutes of meetings should be added to serve as a documentation of teleconferences and other meetings.

DAQ Software

The LBNL DAQ SW group has incorporated the files comprising the firmware and the FPGA code into its version control system.

The LBNL DAQ SW group has written simulators for various non-existent hardware items, in order to allow development of DAQ SW before the availability of hardware.

The LBNL part is understaffed at the 10 to 20 % level.

DAQ Hardware

We find that the experimental hardware is in good shape technically. We thank the collaboration for their hard work and recognize the excellent progress. The collaboration has clearly spent a lot of time thinking and examining possible design and reliability issues.

The schedule for next year is ambitious with little slack.

We understand that the present staffing level seems inadequate and represents additional schedule risk.

There is some concern about a possible funding gap at the end of the 2003/4 Ice Cube fiscal year.

Architecture and Experiment Control

The LBNL IceCube project involvement in Architecture has been 1 FTE (Simon Patton) and is now being increased by 1 more FTE (Chris Day) in January 2004 to 2 FTE to cover both Architecture and Experiment Control. In addition, there is another FTE (Martin Stoffer) under DAQ Software who will be working on one of the two major software deliverables for the Architecture WBS item and another CSE expected in PY3 (post-April 2004).

The technical expertise of the identified individuals is of the highest caliber and sufficient to address the technical aspects of this LBNL responsibility. We expect that the CSE hire in PY3 will be of the same quality. There are many qualified LBNL employees who could fill this CSE role and positively contribute to the project.

The work on Architecture and Experiment Control has really just begun, and therefore a proper review in this area could not yet be held.

Comments

Architecture and Experiment Control

Java has been chosen as the baseline programming language for much of the framework architecture, infrastructure utilities, and experiment control. This decision is entirely consistent with IT and CS trends, but the decision has implications on the physics side. Java programming requires different programming and design choices than FORTRAN and C++ programming. There are Multi-language issues which need to be fully resolved as there still are some C++ and C modules (as well as other Java modules) which will need to interface to these systems.

IceTray is one of the major Architecture Software deliverables. It is still very new and has not been tested by collaborators. There are plans to involve University of Maryland researchers in testing and using IceTray.

Recommendations

DAQ Hardware Recommendations

We recommend that additional manpower be provided. Faster PC board fabrication and loading should be investigated.

We recommend that the collaboration reduce the schedule risk by expanding the Rev. 4 production to be able to instrument one string (as a back up for the schedule South Pole summer installation).

Ice-Cube management and the pertinent engineers must agree on a clear and verifiable requirement for DOM main board and DOR reliability and sign off on a DOM requirements document. The present documentation is not consistent with the views of the engineers working on the project. This agreement is a prerequisite to a successful MOU between LBNL and the Ice-Cube project.

The collaboration needs to finish and sign off on the requirements documents and test and qualification procedures for the DOM and DOR hardware and firmware. These documents should be completed within a month.

LBNL management attention should be paid to non-LBNL contributions to LBNL responsibilities, such as the HUB chassis, DomHub Service board, DOR board (and its firmware). Clear agreements on deliverables, schedule, and chains of responsibility are needed. Quality assurance for reliability must be maintained at remote institutions.

A clear source for the DSB board should be identified.

The collaboration should consider longer burn-in periods for the initial DOM-main board production. Once the collaboration has acquired sufficient statistics regarding infant mortality, shorter periods can be considered. Some boards could be subjected to longer-term aging studies.

The committee recommends that a few chips from the current ATWD production be subjected to destructive physical analysis, to study the production quality.

The project needs formal written procedures for quality assurance for DOM-resident software, including laboratory testing and deployment. All new revisions/modifications must be subjected to an appropriate formal review procedure.

The collaboration needs to develop a policy for dealing with rework on PC boards.

The PC board inspection procedure should confirm the orientation of all polarized capacitors installed on PC boards.

DAQ Software Recommendations

The communication firmware should be finalized sooner rather than later, and all DAQ SW testing at LBNL and elsewhere should be against this final firmware.

DAQ SW should be tested with at least 30 DOMs at LBNL sooner rather than later.

DAQ SW should be tested with a full string at the cold dark lab at Wisconsin sooner rather than later.

The understaffing by 10 to 20 % needs to be addressed immediately.

Recommendations on Software Architecture and Experiment Controls

The Architecture item occurs at Level 5 in the WBS. The Level 3 manager to whom Simon officially reports as Architect does not have direct responsibility to guide and approve this work.

We recommend that the Software Management WBS item #1.4.5.2 which contains Architecture and Design (1.4.5.2.1) and Validation (1.4.5.2.2) be elevated to a level 3 WBS item to more accurately reflect management responsibilities and overarching nature of the item.

- This may be an opportunity to revisit the WBS in general.

We recommend that specific goals be set by the collaboration to ensure the widespread and rapid adoption of the IceTray framework.

BFD is one of the major Architecture software deliverables. It is in active use by the DAQ SW developers and will be used by any IceTray developers. This deliverable needs to be seen in the WBS as its own item.

Experiment Control has interfaces to DAQ control, Online, and Data Movement and to other items such as DOMAPP. These interfaces need to be reflected as items in the WBS under Experiment Control (1.4.5).

- Mechanisms to assure accountability for those interfaces will be easier to manage with explicit lines of responsibility spelled out in the WBS.

The schedule for the Experiment Control and Architecture needs to clearly reflect collaboration priorities and be tied to the deployment schedule for strings at the South Pole. There should be explicit functional and performance goals set for milestones like:

- Transition from TestDAQ to Experiment Control
- Integration of Experiment Control subsystems
- End-to-end testing of the Experiment Control, DAQ, Online, Data Movement and Analysis. (Similar to an accelerator Data Challenge.)

The DOMs contain a bootstrap Firmware/Software load for cold boot which cannot be replaced in situ, once the DOMs have been deployed. This FW/SW load is as critically important to the experiment as is the hardware itself. We recommend a full line-by-line review of this code by experts uninvolved with it authoring to ensure its robustness. This, of course, is in addition to the expected testing of DOMs.

- A Technical Design Review is advised before the Code Review.

The Experiment Control WBS item is very recent, and the project is still too nascent to review. Because of the tight coupling of other subsystems controls to the overall Experiment Control, we believe that an Experiment Control review is indispensable.

Management Recommendations

(Contingency) A bottom's up contingency analysis and profile for contingency at the appropriate WBS level for the LBNL scope should be completed by the LBNL Project Director and **approved by the IPMO** before the LBNL input on the ETC is provided to the overall IceCube project. LBNL's project management function must be integrated into the IceCube project organization before the Hartill-III review in February 2004.

(Reliability) By Feb. 1, 2004, the LBNL Systems Engineer should demonstrate quantitatively that the **reliability program being implemented for LBNL in-ice deliverables is consistent** with the Project's science-driven reliability goals (e.g. less than 5% DOM failure in 15 years of operation).

(Subcontracts) All annual Subcontracts must be reviewed and approved by the Lab's IPMO. (IPMO might delegate responsibility to the General Sciences Deputy for Projects)

(Personnel) By January 15, 2004, LBNL's Engineering Division should provide the additional electrical engineering staff needed for the DAQ hardware (2 FTE) and should assure that the DAQ hardware has an adequate level of senior project engineering, either by offloading Bob Minor's other responsibilities (STAR EMC) or by providing additional qualified personnel.

(Personnel) By January 15, 2004, the **additional computer scientist needed for DAQ software should be brought on board** to avoid schedule issues.

(Personnel) A staffing plan that spans the duration of the project is needed to address current and future staffing issues. This plan should include a detailed description of positions that are needed as well as a long-term closeout plan for future years (what will happen to the staff after the project ends, especially if the envisaged long-term involvement in the main IceCube operations will not be implemented?). The hiring organization as well as the HR department should be made aware of the plan.

(Purchasing) A plan for parts purchasing should be prepared and a part inventory should be built up to the full level as soon as possible, consistent with appropriate reviews), **especially for critical or at-risk components.** The funding requirements for LBNL should reflect aggressive part purchasing.

(Communications Plan) A **communications plan** involving LBNL and the other institutions involved in LBNL deliverables should be developed and **implemented by January 15, 2004.**

(Reporting and Assessments) The reporting requirements of the project are not clearly defined. These **requirements should be documented and distributed to the project team as soon as possible.** Periodic project assessments should be scheduled and the findings should be reported to Wisconsin.

(Schedule & Earned Value) There is not a clear, baselined, integrated schedule. Each of the Level 3 managers has their own schedule; however, these schedules do not roll up into a master project schedule. The project team is working toward the implementation of Earned Value tools. Achieving this goal is problematic without an integrated and baselined schedule. **A well-defined integration plan is necessary to incorporate earned value calculations.**

(Statement of Work) The SOW is an integral part of the annual subcontract between LBNL and Wisconsin. **This document needs to more comprehensively represent the details of the actual work plan.** UW managers expressed concerns about the lack of essential details in past SOWs.

(Risk Management) The Risk Management planning process is in its infancy at LBNL. The LBNL team is in the process of identifying and rating project risks and developing mitigation plans for the risks. **These plans should be developed with all of the project team members and converge into a Risk Management Plan, an active document that is discussed on a regular basis.** An example of an effective Risk Management Plan can be found at LBNL in the Molecular Foundry project.

ACTION ITEMS

Software Architecture and Experiment Controls

1. **A Technical Design Review must be conducted by LBNL and/or the overall IceCube management in June 2004, even at the cost of diverting some manpower from work on the Experiment Control for this review.**

Hardware

2. **Demonstrate that the reliability program for in-ice DAQ hardware meets IceCube science-driven reliability requirements (e.g. <5% module failure over 15 years). Alternately, get verification in writing by the IceCube Project Director that the LBNL reliability approach and process are adequate to meet the project's requirements.**

3. **LBNL Electronics Engineering Department must provide adequate staffing to meet DAQ hardware requirements.**

Management

4. **An LBNL contingency analysis must be completed and approved by IPMO.**

5. **The overall IceCube project and LBNL must agree on cost profile, contingency, and schedule for deliverables as part of the overall IceCube project plan. Target for IceCube to present project plan, cost, schedule, etc. to NSF is before the end of January 2004.**

6. **The LBNL staffing plan must be completed including a model for project closeout.**

7. **Requirements documents for LBNL deliverables must be signed off by overall IceCube project management.**

Action-item Follow-up by March 15, 2004

This section summarizes the progress made by the LBNL IceCube Project on addressing the action items listed on page 18 of this report since the time of the Vetting Review. The following statements have been authorized by K. Robinson, Director of the LBNL Integrated Project Management Office (IPMO).

1. There is general agreement that LBNL will conduct a Technical Design Review in the summer of 2004. Details of the exact topics and the timing of the Review have yet to be worked out.

2. University of Wisconsin and NSF review committee personnel (including a NASA person) have reviewed the LBNL approach to reliability, and are satisfied with it. The IceCube Project is very supportive of the LBNL design approach. Preliminary reliability simulation results indicate close to 30 years mean-time-between-failure (MTBF).

3. The LBNL Electronics Engineering Department has already provided several additional personnel to the IceCube project since the time of the Vetting Review and is working with the project on providing additional resources as required. The project still has one critical need.

4. The overall contingency for the LBNL IceCube project was below 20% at the time of the Vetting Review, and, with some changes in scope, stays now at approximately 23% overall. The LBNL contingency analysis has been reviewed and approved by LBNL management, including IPMO. The DAQ hardware (WBS 1.3.3) has a contingency of about 30% in total; contingency for DAQ software (WBS 1.3.4) is about 17%.

5. The LBNL cost profile, contingency, and schedule for deliverables have already been incorporated into the overall IceCube baseline, and the results presented at the recently completed NSF (Hartill III) Review in Wisconsin.

6. The LBNL staffing plan has been created and is being updated and maintained.

7. Requirements documents for all major LBNL deliverables exist in very detailed form and have been extensively reviewed.

These documents have very few entries without definitive values ("TBD's"), and are being used for the construction of production hardware and software. The format of these documents is being revised / iterated by the UW Systems Engineering Group, and the conversion of the LBNL requirements documents to the new format is occurring presently.

Appendix: Review Agenda

<u>December 10th – Plenary Sessions</u> *(in 2-100B conf. Rm.)*

8:30 Committee executive session
(closed, committee only, session where the purpose of the review is discussed) –

9:00 LBNL IceCube Project overview – science perspective – Stokstad
(scientific goals, collaboration organization, scope of LBNL effort, MOU, etc.)

9:30 Project overview – technical perspective – Edwards
(WBS scope & deliverables, annual SOW, budget, technical status overview, local project organization, staffing, interfaces, risk/issue overview, etc.)

10:15 Break

10:30 DAQ Architecture & System Requirements – Nygren
(history, architecture, science goals flow down to technical requirements)

11:00 DAQ Hardware Overview – Minor

12:00 Lunch

1:00 DAQ Software Overview – McParland

2:00 Integration and Test Plan Overview – Goldschmidt
(status & goals of qualification and production test planning)

2:30 Break

2:45 Data Systems/Exper. Controls /Software Arch. Overview – Patton

3:30 Cost/Schedule Overview – Edwards
(cost estimate, costs to date, funding profile, schedule summary, major milestones, etc.)

4:00 Committee executive session

5:00 Adjourn – day 1

December 11– Breakout sessions

(The rooms reserved for the breakout sessions are 2-100B, 2-300F, 2-400F and 46-150. The committee will initially meet in 2-100B on Dec. 11, then go to the breakout sessions from 8:00 to 11:00 am, then re-assemble in 2-100B for the session on the DAQ HW / SW integration and test plan.)

8:00 DAQ HW Session *(in 2-300F)* - Bebek, Klein (chair), Zimmermann

8:00 DAQ SW Session *(in 46-150)* - Cornell, Singh (chair)

8:00 Software Architecture Session *(in 2-400F)* - Nugent, Tull (chair)

8:00 Management Session *(in 2-100B)* - Slater (chair), Marx

11:00 DAQ HW / SW Integration and Test Plan *(in 2-100B) - All*

12:00 Lunch

1:00 Committee Sessions (discussion and report writing) - *All*

3:00 Closeout session *(in 2-100B) - All*

5:00 Adjourn – day 2