U.S. DEPARTMENT OF ENERGY

OFFICE OF SCIENCE

Review Committee

for the

CEBAF 12 GeV Upgrade Project

Thomas Jefferson National Accelerator Facility

April 27-28, 2010

Daniel R. Lehman, Chair

DOE/SC Review Committee

Office of Science, U.S. Department of Energy

http://www.science.doe.gov/opa/

Review Committee Participants

Daniel R. Lehman, DOE/SC, Chairperson

SC1
SRF Cryomodules and Cryogenics (WBS 1.3.1/1.3.3)

John Weisend, MSU

SC2
Accelerator and Accelerator Physics (WBS 1.3.2/1.3.4/1.3.5/1.8.1)

*Rod Gerig, ANL
Geoff Pile, ANL
Joe Tuozzolo, BNL

SC3
Detector (WBS 1.4/1.5/1.8.2)

*Andy Lankford, UCI
Nicolai Martovetsky, ORNL

SC4
Conventional Facilities (WBS 1.6)

Joe Harkins, LBNL
Elaine McCluskey, FNAL

SC5
Cost and Schedule

*Kurt Fisher, DOE/SC
John Tapia, DOE/SC

SC6
Project Management (WBS 1.7)

*Aesook Byon, BNL
Jim Strait, FNAL

Observers

Timothy Hallman, DOE/SC
Jehanne Gillo, DOE/SC
Jim Hawkins, DOE/SC
Helmut Marsiske, DOE/SC
Joe May, DOE/TJSO
Michael Epps, DOE/TJSO
Paul Bosco, OECM

LEGEND

SC Subcommittee
* Chairperson

Count: 13 (excluding observers)

Charge Questions

1. Is the overall project progressing satisfactorily since the last review?

2. Is the project responding appropriately to recent challenges encountered in conventional construction?

3. Is the project appropriately addressing the recommendations from the prior DOE/SC project review?

Report Outline/Writing Assignments

Executive Summary ..... Fisher

1. Introduction ..... Hawkins
2. Technical Systems Evaluations (**Charge Questions 1, 3**)
   - 2.1 SRF Cryomodules and Cryogenics (WBS 1.3.1/1.3.3) ..... Weisend, Subcommittee 1
     - 2.1.1 Findings
     - 2.1.2 Comments
     - 2.1.3 Recommendations
   - 2.2 Accelerator (WBS 1.3.2/1.3.4/1.3.5/1.8.1) and AC Physics..... Gerig, Subcommittee 2
   - 2.3 Detector (WBS 1.4/1.5/1.8.2) ..... Lankford, Subcommittee 3
3. Conventional Facilities (WBS 1.6) (**Charge Questions 1, 2, 3**)..... Harkins, Subcommittee 4
4. Cost Estimate (**Charge Questions 1, 3**) ..... Fisher, Subcommittee 5
5. Schedule and Funding (**Charge Questions 1, 3**)..... Fisher, Subcommittee 5
6. Management (WBS 1.7) (**Charge Questions 1, 3**) ..... Byon, Subcommittee 6

1. Is the overall project progressing satisfactorily since the last review? Yes

3. Is the project appropriately addressing the recommendations from the prior DOE/SC project review?

   Yes. They are making a good effort to test a cryomodule in the linac shortly after the 6 month shutdown but may be constrained by reasonable concerns about possible impacts on the remaining 6 GeV program. They have addressed the need for an extended 12 month shutdown by moving work to earlier shutdowns.

- **Findings**
  - **The Central Helium Liquefier (cryoplant) procurement is well underway. The CHL building will be completed this week and all the major equipment orders have been placed. The preliminary design reviews for the coldbox and warm compressor have been held at the vendor. The heat exchangers have been ordered. There is very little remaining cost risk.**
  - **The cost of the 4.5 K cold box was 2.4 M$ over the estimate due mainly to a rise in the cost of materials, competition for manufacturing resources with the natural gas industry and an unfavorable foreign exchange rate.**
  - **Overall, the cryoplant shows a** 0.1 M$ cost variance and a 1.2 M$ schedule variance

2.1. SRF Cryomodules and Cryogenics

John Weisend, MSU

- Large numbers of component parts of the cryomodules have been ordered and have started to arrive. Cavity fabrication costs came in 2.4 M$ over the estimate due to Nb costs and foreign exchange issues.
- Cryomodules have - 0.7 M$ schedule variance and a -1.6 M$ cost variance.
- The first Cryomodule completes testing in March 2011
- The TEDF project involves rehabbing the test lab and this may slow down testing. They are working hard to coordinate with this project, are adding people to speed up the cryomodule assemblies and training additional testing operators.

- **Comments**
  - **Timely testing of full prototype cryomodules is important to success. The impact of the TEDF project on the test lab and testing schedule has been rightly identified as a potential problem and needs to be managed carefully.**
  - **No technical issues on either the cryoplant or cryomodules were seen**

- **Recommendations**
  - **None**

1. Is the overall project progressing satisfactorily since the last review? Yes, the committee is impressed with the ramping up of construction activities within accelerator systems.

3. Is the project appropriately addressing the recommendations from the prior DOE/SC project review? Yes, but see findings and comments.

2.2. Accelerator and AC Physics

Rod Gerig, ANL; Geoff Pile, ANL;
Joe Tuozzolo, BNL

- Findings:
  - Costs: Are under control, increases in these WBS elements is 8% since CD2.
  - Schedule: This work scope is on schedule.
  - The project did not respond to our recommendation to present a plan for a longer 12 month shutdown. They did however, deal with the sentiment of the recommendation by moving work from the 12 month shutdown into the six month shutdown, and other work earlier into 2009 and 2010 shutdown periods, comment follows…
  - The project is making efforts to perform the rf vertical slice test in the six month shutdown
  - Considerable fabrication and delivery progress has been made since the last review.
  - Lessons learned from project work performed during the winter 2009/2010 shutdown are providing valuable lessons, and assurances that planned procedures are effective.
  - A critical spares plan was provided, satisfying the committee's recommendation

2.2. Accelerator and AC Physics

Rod Gerig, ANL; Geoff Pile, ANL;
Joe Tuozzolo, BNL

- Comments
  - The committee is satisfied with the approach taken to off load work from the 12 month shutdown. This approach moves work forward rather than planning for a longer shutdown. We note effects associated with this approach.
    - The manpower spike has been leveled somewhat, however the six month shutdown becomes more critical, and exhibits the severest need for effort.
    - Moving work earlier allows lessons learned to be applied earlier; for instance work already performed in the 2009/2010 winter shutdown has shown that installation activities needed to be better staffed.
    - We are concerned with the statement that the present CEBAF operation could need to be extended and impact the 2010 summer shutdown, pushing planned work into the six month shutdown.
    - This work will need to be carefully monitored, but bringing the critical installation activities earlier allows for downstream remediation
  - The project expressed concern regarding manufacturing problems with a room temperature septum magnet. The committee agrees, and encourages strong vendor oversight. (the same vendor is building superconducting magnets for the physics program)

2.2. Accelerator and AC Physics

Rod Gerig, ANL; Geoff Pile, ANL;
Joe Tuozzolo, BNL

- Recommendations
  1. Maintain strong vendor oversight for vendors which have exhibited problems.

2.3. Detectors

Andy Lankford, UCI;
Nicolai Martovetsky, ORNL

1. Is the overall project progressing satisfactorily since the last review? **Yes**

3. Is the project appropriately addressing the recommendations from the prior DOE/SC project review? **Yes, but see comments and recommendations concerning Hall D.**

Hall B (CLAS12)

- **Findings**
  - **Design-build contracts for both SC magnets were awarded in Fall 2009, and both have since passed preliminary design reviews. Schedule shows 3 mo. float** (wrt Hall B completion)
  - **A tight collaboration, including close supervision, has been established with SC magnet vendor in order to ensure timely delivery.**
  - **TJNAF has continued to develop local expertise in silicon strip detectors for SVT to complement expertise of collaborators.**
- **Comments**
  - **A full SVT chain test, from sensors thru readout electronics to DAQ, should be completed before full sensor and electronics production.** (reiteration of comment from Sept 09 review).

Hall C (SHMS)

- **Findings**
  - **Bids received in Jul 09 for Dipole & Q2Q3 SC magnets were few & higher than expected. Package has been split for rebid to attract more vendors and better prices. Bids due 5/12 & 6/12.**
  - **Q1 & HB SC magnets (+ other magnet systems) are proceeding well.**

- **Comments**
  - **Dipole cost may be significantly larger than budgeted.**

Hall D (GlueX)

- **Findings**
  - **A strengthened management structure has been established.**
  - **Silicon photomultipliers (SiPM) selected for readout of BCAL. Procurement process has been initiated. Fine mesh PMT back-up solution has been retained.**
  - **MoU process for detectors, including university labor, is progressing well.**

Hall D SC Solenoid

- **Findings**
  - **Recent review of existing SC solenoid concluded:**
    - **Design & fabrication of a replacement solenoid would delay CD-4 significantly**
    - **Refurbishment of the existing solenoid should continue.**
  - **Leaks and shorts to ground are being repaired. Shorts to the supporting strip cannot be repaired.**
  - **Individual coil tests will complete in May 2011. Full solenoid tests, with realistic operating conditions, will complete in September 2012.**

Hall D SC Solenoid

- **Comments**
  - **The solenoid is prone to shorts. In GlueX, it will be operated under different conditions than in the past, and its coils will be exposed to larger mechanical forces. Consequently, there is risk of new shorts that could compromise operation or permanently damage the solenoid during a quick discharge.**
  - **Analysis of the impact of shorts should be extended to worst case situations.**
  - **Means to reduce risk of permanent damage should be developed, for instance by decreasing induced voltage in shorted turns,** *e.g.* by reducing discharge voltage or using additional low heat load current leads and cold diodes.
  - **Design & structural analysis of coil supports against axial forces should be completed.**
  - **Means should be pursued to shorten the projected schedule for producing a replacement solenoid.**

Hall D SC Solenoid

- **Comments**
  - **Refurbishment and testing of the existing solenoid should continue expeditiously.**
  - **The SC solenoid is a critical component of the GlueX spectrometer, which is a centerpiece of 12 GeV Upgrade Project.**
- **Recommendations**
  - **Initiate design of a back-up, replacement solenoid now.**
  - **Convene an external peer review to review risk mitigation plans and to advise regarding implementation of a replacement solenoid. Report on outcome at next DOE review.**

3. Conventional Facilities

Joe Harkins, LBNL;
Elaine McCluskey, FNAL

1. Is the overall project progressing satisfactorily since the last review?

   Yes

2. Is the project appropriately responding to recent challenges encountered in conventional construction?

   Yes, dewatering REA settlement pending May mediation

3. Is the project appropriately addressing the recommendations from the prior DOE/SC project review?

   Yes, both issues resolved.

Findings:

1. Civil Construction is 19.2% complete and ~2 months behind schedule (SPI 0.84) but has recovered significantly in recent months
2. Hall D Contractor has improved 2 months on forecast schedule in the last 3 months
3. Approximately 70% of the civil construction contracts have been awarded
4. CHL Addition is being accepted from contractor 5 months ahead of schedule, even with supplier issues
5. Hall D contractor is taking a proactive approach to safety

Comments:

1. Committee provided comments on Transition to Operations plan
2. Suggest sharing schedule improvement opportunities with Ballard prior to settling the REA for groundwater, as appropriate
3. Cooling tower level 3 baseline date should be revised at the time of contract award
4. Confirm the process for approval of the Buy American Act waivers on ARRA funding
5. Moving the LCW Header installations in West Arc to accelerator maintenance in Summer 2010 is aggressive and may still result in some of this work slipping into the 6 month down. Cost risk to Civil outweighs the schedule benefits to the project

Comments (cont):

6. Project should provide some security from cars and pedestrians entering the project site during off hours
7. Need to settle the Dewatering mediation soon to establish a clear schedule and to not allow this issue to damage relations with the contractor going forward
8. Project is commended for decision to increase Agent CM efforts on Hall D construction providing additional oversight and responsiveness and thereby aiding schedule recovery
9. The committee notes the good practice of sharing Lessons Learned from other Labs with construction contractors

Recommendations:

1. None

4. Cost Estimate

Kurt Fisher, DOE/SC;
John Tapia, DOE/SC

1. **Is the overall project progressing satisfactorily since the last review?**

   Yes, the project is making good progress and maintaining contingency.

3. **Is the project appropriately addressing the recommendations from the prior DOE/SC project review?**

   Yes, the project team has responded appropriately to cost recommendations from previous review.

4. Cost Estimate

Kurt Fisher, DOE/SC;
John Tapia, DOE/SC

Findings

- **Project is proceeding on schedule for a CD-4 date of June 2015 and on budget ($310M TPC).**
- **Project is currently 22.8% complete. Overall CPI is 0.93. No major issues or concerns.**
- **Project has received $65M of ARRA funding .**
- **Potential of Continuing Resolutions in the out years have been identified as a concern.**
- **Current project cost contingency and management reserve is $66.2M which is 50.9% of ETC obligations .**

4. Cost Estimate

Kurt Fisher, DOE/SC;
John Tapia, DOE/SC

Comments

- **The management team is effectively managing the project budget and schedule.**
- **Utilizing a project planning / integration engineer is a definite resource to the project.**
- **TJNAF practice is that 5% is added to all civil contracts as Management Reserve for field modifications.**
- **The management team has responded appropriately to cost recommendations from the previous review.**
- **The management team performs a monthly "Contingency/Risk Assessment" which indicated a needed contingency and management reserve of $ 66.2M.**
- **The contingency includes a staffing contingency of approximately $31.0 M.**

Recommendations

- **Revisit staffing profiles to ensure current staffing contingency is realistic and appropriate prior to the September 2010 Lehman**
- **Ensure the process for implementing practice for the 5% MR added to civil contracts is documented.**
- **Develop a contingency usage plan that can be implemented should contingency be available . This should be completed prior to the next Lehman .**

5. Schedule/Funding

Kurt Fisher, DOE/SC;
John Tapia, DOE/SC

1. **Is the overall project progressing satisfactorily since the last review?**

   Yes, overall the project is making good progress.

3. **Is the project appropriately addressing the recommendations from the prior DOE/SC project review?**

   There were no schedule recommendations in the previous review.

5. Schedule/Funding

Kurt Fisher, DOE/SC;
John Tapia, DOE/SC

Findings

- **Project is proceeding on schedule for a CD-4B date of June 2015 and on budget ($310M TPC).**
- **Project is currently 22.8% complete. Overall SPI is 0.97, four weeks behind schedule. Civil construction delays have been resolved and project is catching up.**
- **The project schedule currently has 3 accelerator shutdowns identified: July 2010 for one month; May 2011 for six months; May 2012 for 12 months.**
- **Current baseline schedule includes approximately six months of schedule contingency to CD-4B for Halls B & C due to funding limitations.**
- **Project developed a 13 point schedule recovery plan that is being implemented and should continue to improve overall performance.**

5. Schedule/Funding

Kurt Fisher, DOE/SC;
John Tapia, DOE/SC

Comments

- **The management team is effectively managing the project funding and schedule. The Project Manager is managing to the early finish dates.**
- **The project team is actively evaluating how much work can be advanced into earlier shutdowns identified in the project schedule.**
- **If contingency funding is identified the commissioning of Halls B and C should be brought forward in the schedule .**
- **The ARRA funding has supported some earlier procurements, however some vendors have avoided work tied to ARRA funds due to burdensome reporting requirements.**

5. Schedule/Funding

Kurt Fisher, DOE/SC;
John Tapia, DOE/SC

Recommendations

- **None**

6. Management

Aesook Byon, BNL;
Jim Strait, FNAL

1. Is the overall project progressing satisfactorily since the last review?

   Yes.

3. Is the project appropriately addressing the recommendations from the prior DOE/SC project review?

   Mostly:

   - The committee remains concerned about the Hall D solenoid, although the Project has viewed the recommendation from the previous review to be closed.
   - 9 of 15 recommendations from the previous review remain open, and one from an earlier review; however, the project is addressing these recommendations appropriately.

6. Management

Aesook Byon, BNL;
Jim Strait, FNAL

- Findings & Comments
  - The priority of project within the laboratory seems to be well understood and appropriately high. Still, focus will be required to ensure that shorter-term priorities do not jeopardize progress on the 12 GeV Upgrade Project.
  - The staffing situation is under reasonable control, and the project is nearly hitting the goal of a ramp-up of 4 FTEs per month.
    - However, there has still been 5.5 FTE-year shortfall over last 6 months (and a 25 FTE-year shortfall since CD-2).
    - The staffing goal includes a substantial “labor contingency” totaling 312 FTE-years, or $31M, concentrated particularly in FY13 – FY15. In FY13 and beyond labor contingency exceeds 100%.
    - Identifying and securing matrixed labor from JLab will continue to be one of the major challenges for meeting the project schedule.
    - University contributed labor is particularly important for detector installation during the FY12 long shutdown.

6. Management

Aesook Byon, BNL;
Jim Strait, FNAL

- Findings & Comments
  - Resource Management:
    - The SPI, now at 0.97, has largely recovered; however, the project overall remains about 4 weeks behind the baseline schedule
    - The CPI continues to degrade slowly, with modestly negative cost variances each month for the past half year.
    - The negative CPI is mainly due to the project being slow to make baseline changes based on up-to-date knowledge where the expected costs are higher than the baseline.
    - The % contingency as presented at this review, which is based only on obligations, might be misleading.
    - There are no significant current funding issues (thanks to ARRA). However, lengthy CR in FY11 or FY12 could significantly impact the project schedule.
  - Procurement: no issues

6. Management

Aesook Byon, BNL;
Jim Strait, FNAL

- Recommendations
  - Make detailed estimates of the specific uses of “contingency labor” and include it as a part of project baseline plan, via baseline change request, in timely manner (6 months before planned execution date).
  - Process change requests promptly to ensure CPI & SPI can be meaningful indicators.
  - Review each university construction MOU, which specifies labor that they will contribute, within ~1 year of the need date for that labor.
  - Schedule the next DOE/SC progress review of the project for September 2010.