U.S. DEPARTMENT OF ENERGY

OFFICE OF SCIENCE

Closeout Report

for the

Star Heavy Flavor Tracker(HFT) Project

at

Brookhaven National Laboratory

July 14, 2011

Ethan Merrill

Review Committee Chair

Office of Science, U.S. Department of Energy

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

Review Committee Participants

Department of Energy

Ethan Merrill, DOE/SC, Chairperson

Observers

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Jehanne Gillo
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Review Committee

Subcommittee 1: Pixel Detector
*Tim Nelson

Subcommittee 2 : Intermediate Silicon Tracker/Silicon Strip Detector
*Ron Lipton

Subcommittee 3: Electronics
*Bob DeMaat

Subcommittee 4: Integration
*Walt Sondheim

Subcommittee 5: Safety/ESH
*Steve Hoey

Subcommittee 6: Cost and Schedule/Management
*Joe May
Lyn Wells
Ray Won

Charge Questions

1. Is the design of the STAR HFT MIE technically sound and sufficiently mature? Are there credible plans in place for resolving any remaining technical issues? Is the project likely to met the CD-4, *Approve Start of Operations,* performance requirements?

2. Can the project be completed within the cost and schedule proposed for the Performance Baseline? Are cost and schedule estimates complete and reasonable to accomplish the planned scope? Do these estimates include adequate contingency based on risk analysis?

3. Is the project being properly managed for its successful execution? Is the management team appropriately organized and staffed?

4. Are ES&H aspects being properly addressed? Are Integrated Safety Management Principles being followed?

1. Is the design of the STAR HFT MIE technically sound and sufficiently mature? Are there credible plans in place for resolving any remaining technical issues? Is the project likely to meet the CD-4, *Approve Start of Operations,* performance requirements?

Yes to all.

3. Is the project being properly managed for its successful execution? Is the management team appropriately organized and staffed?

Yes to both with respect to achieving success on the technical goals of the project

2.1.1 Findings

•Recommendations of CD-1 review have been adequately addressed.

•The KPP define the system performance sufficiently to ensure that the Pixel fulfills its physics mission in the presence of the anticipated radiation and background environment.

•Technical solutions have been demonstrated that fulfill the KPP.

2.1.2 Comments

- Testing should continue to assure that the design and technical solutions extend to the full and completed system.
- Efforts should continue to better understand the ultimate radiation and background environment at small radius and the impacts on sufficiency of the design in ensuring the success of the HFT in delivering physics.
- The complete set of KPP don't define the physics performance of the HFT in the face of uncertain backgrounds. It would be useful to have a simple physics benchmark (not an additional KPP) that can be used to assess the physics impacts resulting from a better understanding of backgrounds and operational challenges.

2.1.3 Recommendations

- Decide by September 1 which technology, Phase-I or Ultimate Prototype, to implement in the engineering run. However, CD-2/3 approval is not contingent upon this decision.

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Yes

3. Is the project being properly managed for its successful execution? Is the management team appropriately organized and staffed?

Yes

2.2 Intermediate Silicon Tracker/Silicon Strip Detector

Ron Lipton, FNAL

Findings

- The STAR collaboration has provided detailed responses to the recommendations of the CD-1 review, including an EXCEL summary spreadsheet. They explored the effects of Heavily Ionizing Particle (HIP) dead time of the APV, both for pp and heavy ion running, quantified the effects of pixel material for low momentum D reconstruction (x1.5-2 in significance, which can be recovered by modified cuts), and argued that a second IST layer would be more expensive and take longer than the refurbishment of the SSD.

2.2 Intermediate Silicon Tracker/Silicon Strip Detector

Ron Lipton, FNAL

Findings

- The IST as presented is planning to use the APV chip in a 36 chip hybrid. The initial work has been on smaller modules which had significant coherent noise.
- The schedule allows time for a single prototype run for the hybrid module.
- The support structure is 30% designed and the cooling system 20%, this is low for a project at this stage.

2.2 Intermediate Silicon Tracker/Silicon Strip Detector

Ron Lipton, FNAL

Comments

- The IST design is reasonable and leverages available and tested technologies, such as the APV chip, an ATLAS (and RunIIb)-style stave design, readout very similar to the tested FGT system and Hamamatsu detectors.
- Given the large number of chips/hybrid, yield and reworkability may be important and the design and production plan should be developed with this in mind.
- Initial hybrid prototypes often have issues, and any problems with the prototype hybrid may have schedule impact. There is 5 months of schedule float in the IST. Much of this would be absorbed by a second hybrid run. The project might want to consider mitigation strategies, such as parallel production of prototypes with a second vendor.

2.2 Intermediate Silicon Tracker/Silicon Strip Detector

Ron Lipton, FNAL

Findings

- The SSD system will consist of refurbished existing detectors with new readout electronics. Twenty modules are necessary, 21 are available.
- All modules are now at Subatech being refurbished. They will then go to LBNL for CMM measurement. It is not yet clear where the new ladder cards will be installed.
- The initial version of the ladder card had several layout problems. The schedule for redesign depends on availability of engineering at Subatech.
- The efficiency of the working ladders is about 95%.
- There are no specific SSD detector performance KPPs other than readout speed.

2.2 Intermediate Silicon Tracker/Silicon Strip Detector

Comments

- The SSD system refurbishment is, to a significant extent, beyond control of the project. This represents a risk which is difficult to control. This is partially mitigated by the redundant nature of the SSD/IST system.
- Tasks such as the redesign of the ladder board and the specification of readout board FPGA pinout are already being paced by availability of engineering at Subatech.
- The collaboration might consider adding a KPP to track SSD physics performance goals.

2.2 Intermediate Silicon Tracker/Silicon Strip Detector

Ron Lipton, FNAL

Recommendations

- none

2.3 Electronics

Bob DeMaat, FNAL

1. Is the design of the STAR HFT MIE technically sound and sufficiently mature? Are there credible plans in place for resolving any remaining technical issues? Is the project likely to meet the CD-4, *Approve Start of Operations,* performance requirements?

Yes

3. Is the project being properly managed for its successful execution? Is the management team appropriately organized and staffed?

Yes

Findings

- As recommended in the CD-1 review, a Grounding & Shielding Plan has been developed by the project

- As recommended in the CD-1 review, an Electronics System Engineer has been named by the project

- A sampling of electronics tasks that were scheduled to recently complete, or scheduled to complete in a few months, indicate that the electronics work thus is far keeping to the schedule

Comments

- The project has proven adept at heading off a potential delay resulting from an error in the layout of a printed circuit board by quickly developing a simplified version of the board at a second institution. This simplified board will serve to avoid schedule slips in the testing of other components

Recommendations

- None

1. Is the design of the STAR HFT MIE technically sound and sufficiently mature? Are there credible plans in place for resolving any remaining technical issues? Is the project likely to met the CD-4, *Approve Start of Operations,* performance requirements?
   Yes.
2. Is the project being properly managed for its successful execution? Is the management team appropriately organized and staffed?
   Yes.

Findings:

- A better understanding on the performance of the HFT cooling systems should be demonstrated as a part of a prototype test run.

Comments:

- If a first IST ladder is available for inclusion in a prototype test run it should be included.
- A project management team has been identified whose members have many years of experience building technically challenging detectors.

2.4 Integration

Walt Sondheim, LANL

- Analysis were presented showing the support structure will meet the positioning tolerances specified by the detector subsystems.
- Choreography will be a key element in the installation and operation of the HFT in STAR. There are many other detectors that will become integral to this operation; beam beam counter, East start counter, forward GEM detector, beampipe and bake out.
- Concern over long carbon fiber cylinder being susceptible to eddy currents is not an issue based on analysis.
- Recommendations:
- All three HFT subsystems make use of the LBNL composite facility – it is recommended that a series of milestones be incorporated in production schedules in order to keep track of numerous components.
- A detailed assembly document should be generated for both the pixel and IST ladder construction. Tracking components used in ladder assemblies will become integral to a data base for the detector.

3. Is the project being properly managed for its successful execution? Is the management team appropriately organized and staffed? YES

4. Are ES&H aspects being properly addressed? Are Integrated Safety Management Principles being followed? YES

Findings

- CD-2/3 ESSH&Q Project requirements are mostly in place and adequate including the Preliminary Hazards Analysis Report (PHAR), Integrated Safety Management system, Safeguards and Security requirements and NEPA determination and QA program.
- Project uses BNL institutional ISM and QA programs
- ESH Coordinator assigned to project

Comments

- Hazards Analysis (HA) Report for the HFT Project Document dated June 2011 is comprehensive and meets the intent of DOE O 413.3B "Program and Project Management for the Acquisition of Capital Assets" that requires a Preliminary Hazards Analysis Report. The HA states that CAD will authorize the safety approval through and Unreviewed Safety Issue (USI) for the RHIC Safety Analysis Document (SAD), and that the HFT does not change the Accelerator Safety Envelope for RHIC. This USI has not been generated at this time nor is the HA finalized/signed. No new hazards were identified and a determination that the HFT hazards are bounded by the existing CAD Safety Assessment Document should be stated in the PHAR. The HA should be re-titled to a Preliminary Hazards Analysis Report so there is no confusion that it meets the 413.3B requirements

- A NEPA review was conducted and concluded that the HFT proposed actions fall within the scope of the RHIC Environmental Assessment, DOE EA #0508. The memo dated September 16, 2010 is from the BNL site NEPA coordinator to the CAD Associate Director for ESH and states that the review was coordinated with the BHSO NEPA Coordinator, however a memo from BHSO was not issued.

Recommendations

1. Finalize and sign off the Hazard Analysis for the HFT including adding/ clarifying language that discusses that the hazards of the HFT are bounded and do not impact the authorization basis or the ASE for the RHIC which the HFT will fall under by CD-2/3. This declaration should be documented using the USI process prior to CD-4.

2. Assure buy in from the BHSO NEPA coordinator that the HFT project falls within the bounds of the RHIC Environmental Assessment by 11/1/11

3. Prior to CD-4 update the security evaluation to show the project is covered under the most current update to the site assessment.

- Can the project be completed within the cost and schedule proposed for the Performance Baseline? Yes.
- Are cost and schedule estimates complete and reasonable to accomplish the planned scope? Yes.
- Do these estimates include adequate contingency based on risk analysis? Yes.

Findings

- Cost estimates are developed from quotes, calculated estimates, and expert judgment.
- Labor estimates use BNL, LBNL, MIT rates
- Contingency is calculated using weighted values and expert judgment
- Cost contingency is 34%
- BA/BO cost controls are in place to maintain approved contingency levels to available funding and continuing resolution
- Schedule is based on BNL, LBNL, MIT experience with similar projects
- Schedule contingency is determined quantitatively and supported by risk analysis
- The Critical Path goes through IST and then Integration

Comments

- Cost estimate appears reasonable for achieving KPPs
- Cost contingency is $3,655k and appears reasonable
- Schedule contingency is conservative at17 months
- MOUs are an essential project resource but 5 of 7 are not approved
- Off project activities (FGT and beam-pipe) appear to be appropriately integrated with this HFT project
- The Critical Path contains parallel activities that causes ambiguity

Recommendations

- Evaluate the Critical Path for ambiguities prior to CD-2/3 ESAAB Equivalent

PROJECT STATUS as of July 14, 2011 (without Redirect of $1,103k)		
Project Type	MIE	
CD-1	Planned:	Actual: 8/31/10
CD-2	Planned: 8/31/11	Actual:
CD-3	Planned: 8/31/11	Actual:
CD-4	Planned: 6/4/15	Actual:
TPC Percent Complete	Planned: 14%	Actual: 14%
TPC Cost to Date	$764K	
TPC Committed to Date	$1,039K	
TPC	$15,500K	
TEC	$15,200k	
Contingency Cost (w/Mgmt Reserve	$3,655	34 % to go
Contingency Schedule: CD-4	17 months	29%
CPI Cumulative	N/A	
SPI Cumulative	N/A	

- Is the project being properly managed for its successful execution? Yes.

- Is the management team appropriately organized and staffed? Yes.

Findings

- The IPT is established and in place and led by the FPD
- The IPT is supported by both DOE and BNL management
- Risk Management plan and registry are in place
- Acquisition Strategy is approved and in place
- The project is being executed in accordance with the PEP and it is consistent with other project documentation
- The Contractor Project Director (CPD) allocation to project management support and oversight of the project is 25%
- The KPPs consist of high and low level parameters
- In addition to the KPPs there are a large number of deliverables
- Contingency was reduced by $1.346M from CD-1 due to refined estimates

Comments

- IPT members have appropriate experience for the project
- It is unusual to have both low and high level KPPs as well as Deliverables
- As currently written the low-level and high-level KPPs appear overly complicated
- Installed commissioning activities are funded by RHIC operations funds
- CPD at 25% appears to be reasonable for a project of this size
- CD-1 Recommendations have been addressed

Recommendations

- Evaluate KPPs and Deliverables to determine if they are vital and essential for achieving mission needs prior to CD-2/3 ESAAB-equivalent
- MOUs should be approved prior to CD-2/3 ESAAB-equivalent
- Review the scope of WBS 1.6 prior to CD-2/3 ESAAB-equivalent
- Assess the potential project risk of a FY 2012 Continuing Resolution longer than 3 months prior to CD-2/3 ESAAB-equivalent
- Consider adding interim milestones to effectively monitor Project performance prior to CD-2/3 ESAAB-equivalent
- Recommend seeking SC guidance on how to account for redirected labor and scientific resources on the project that are not MIE funded prior to CD-2/3 ESAAB-equivalent