

## Summary:

The US Belle II Directors Review conducted January 16-17, 2014 concluded the project team is ready to seek Critical Decision 2/3 approval while addressing the following two major actions:

- Update the project budget and schedule to reflect use of optical components already produced and accepted during the prototyping to increase the project contingency
- Finalize design parameters for the quartz bar box and the electronics

Overall, the review team found the project team to be competent, enthusiastic, well managed and poised for success.

The project review was chartered by the Pacific Northwest National Laboratory (PNNL), Chief Operating Officer. The charge letter, agenda, and close-out presentation are attached. The review teams comments, observations and recommendations are listed below and organized by specific charge question.

### **1. Has the team responded appropriately to recommendations, including those from prior reviews? *Yes.***

- The project has undergone extensive reviews over the last two years. The team has responded to findings and recommendations from the prior reviews.
- There was a Belle Physics Advisory Committee (BPAC) review held in December 2013. The team just received the report. There are ongoing actions to address the recommendations made in reference to the BPAC report. US Belle actions to the BPAC report prior to CD2/3 IPR are important.

### **2. Are the project scope and specifications sufficiently defined to support cost and schedule estimates? *Yes, with recommendations.***

- The project has well defined scope and specifications; however, quantity of quartz bars to be produced with TEC funds and the version of KLM Read-Out boards has not been finalized.
- The Project Director said there is no difference between prototype quartz bars and final bars.
- Recommendation: Number of quartz bars to be produced with TEC funds needs to be finalized and incorporated in baseline prior to CD 2/3 IPR.
- Recommendation: KLM read-out board selection for baseline scope needs to be finalized prior to CD 2/3 IPR.
- Recommendation: Clearly state the baseline plan. Alternatives to the baseline can be considered as risk mitigation options.

### **3. Is the design sound and likely to meet the technical performance requirements described in the Mission Need Statement? *Yes.***

- Production ASICs: Final versions of IRSX/IRS3D and TARGETX chips have been submitted to foundry for production. If these chips fail there is no cost and schedule impact of falling back to IRS3C and TARGET 6 chips because the

engineering run includes 800 chips of each type. Testing of the final chip versions will occur in April.

- The baseline iTOP electronics (ISR3X) has some risk, since the ASICs have not yet been produced. The backup chip (ISR3C) has been tested on the bench, but not yet in a full system.
- The TOP counter with the CFD electronics has demonstrated that the beam test data agree with the MC simulation, for the small set of incident positions and angles that were tested. However, this test lacked several desirable features that would have resulted in a more complete system test.
- Both of these issues (ISR3C and more detailed optical tests) could be addressed by instrumenting the TOP prototype in the cosmic ray telescope (CRT) with the IRS3C electronics, and demonstrating that its data also agree with the MC simulation. Such setup is ideal to discover and fix any possible glitches in this type of electronics. In fact the CRT setup could be used to test new firmware upgrades in years to come.
- There are a few items related to the bar box construction, which are yet to be finalized and fully tested. For example, we note these items: (a) final glue choice for the bar box closure at the photon camera end, (b) details of the laser entry into the bar box near photon camera and at mirror end, (c) gas entry and exit, (d) choice of glue to seal the entire bar box, (e) final selection of RTV for MCP-to-bar box coupling, (f) many small items, which have to be exercised during several trial bar box assemblies. These items do not appear to bear directly on the quartz dimensions and so do not absolutely need to be settled before the CD-2/3 review. However, they must be settled before bar box production begins, which follows the review by only a few months. They should, therefore, be addressed as quickly and as thoroughly as possible.
- Assembly of complete prototype bar box should be completed as soon as possible following the resolution of the above items and before receipt of the first production bars. In case unexpected problems appear, this may allow for adjustment of the dimensions of the quartz bars, wedges or mirrors.
- We suggest providing a large area tracking in the CRT by KLM detectors, placed sufficiently apart to deliver required angular resolution. The main reason is that this type of detector is stable and requires minimum maintenance.

**4. Are the cost and schedule estimates credible and realistic for this stage of the project? Yes. Do they include adequate cost, schedule and scope contingency? Yes, with recommendations.**

- Project has mature cost and schedule estimates based on vendor quotes and experience in building prototypes.

- The project showed a budget with 21% overall contingency on TEC funds if it procures 36 quartz bars in addition to already delivered/contracted prototypes. Quartz bar procurement contingency of 5% is inadequate given that Aperture has not yet produced a viable prototype and firm pricing for remaining optics components has not yet been secured from Zygo. If the project uses four Zygo prototype bars to meet KPP target of 36, contingency percentage would increase to approximately 31%.
- Aperture was ~one year late in delivering first prototype bar which did not meet spec, but Aperture has addressed issue with a new material vendor. Four additional prototypes are expected from Aperture before CD 2/3 IPR. Zygo has had good schedule performance with prototype and the first bar met specifications. Aperture has one polishing machine and Zygo has five. Current plan is for each vendor to provide ½ of the bars. If Aperture is unable to produce bars within specifications, the Project Director said that Zygo has indicated they have capacity to produce all bars. Zygo bars are ~35% more expensive. Cost impact if Zygo produces all bars would be ~\$650K. Working to get a fixed price contract in-place with Zygo, including options for additional bars. It takes approximately 1 week for Zygo to produce a bar after approximately 3 months of material lead time. Cost risk for damage during shipment is owned by vendors.
- Quartz procurement must start in April 2014 to meet Japanese schedule for 2015 installation which assumes half of the bars coming from each vendor. It may be possible to increase schedule contingency with an accelerated schedule from Zygo.
- There is no schedule contingency on 2015 quartz bars. The project team should consider seeking accelerated schedule from Zygo to increase schedule contingency.
- 54% of the readout system cost is based on commodity materials. The cost estimate based on vendor quotes and/or prices for prototype parts.
- Presentation of baseline schedule would be more effective with select summary schedules for each WBS element. In particular, the iTOP schedule presentation should show delivery of parts for each module and Belle II integration deadlines organized by module rather than by parts.
- Project depends on continuing program money to partially fund university participants. Discussed that there is an understanding within the Office of Science that the project can't be successful without scientific grant support. Project has estimated the cost of program support being funding by grants. Worst case scenario would be a complete end to program grant funding (extremely unlikely) with a cost impact in the \$1M range according to the Project Director.

- Project Integration cost elements are based on an 18 month run time and good indication of future cost.
- Recommendation: Reduce number of TEC bars budgeted from KPP target of 36 to minimum of 32 using the Zygo prototype bars as the 4 spares. Obtain fixed pricing proposal from Zygo with options to produce all bars within schedule constraints. Reducing the number of bars budgeted to the threshold KPP level and using prototype bars as spares will increase contingency on TEC to 31%.

**5. Is the project being properly managed at this stage? Are the roles and responsibilities of the various project participants clearly identified, and have communication plans been established? Yes.**

- The project is more important to PNNL than the dollar value. The FCSD Associate Lab Director stated that PNNL will provide all necessary resources to be successful. "We not only want to meet the KPPs, but we want the upgrade to be successful to participate in the science."
- The project manager has done a good job of unifying the team. There appears to be improved cohesion from the December 2011 and March 2012 reviews.
- The L2 managers showed evidence of taking ownership for their scope.

**6. Has the management team met all the prerequisite requirements for CD-2/3 approval? Yes. *With recommendations.***

- CD 2/3 IPR is scheduled on March 19<sup>th</sup>.
- From a scope, cost, and schedule perspective the project is on target to seek CD 2/3 approval in March provided they resolve the scope definition problems (number of quartz bars and which detector board) which will lead to increased budget contingency.
- Some work still remains to achieve CD-2/3 approval. However, this work should be able to be completed in the next two months prior to the CD-2/3 review.
- The commissioning detector is ready for the CD-2/3 review. The addition of the more traditional He3 thermal-neutron counters provides an important backup to the innovative fast-neutron TPC detectors.
- The optical design and specification of optical elements has progressed considerably. Many questions were answered well during the review and clearly show that the project team is very detail orientated.
- The very quick and successful completion of the KLM part of the project is a notable achievement.
- The commissioning detector is ready for the CD-2/3 review. The addition of the more traditional He3 thermal-neutron counters provides an important backup to the innovative fast-neutron TPC detectors.

- Recommendation: Before placing the order for the remaining quartz bars, the project must be certain that the specified bar dimensions are compatible with a bar box design that satisfies design requirements and fits the available space in Belle II. Although there is not sufficient time remaining before CD-2/3 to build a functional prototype of the full design, a mock-up may be built that demonstrates all of the features of the camera end of the bar box, where most of the design complications lie. These include gluing of the wedge to its frame, support for electronics and services, and optical coupling of the PMTs to the wedge. It's recommended that construction of a mock-up prototype be given highest priority, as it is the best way to demonstrate to the CD-2/3 committee that the design requirements have been met.
- Recommendation: The bar box design results in significant forces being applied to the wedge. These forces are taken up by a frame surrounding the wedge and glued to it. A simple calculation presented at the review indicated that the resulting stress of the glue joint was not excessive. However, this calculation should be augmented by an FEA or other engineering analysis to calculate more accurately the stresses on the quartz and glue joint.

## Attendees:

### Review Committee:

Jim McClusky, PNNL Retired  
Mark Convery, SLAC  
Jerry Va'vra, SLAC (via phone)  
Dick Kouzes, PNNL  
Vince Genetti, PNNL

### Project Team

Jim Fast, PNNL  
David Asner, PNNL  
Paul Weinman, PNNL  
Lynn Wood, PNNL  
Gary Varner, University of Hawaii  
Leo Piilonen, Virginia Tech  
Sven Vahsen, University of Hawaii  
Tom Browder, University of Hawaii  
Matt Andrew, University of Hawaii  
Brian Kirby, University of Hawaii  
Brad Atencio, PNNL (NEPA)  
Amanda Stegen, PNNL (Worker Safety and Health)  
Kevin Grubbs, PNNL (Contracts)  
Kline Welsch, PNNL (Quality Assurance)  
Mike Toyooka, PNNL (Hazard Analysis)

### DOE Observers:

Alan Stone, DOE Office of High Energy Physics (HEP)  
Helmut Marsiske, Program Manager for Instrumentation, DOE HEP  
Jeff Day, Federal Project Director

### PNNL Management Team

Mike Schlender, PNNL  
Doug Ray, PNNL

### Belle II Observers

Yoshihide Sakai, KEK  
Toru Iijima, Nagoya University

### Additional PNNL Observers

Angus Bampton, PNNL



Review attendees during a break. A partial electronics assembly prototype was on display - center table.

## **Attachments**

Charge Letter – 2 pages

Agenda – 3 pages

Closeout Presentation – 5 pages



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OUT-0094-2013

October 23, 2013

Mr. Dale E. Knutson  
Director  
Strategic Projects  
PO Box 999, K9-69  
Richland, WA 99352

Dear Mr. Knutson:

**NEXT GENERATION B FACTORY DETECTOR SYSTEMS DIRECTOR'S REVIEW IN PREPARATION OF CRITICAL DECISION-2/3**

The objective of the Next Generation B Factory Detector Systems Development Project, managed by Pacific Northwest National Laboratory (PNNL), is to design, construct, and deliver detector systems for an Intensity Frontier experiment capable of making precision measures of the properties of B mesons and other types of heavy quarks and leptons.

In order to determine if the project management team has fulfilled the requirements for Critical Decision-2/3 and is ready to request a DOE CD-2/3 review and subsequent CD-2/3 approval, I am requesting that you organize and conduct a Director's Review of the Next Generation B Factory Detector System Development Project. The review should examine the state of the design, as well as plans for executing the project, system engineering, and overall integration.

In carrying out its charge, the Review Committee should respond to the following questions:



Mr. Dale E. Knutson  
October 23, 2013  
Page 2

1. Has the team responded appropriately to recommendations, including those from prior reviews?
2. Are the project scope and specifications sufficiently defined to support cost and schedule estimates?
3. Is the design sound and likely to meet the technical performance requirements described in the Mission Need Statement?
4. Are the cost and schedule estimates credible and realistic for this stage of the project? Do they include adequate cost, schedule and scope contingency?
5. Is the project being properly managed at this stage? Are the roles and responsibilities of the various project participants clearly identified, and have communication plans been established?
6. Has the management team met all the prerequisite requirements for CD-2/3 approval?

Angus Bampton has agreed to serve as the contact person for this review. In order to meet the project schedule, I ask that the Director's Review take place before the end of January 2014, and request receipt of the formal report within 2 weeks of the review.

I very much appreciate your assistance in the matter and look forward to receiving the report from the review committee.

Sincerely,



Michael H. Schlender  
Associate Laboratory Director  
Operational Systems Directorate

MHS/ACB/grr-jcb

cc: David M. Asner, Research Manager for High Energy Physics, NSD  
Angus C. Bampton, Project Manager, Strategic Projects Division, OSD  
Harvey Bolton, Jr., Interim Deputy Associate Laboratory Director, FCSD  
Jim Fast, US Belle II Contractor Project Manager, NSD  
Douglas Ray, Associate Laboratory Director, FCSD  
Michael R. Thompson, Interim Division Director, CS&M

# PNNL Director's Review – Belle II Project (Pre-CD-2/3)

Thursday, January 16, 2014  
8:00 am – 4:30 pm  
CSF Mural 1508A

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## AGENDA

TIME	TOPIC	LOCATION
8:00 am	Executive Session	Review Team Only
8:30 am	Introduction – Associate Laboratory Director of Operational Systems	Michael Schlender
8:40 am	Introduction – Associate Laboratory Director of Fundamental & Computational Sciences	Dr. Douglas Ray
8:55 am	Physics Impact	Dr. David Asner
9:15 am	Project Overview	Dr. Jim Fast
9:55 am	WBS 1.01 Project Management	Dr. Jim Fast
10:15 am	Break	
10:30 am	WBS 1.02 Scope, Cost & Schedule	Dr. Jim Fast
10:50 am	WBS 1.02 Specifications & Design	Dr. Jim Fast
11:20 am	WBS 1.03 Scope, Cost & Schedule	Dr. Gary Varner
11:40 am	WBS 1.03 Specifications & Design	Dr. Gary Varner
12:25 pm	Working Lunch (provided onsite)	All

# **PNNL Director's Review – Belle II Project (Pre-CD-2/3)**

Thursday, January 16, 2014  
8:00 am – 4:30 pm  
CSF Mural 1508A

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TIME	TOPIC	LOCATION
<b>1:25 pm</b>	WBS 1.04 Scope, Cost & Schedule	Dr. Leo Piilonen
<b>1:45 pm</b>	WBS 1.04 Specifications & Design	Dr. Leo Piilonen
<b>2:05 pm</b>	WBS 1.05 Scope, Cost & Schedule	Dr. Sven Vahsen
<b>2:25 pm</b>	WBS 1.05 Specifications & Design	Dr. Sven Vahsen
<b>2:55 pm</b>	Break	
<b>3:15 pm</b>	Executive Session (set schedule for p.m.)	
<b>3:30 pm</b>	Breakout session as needed	TBD
<b>5:00 pm</b>	Executive Session	Review Team Only
<b>6:00 pm</b>	Dinner – TBD	All

# **PNNL Director's Review – Belle II Project (Pre-CD-2/3)**

Friday, January 17, 2014  
8:00 am – 4:30 pm  
CSF Mural 1508A

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## **AGENDA**

TIME	TOPIC	PARTICIPANTS
<b>8:00 am</b>	Executive Session	Review Team Only
<b>8:30 am</b>	Response to Homework	TBD
<b>9:00 am</b>	Breakout Session Topics with Formal Presentations: <ul style="list-style-type: none"> <li>• Baseline Estimate Development</li> <li>• Project Management Support</li> <li>• Technical</li> </ul>	TBD
<b>12:00 pm</b>	Working Lunch (provided onsite)	All
<b>1:30 pm</b>	Executive Session/Report Writing	TBD
<b>4:00 pm</b>	Closeout Presentation	TBD
<b>4:30 pm</b>	Adjourn	



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# US Belle II Project Charge Question Overview

DIRECTORS REVIEW TEAM – CLOSEOUT REPORT

Richland, WA

January 30, 2014

# Charge Questions

1. Has the team responded appropriately to recommendations, including those from prior reviews? **YES**
2. Are the project scope and specifications sufficiently defined to support cost and schedule estimates? **YES**
3. Is the design sound and likely to meet the technical performance requirements described in the Mission Need Statement? **YES**
4. Are the cost and schedule estimates credible and realistic for this stage of the project? **YES** Do they include adequate cost, schedule and scope contingency? **SEE RECOMMENDATIONS**
5. Is the project being properly managed at this stage? **YES** Are the roles and responsibilities of the various project participants clearly identified, and have communication plans been established? **YES**
6. Has the management team met all the prerequisite requirements for CD-2/3 approval? **ON TRACK FOR MARCH**

- ▶ Project team is dedicated and the project manager provides strong leadership to the project team.
  - Project manager needs to rely more heavily on staff to cover all aspects of the project.
- ▶ KLM is complete and a notable achievement.
- ▶ Commissioning detector is ready for CD-2/3.
- ▶ Baseline iTOP electronics (3X) has some risk but there is a back-up (3C). Proceed getting the 3C into the cosmic ray test. This should allow a full comparison of Monte Carlo and data.
- ▶ Schedule graphics should show improved summary schedules including delivery of parts for each module and Belle II integration deadlines.
- ▶ The project has undergone extensive reviews over the past two years. These reviews have prepared the project for CD-2/3.
- ▶ Consider using spare KLM planes for iTOP cosmic test.

# Recommendations Prior to CD-2/3

- ▶ Success oriented plan
  - Communicate the end state (CD-4 success criteria)
- ▶ State baseline definitively
  - Scope and specifications
  - Finalize the number of quartz bars to be produced with TEC funds and update baseline schedule, budget and contingency
  - Consider accelerating quartz bar delivery with Zygo for 2015 bars
- ▶ Finalize the dimensions of the parts that need to be ordered
  - Have a complete QBB camera mock up
- ▶ Address any outstanding issues that pertain to any technical design review items for the US project
  - BPAC Review 12/2013
  - Addressing issues in the review is in progress



# Conclusion

- ▶ The committee supports the project moving forward to seek CD-2/3 approval