Report

of the

NSLS-II Project Advisory Committee

at

Brookhaven National Laboratory

December 10 – 11, 2009

Executive Summary

A meeting of the NSLS-II Project Advisory Committee (PAC) was held at Brookhaven National Laboratory (BNL) on December 10-11, 2009, to review the progress of the NSLS-II Project and make recommendations on matters related to project planning, execution, management, and safety.

The NSLS-II project has a very strong management team lead by Dr. Steve Dierker, Project Director, and Dr. Aesook Byon, Deputy Project Director. This team is capable of completing the project and delivering the baseline scope within budget and on schedule. Much progress has been made in management since the DOE CD-3 Review, the External Independent Review and FY 2009 funding changes. Open group leader positions were filled and 70 staff members were hired for a total of 220. Management team expertise was broadened with the addition of the Associate Director for Life Sciences. Accelerator Systems management was strengthened with the addition of the Deputy Division Director and a Project Engineer. The Construction Management team is now fully staffed and working effectively. Advanced plans for building out the experimental facilities were developed with users in workshops and with frequent interactions with sponsors (DOE-BES, DOE-BER, NIH, NSF, and others). Project management systems and controls have been fully implemented and are functioning well. Contracts have been awarded generally in line with estimates.

Overall design is progressing well and according to the Final Design Plan. All designs for the Conventional facilities are complete, including for the Laboratory Office Buildings (LOBs). The accelerator system R&D program is largely complete and designs are either completed well advanced. Prototypes have been built and successfully tested and all critical technical issues are being addressed. R&D for the Experimental Facilities program is progressing well. A Beamlines Final Design Plan outlines a phased completion plan and the beamline conceptual designs have been completed.

Construction progress has been excellent. The only remaining Conventional Facilities procurement to be placed is the LOBs. Site preparation was completed ahead of schedule. The Ring building construction is underway and modestly ahead of schedule. Significantly, the schedule was advanced using American Recovery and Reinvestment Act (ARRA or Recovery Act) funding. Procurement of major accelerator systems is underway and good progress has been achieved in preparing facilities and refining plans for the production and integration phase. The Experimental Facilities optics laboratory space is now established and procurement and installation of optics fabrication equipment is underway.

There are several activities important to the NSLS II scientific program in addition to the 6 beamlines that are in the line item scope, e.g. moving 20 beamlines from NSLS, building ~16 beamlines with BES MIE finding, plus beamlines funded by other sponsors such as NIH and NSF. A plan should be prepared which integrates these activities with other project work.

The Total Project Cost is unchanged at $912M and the current Baseline Estimate is $757M. There remains a contingency of $155M or 26% of work to go. $160M or 21% of the project work has been completed and another $175M is committed. This contingency is sufficient to successfully complete the project within the current estimate. Cost performance to date has been excellent; with a Cost Performance Index (CPI) of 1.04 through October 2009. Planning is underway to increase the baseline scope of the project if the very positive cost experience continues. This would be done by

adding, in a prioritized way, items removed from the scope prior to CD-2. A decision to enlarge the scope in this way does not need to be made earlier than October 2010. Developing and refining such a plan now is prudent; waiting to implement it until more cost experience is in hand would be wise.

$150 million in ARRA funds were allocated in April 2009 to advance funding for the project. This has significantly reduced project schedule risk by allowing earlier funding and award of the ring building contract which had been on the critical path. The new project schedule has an early completion date of June 2014 with four months of schedule float. CD-4, project completion, is scheduled 12 months later for June 2015. The PAC considers this schedule very likely to be achieved; the Project is currently on schedule and budget. The project maintains a formal risk management plan with a risk register where risks are identified, tracked and managed until they are retired.

A significant risk to the project and a challenge for management has been highlighted with the recent injury of a construction worker on the Ring Building construction. This was a "DOE Type B" type incident and one of three reportable injuries on Ring Building construction raising the TRC rate to 7.42. Project Management is committed to achieving a Best in Class ES&H program. Their program is a strong one; it is well defined and documented with extensive involvement of well qualified ES&H staff in all aspects of the project. A challenge remains to ensure a more effective implementation of this program by contractors and their subcontractors. More effective oversight of contractor safety by project personnel is needed. Project Management is committed to this and the implementation of all recommendations from the review of the Ring Building injury incident.

Overall, the project is on track for successful completion.

1) Introduction

The NSLS-II Project Advisory Committee (PAC) is appointed by and reports to Dr. Sam Aronson, the Brookhaven National Laboratory (BNL) Director. It is intended that the PAC will provide continuity of oversight for the project until its completion. A meeting was held at Brookhaven National Laboratory (BNL) on December 10 - 11, 2009, to review the progress of the NSLS-II Project and make recommendations on matters related to project planning, execution, management, and safety. The charge included a list of topics and specific questions to be addressed as part of the review. The PAC heard presentations from project leaders on subjects related to its charge. In addition, the PAC considered the reports of other technical advisory committees and the reports of review panels assessing the health of the project. The assessment of the Review Committee is documented in the body of this closeout report.

The sections in this closeout report are organized by Findings, Comments and Recommendations, which are defined as follows:

i) Findings are statements of fact that summarize noteworthy information presented during the review.

ii) The Comments are judgment statements about the facts presented during the review and are based on committee experience and expertise. The comments should be evaluated by the project team and actions taken as deemed appropriate.

iii) Recommendations are statements of actions that should be addressed by the project team.

Reference materials for this review are contained in the Appendices. The Charge for this review is shown in Appendix A. The review was conducted following the agenda shown in Appendix B. Committee members and their contact information are listed in Appendix C.

2) Technical Progress: Review the overall technical progress and assess the appropriateness of the project execution plans for meeting performance, cost, and schedule goals.

a) Findings

i) Outstanding results have been achieved for the development of the technical systems. Critical developments have been further advanced and correspondingly their risk reduced. The design goals are considerably above the basic scope. The base program foresees the operation at 300 mA and additional RF is needed to reach the design value of 500 mA. An emittance of 0.6 nm can be reached if the length of damping wiggler is increased from 21m to 56m.

ii) At the beginning six beamlines will be available and in addition 20 (bending magnet) beamlines will be transferred from NSLS.

iii) The strategy for booster procurement was presented. The decision was made for "turnkey" booster procurement, with some subsystems provided by NSLS-II (electronics, racks, RF). Injector design has been completed and the RFPs for the LINAC and Booster procurements are about to be published. Four potential vendors for the LINAC and up to three potential vendors for the booster are known.

iv) Prototypes for all magnets have been built and series production could be started (distributed over 5 vendors in 7 contracts). An optimized girder system has been presented and an integration procedure for the girder-magnet system was developed. The logistics for this procedure has been studied. Magnet survey and positioning on the girder and the alignment of the girder in the ring has been worked out.

v) The work on the vacuum system and the vacuum infrastructure is advanced and a prototype chamber has been constructed; a second prototype version of a shielded bellow has been completed. The developments on the RF-system are progressing well but the power coupler has to be improved. As a further design activity the development of advanced BPM electronics is performed in house.

vi) Full performance of the control system at commissioning start is envisaged.

vii) On the beamline sector R&D is under way for nm focusing and 0.1 meV resolution.

viii) The committee appreciates the impressive work done for the conventional facilities. A well structured execution plan with risk assessment has been presented.

b) Comments

i) An evaluation of the tradeoff between a gain in brilliance (i.e. reduction of emittance) with the loss of space for the implementation of insertion devices should be made. Damping wigglers are not an optimum radiation source for a high performance light source and the

incremental gain in emittance with an increasing number of damping wigglers is reduced for larger numbers of elements.

ii) The percentage of initial ID beamlines is comparably small. No planning was presented for the transfer of the NSLS beamlines. A resource loaded plan should be developed for the transfer of the 20 NSLS beamlines. It is unlikely that at the early stage of commissioning manpower from NSLS-II will be available for this operation. Also, the staff transfer from NSLS should be planned in more detail.

iii) Progress has been made with the booster procurement; three vendors would have the capability to execute the contract. Place the booster contract at the earliest possible date. Delays with the delivery have to be expected. Evaluate the performance of the vendor by looking at the execution of similar contracts. Part of the control system for the booster will be provided by the vendor. The Project should consider a fully harmonized control system for the booster by taking into account the double expertise needed for two different systems and the spare part policy.

iv) For the same reasons, place the Linac contract at the earliest possible date and evaluate if a full integration in the NSLS-II control system is possible.

v) Only 20% of the magnets will be re-measured after arrival. Be prepared (and provide planning) to perform the magnetic measurements of all magnetic elements in house. The alignment philosophy of the multipoles on the girder and the girder in the storage ring is convincing.

vi) Promising solutions for the RF coupler were presented but there is still a substantial risk regarding its full performance. When considering enlarging the project scope give less priority to the implementation of the full RF-system if budget or manpower difficulties should arise.

vii) The commercial fallback solution for the BPM electronics would be acceptable from the performance point of view.

viii) The design of the hardware architecture for the control system should be accelerated. Consider developing a staged implementation of the control system as a fallback solution.

ix) The procedure for approval of the beamlines is established. The strong involvement of the users via the BAT and ad hoc external committees is convincing. Excellent performance in scientific and technical scopes can be expected, it is an appropriate approach to guarantee sufficient influence on the design of a beamline by the users. R&D for nm focusing and 0.1 meV resolution is essential to reach the ultimate scientific goals; however, obtaining such resolutions is not the project's deliverable and therefore does not manifest a high risk to the overall project.

x) Carefully monitor the installation of potential vibration sources and the adequacy of their damping systems.

c) Recommendations

i) Relatively high priority is given to the current increase to 500 mA. Put the emphasis for initial operation rather on the achievement of the stability, the proper functioning of top-up injection and on the reliability of the machine.

ii) When considering enlarging the scope of the project, give beamline construction a higher priority.

iii) Speed up the construction of the insertion devices to shorten the overall commissioning time; evaluate the possibilities for external contracts.

iv) Make an attempt to have the insertion devices installed right from the beginning in order to save an additional 3 months shut down for their installation after first commissioning. Soleil has demonstrated that commissioning can be easily performed also with insertion devices and low gap vacuum chambers in place.

v) The risk on the vacuum system was evaluated as low but it might be higher than anticipated. Pay attention to the development of the vacuum system; for most of the light sources the vacuum system ended up on the critical path.

vi) Place the order for beamline optics as soon as possible. Major delays have been experienced for their fabrication. This procurement may be in competition with TPS, the ESRF upgrade and the APS upgrade.

3) Safety Management: Review adequacy of the safety program and whether it is being fully integrated and effectively managed.

a) Findings

i) The project has a strong Integrated Safety Management (ISM) plan.

ii) The plan flows down to contractors, and the implementation has been reviewed and audited.

iii) A serious accident involving a construction laborer occurred recently. The worker sustained a compound fracture of his leg, resulting in several days in the hospital. A full accident analysis has been completed.

iv) A new methodology for financial incentives for safety performance has been developed, which will make the incentives more effective, and the current contract will be amended to reflect it. These provisions should also be added to the solicitation for the LOB construction.

v) There have been a number of accidents recently at BNL, not just at the NSLS-II construction site.

vi) The CDRs for the six proposed beamlines were reviewed for safety using methods developed at NSLS.

b) Comments

i) The project has an active and dedicated safety management approach, not only in the ES&H group, but also extending to Project and Laboratory management.

ii) Prior to the accident of September 30, oversight of and communication with contractor staff was not adequate, and additional measures were needed. Improved mechanisms have been implemented and additional actions are being considered, specifically including the revised safety incentive program among others.

iii) In planning for the move of beamlines from NSLS and commissioning of the new beamlines, a longer look-ahead is warranted to prevent future problems.

iv) The Project should consider establishing an external safety review committee that would advise on the adequacy of safety analysis and documentation and also conduct readiness reviews. Ideally, such a committee should be established early so that it can have continuity as the work proceeds.

c) Recommendations

i) Continue to evaluate and improve oversight of contractors and subcontractors and their contractor and subcontractor ES&H programs.

ii) The project should begin planning now for the required safety readiness reviews (internal) for beamline commissioning.

4) Production, Installation, Start-up, and Commissioning: Assess the plans for production, assembly, and installation of the accelerator systems and plans for startup and commissioning.

a) Findings

i) The Project presented a scenario with the Linac and Booster procured as turnkey systems, with Booster installation labor provided by the Project. The storage ring relies on industrial component procurements with girder integration taking place in-house at BNL. Girders are shipped and installed into the ring enclosure without subsequent in-situ alignment. Six beamlines are provided as part of the CD-4 baseline. In addition the project plans to move approximately 20 beamlines from NSLS to NSLS-II starting in 2012. Additional beamlines are envisaged from other funding mechanisms.

ii) Major system procurements have started for many ring components such as magnets and vacuum. RFP's for the Booster and Linac are expected within the next few weeks. Other systems such as RF and power supplies will be on the street in the next 12 months.

iii) Installation activities are scheduled to start by mid FY11 with the first beam in the injector in April 2012. The storage ring beam commissioning will take place in FY13/14 in two phases. The second phase envisages the insertion devices in place. The Project is working toward a completion date of February 2014 which provides a nominal schedule float of 16 months.

b) Comments

i) Magnet-Girder integration will be an important step in the next 12 months. The mechanical tolerances are challenging and ultimately two girders per week will be required. Facilities and resources to achieve this have been identified but demonstrating girder fabrication will be a critical issue for the next 12 months.

ii) The Booster procurement, installation and commissioning relies on an as yet unknown vendor maintaining a brisk schedule over an estimated two year period. Integration into the overall accelerator complex will not be completely straightforward either. While the PAC does not see any obvious problems at this time a high priority must be given to a timely award of the contract. The PAC also believes that significant interaction between the Project and the vendor will be required and the Project needs to prepare for this eventuality. The overall Booster schedule is the major risk for the accelerator systems at this time.

iii) The PAC commends the Project for an early start in assessing the commissioning scenario and the associated authorization basis. Accelerator commissioning protocols are well established at Brookhaven and the Project is knowledgeable of these requirements. The PAC

was less clear on the planning to commission the experimental facilities and the exact requirements for launching the experimental program. To a certain extent this was created by the sixteen-month schedule float at the end of the Project and what activities are proposed to take place during this time. The PAC suggests more clarity in this regard is necessary.

iv) Probably the biggest issue for facility commissioning involves the additional beamlines beyond the nominal six. The plan is to move twenty beamlines from the NSLS and also implement additional ones from other funding sources such as NIH and DOE-MIE funds. This is an excellent idea, as it will allow NSLS-II to ramp up the user program much faster, which is especially important in view of the projected shut-down of NSLS as soon as NSLS-II is operational. It is also evident that this will be a major activity in its own right and it will have direct impact on any facility commissioning plans and manpower needs. The PAC believes that much more work is needed in this area.

c) Recommendations

i) The project should develop a detailed plan for the complete beamline installation scope, dealing specifically with manpower needs, coordination with contractors (who will not have left the site), as well as scientific rationale for particular choices.

ii) The Booster procurement and subsequent vendor liaison should be closely monitored.

iii) The detailed choreography associated with the experimental beamline commissioning, transition to operations, the role of the schedule float, and formal readiness requirements needs better definition.

5) Procurement and Contract Management: Assess the plans for remaining procurements and contract management.

a) Findings:

i) The procurement staff is fully integrated and works well with the technical staff.

ii) Future planning for additional staff to manage a significant surge in activity is in place and supported by BNL central procurement.

iii) Advance planning methodology is in place for FY10 and beyond procurements such as Linac, Booster and the LOBs.

iv) All of FY09 Major Procurements are under contract and are on schedule.

v) RFPs for all FY10 Major Procurements are in process and will be issued to industry not later than January 2010.

vi) Renegotiation of the safety incentive with the Ring Building contractor was completed. A request for approval of the revised incentive was submitted to DOE, and approval is anticipated by late December.

b) Comments:

i) The procurement planning and contract management is being conducted professionally by a fully integrated and competent staff.

ii) The staff planning for future workload growth is in place and should support the project needs.

iii) The working relationship between the technical staff and the procurement staff is excellent.

iv) The safety incentive changes, in award methodology, are appropriate for the conditions that exist and should enhance the safety performance of the contractor.

v) The advance procurement planning being conducted demonstrates the commitment to staying ahead of the project needs.

c) Recommendations:

i) Continue to monitor manpower needs to ensure adequate staffing is in place to handle the FY10 and beyond increase in contract administration workload. Consider adding two additional staff.

ii) The renegotiation of the safety incentive on the Ring Building should be completed as soon as possible.

iii) The new safety incentive should be included in the LOB procurement.

6) Risks: Are the Project's risks being managed effectively and is the contingency adequate for the remaining risks?

a) Findings

i) The project is about 21% complete through October 2009. The remaining contingency $155M is about 26% based on actual work to go, but 37% based on uncommitted work to go, due largely to the large fixed price contract awarded for the Ring Building.

ii) The project has a risk management program to help identify and manage technical, cost and schedule risks. The risk register currently has 23 items. The cost risk identified in these items totals about $66M.

b) Comments

i) The risk management process is mature and seems to be an effective tool that is being used by NSLS-II management.

ii) The remaining contingency is adequate for the remaining risks.

7) **Contingency spend plan: Assess the appropriateness of the contingency spend plan related to risks and the project funding profile.**

a) Findings

i) A contingency spend plan was presented to the committee based on NSLS-II management's assessment that currently identified risks may not require full use of the remaining contingency.

ii) Remaining contingency could be utilized to provide additional scope to maximize the scientific potential of the NSLS-II facility.

iii) A list of 13 items totaling ~$86 M was presented, along with a candidate timeline for how the added scope might be phased over the remainder of the project to always keep a balance of ~25% of work to go, available for contingency draws.

b) Comments

i) Given the good cost experience to date and the assessment that remaining risks seem to be under control, the committee believes that it is fully appropriate to begin planning for effective utilization of contingency funds that might become available. Nevertheless, the project is many years away from completion and there could be many demands on this contingency that are currently unforeseen. The project should wait for significantly more cost experience before enlarging the scope in this way.

Appendix A

Charge to the NSLS-II Project Advisory Committee
December 10-11, 2009

Since obtaining CD-3 approval on January 9, 2009, the NSLS-II project has made a substantial progress on construction of the Conventional Facilities and procurements of the production components for the Accelerator Systems. The Conceptual Design of the Experimental Facilities also has been completed.
Following a successful DOE Lehman Review in June 2009, the Project held a Conceptual Design Review for Experimental Facilities on October 13-14, an Accelerator Systems Advisory Committee meeting on October 22-23, and a Conventional Facilities Advisory Committee meeting on November 9-10.

The primary goals for 2010 are to keep the Project on schedule and on budget while ensuring safety, to refine plans to begin assembly and installation of the accelerator systems, and to refine plans to successfully transition from construction to commissioning. In addition, the Project has developed a contingency spend plan to plan for scope additions in case of continued good cost performance. In this context, the PAC is kindly requested to evaluate and make recommendations on the following topics:

1. Technical Progress: Review the overall technical progress and assess the appropriateness of the project execution plans for meeting performance, cost, and schedule goals.
2. Safety Management: Review adequacy of the safety program and whether it is being fully integrated and effectively managed.
3. Production, Installation, Start-up and Commissioning: Assess the plans for production, assembly, and installation of the accelerator systems and plans for startup and commissioning.
4. Procurement and Contract Management: Assess the plans for remaining procurements and contract management.
5. Risks: Are the Project's risks being managed effectively and the contingency adequate for the remaining risks?
6. Contingency spend plan: Assess the appropriateness of the contingency spend plan related to risks and project funding profile.

A review report is requested to be sent to the BNL Laboratory Director by January 11, 2010.

Appendix B

NSLS-II Project Advisory Committee Meeting

AGENDA

Large Conference Room, Bldg 703

Thursday, December 10, 2009

08:00 - 09:00 Committee Executive Session
09:00 - 09:10 Welcome ..... S. Aronson
09:10 - 09:50 NSLS-II Overview .....S. Dierker
09:50 - 10:10 Break
10:10 - 10:40 Conventional Facilities ..... M. Fallier
10:40 - 11:10 Accelerator Systems..... F. Willeke
11:10 - 11:40 Experimental Facilities .....Q. Shen
11:40 - 12:10 Accelerator Production and Installation Plan ..... E. Johnson
12:10 - 12:50 Lunch
12:50 - 02:50 Tour
02:50 - 03:00 Break
03:00 - 03:20 Authorization Basis Plan.....S. Hoey
03:20 - 03:40 Start-up/Test/Commissioning Plan ..... F. Willeke
03:40 - 04:00 Break
04:00 Start Committee Executive Session
04:00 - 04:20 Project Performance and Risk Management .....A. Byon
04:20 - 05:00 Contingency Spent Plan .....S. Dierker
05:00 - 06:00 Committee Executive Session
06:00 Adjourn

Friday, December 11, 2009

08:00 - 08:30 Project Management and Support ..... D. Hatton
08:30 - 08:50 Procurement and Contract Management ..... T. Guadagni
08:50 – 12:00 Committee Executive Session
12:00 – 01:00 Lunch
01:00 – 02:00 Closeout
02:00 Adjourn

Appendix C

Project Advisory Committee Membership:

Ken Stanfield, Chair, FNAL (retired)	stanfield@fnal.gov
Gene Desaulniers (retired)	desaulgene@aol.com
Michael Harrison, BNL	Harrison@bnl.gov
Suzanne Herron, ORNL (did not attend this meeting)	herronsa@ornl.gov
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