Report

of the

NSLS-II Project Advisory Committee

at

Brookhaven National Laboratory

February 8 – 9, 2011

Executive Summary

A meeting of the NSLS-II Project Advisory Committee (PAC) was held at Brookhaven National Laboratory (BNL) on February 8-9, 2011, to review the progress of the NSLS-II Project and make recommendations on matters related to project planning, execution, management, and safety.

The project is making excellent progress and is now 48% complete. The project is now in full construction phase and is in its peak spending year ($245M in FY 2011). It is currently on schedule and on budget and has had excellent technical, cost and schedule performance to date. The current baseline cost estimate is $785M, an increase of $23.7M since December 2009. The Total Project Cost remains $912M. The remaining contingency of $127M is adequate for the remaining work which is valued at $426M. At present there are 15 months of float relative to the CD-4 date of June 15, 2015. Project management systems are now fully implemented and functioning well to provide information for project decision makers.

The NSLS-II project team, led by Dr. Steve Dierker, Project Director, and Dr. Aesook Byon, Deputy Project Director, is fully capable of completing the project while delivering the baseline scope within budget and on schedule. Management progress the past year includes the appointment of a new Science Advisory Group (SAC) which replaces the previous SAC and the Experiment Facilities Advisory Committee. The Photon Sciences Directorate has been reorganized to merge the NSLS-II Project organization and NSLS operations. This has the benefit that workforce planning can be more cost effective and efficient. But it also adds significant non-project responsibilities to NSLS-II project staff, especially within the accelerator and experimental facilities areas. This should continue to be closely monitored and it should remain clear that the priority lies with the NSLS-II Project work.

Technical Progress

Overall design continues to progress well according to the Final Design Plan. The nano-probe building and bid package were completed and added to the LOB contract. Accelerator designs are now either completed or far advanced. Prototypes have been built and successfully tested. Many critical technical issues have been addressed and solved. R&D for the experimental facilities has progressed well. Preliminary designs have been completed and undergone technical review. Beamline baseline scope and future upgrade paths are now well defined.

Safety Management

There has been a substantial increase in R&D, operations, and construction activity this year. Over 1.2M project hours have been worked to date with one recordable injury. Over 0.5M contractor hours have been worked with 6 recordable injuries and 3 DART cases. Over the past year significant improvements in contractor oversight and contractor's implementation of the ES&H program have substantially strengthened the project safety program. Lessons learned from the ring building contract are now being applied to the LOB contractor safety program. Early deficiencies in construction safety program implementation have been addressed and processes are in place to move forward safely with minimum risk. Significant planning for future project activities has been made including developing the authorization basis strategy and documentation and establishing the

Beneficial Occupancy Readiness Review process.

Production, Installation, Startup, and Commissioning

Conventional construction activities are progressing well. The ring building construction is on schedule and beneficial occupancy of the first pentant is complete; the LOB contractor has mobilized.

Generally, good progress has been made in starting production activities according to schedule. However, production of storage ring magnets that meet acceptance criteria has been delayed. These magnets and other accelerator components lie on the critical path for the project and their schedule no longer has float relative to the early 2014 completion date. Mitigation plans are being developed including the possibility of parallel production lines. We recommend that cost and schedule risk be re-evaluated for these technical component production activities realizing that they have the potential to significantly delay the entire project and thereby cause the utilization of cost and schedule contingency beyond what has been estimated.

Planning for the commissioning phase has progressed; commissioning plans are advanced. The integrated project plan for these activities has in some cases not been updated since CD-2. This should be done at the next global update of the integrated cost and schedule. A lesson learned from other projects is that resources for commissioning are often significantly underestimated.

Risk and Contingency Spend Plan

Risks are identified and maintained in a risk register. These risks are quantified by estimating their potential cost and schedule impact. The PAC is concerned that this process does not always establish a complete view of the possible impacts to the full project and in some cases their impact on overall cost and schedule could be underestimated.

Photon Sciences Directorate Portfolio and Planning

An excellent process has been developed for selecting and establishing the future program. This process utilizes the SAC and has good community participation. Funding is an issue for keeping the plan on schedule for the early start date in 2014. Potential funding sources for this plan were described; they include the possible use of project contingency funds. The plan which would develop beamlines beyond the project baseline scope of 6 project beams is very ambitious.

Scope options, including additional beamlines, should continue to be evaluated while contingency usage experience is gained. Risks such as arise from possible significant production delays should be mitigated prior to adopting any plan for significant scope additions.

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 February 8 – 9, 2011, 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 Project Advisory Committee is documented in the body of this report.

The sections in this 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) The technical status and the technical progress in the past 12 months are consistent with the project schedule.

ii) Conventional construction is proceeding well; the design is stable as witnessed by the errors and omissions which are currently running at the commendable level of 2%. The ring building is on schedule and beneficial occupancy of the first pentant is complete. Final Design is complete and 98% of CF construction costs are under fixed price contract.

iii) The accelerator systems have essentially concluded all of their final design reviews (Linac, booster, instrumentation, power supplies, insertion devices, transfer lines ….). Additional designs have been completed; remaining designs are far advanced. Final design reviews and/or manufacturing problems of vacuum components resulted in redesign and delay, but are not expected to impact major milestones. Review of BL front-end resulted in re-design and delays, but is not expected to impact key milestones.

iv) There has been good progress in defining the baseline and instrument conceptual designs for the six project beamlines. The choice of beamlines is appropriate, and will create best in class instruments when completed and when NSLS-II is fully operational. The 6 project beamlines have completed their conceptual design, and the final design is underway (user workshops, preliminary design reviews) and should be completed during the next 12 months.

v) A new MLL deposition system has been delivered and assembled, and used to perform initial MLL deposition runs.

b) Comments

i) Overall the technical status and the technical progress in the past 12 months have been good.

ii) The machine design appears stable and there are no obvious areas remaining that require significant additional design work.

iii) The design maturity of the Experimental Facilities meets the requirement specified in the Experimental Facilities Final Design Plan.

iv) Design reviews are being held and there is evidence that redesign is being performed as needed.

v) Overall cost and schedule performance to date is excellent. The negative schedule variances in specific areas (e.g., ASD) appear to be understood and are being addressed.

vi) The project is to be commended on the continuous update and analysis of the critical path, schedule float, and resource and spending profiles in addition to the formal risk management process. These processes will continue to help keep the project on track to meet cost, schedule, and technical objectives

vii) Now that the conceptual design reports for the beamlines are complete, work must continue on developing more detailed designs in order to ensure that there are no impacts on existing infrastructure designs.

viii) It is important to complete fabrication of the MLL devices using the new growing apparatus to ensure that this path is indeed open.

c) **Recommendations** (None)

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

a) Findings

i) The NSLS-II Project has developed its strategy for commissioning the accelerator, consistent with the Accelerator Safety Order. Four commissioning stages – Linac, booster, storage ring, and final operations – are planned.

ii) A team comprised of BNL and external experts will conduct the Accelerator Readiness Reviews (ARR). The ARR for the Linac is scheduled for November 2011.

iii) The safety management program has used the bad early experience with the ring contractor as a lesson learned, and has greatly improved oversight. Although it is early times, the interaction of the two on-site contractors (ring and LOB) has been improved, and the safety culture has been passed on to the new contractor. The accident rate has improved dramatically since the first year, although it is not yet at the DOE goal.

iv) The overall safety culture has been strengthened for both contractors and BNL staff, with apparent buy-in from the entire project, and strong management support. The ES&H program is well established, and is making good use of other Laboratory resources.

v) The process for instrument readiness reviews has been developed to a good draft form, and seems appropriate for this stage of development. Past operating experience at NSLS has been well utilized in developing this process.

b) Comments

i) The committee fully supports the approach adopted for the ARR. Further, we believe it would benefit the project for the ARR team to review and provide feedback on the overall NSLS-II safety plans and documentation as early as practicable.

ii) Although the improvement is dramatic, and support is strong, the Project must remain vigilant and work to continue improvement, paying special attention to the two on-site contractors.

iii) The Project should adopt stretch goals for reducing safety incidents, which go beyond the DOE goals.

iv) The IRR process (not individual instruments) should be reviewed by an external group, such as the ARR team, when fully developed.

c) Recommendations

i) Establish the charter for the initial task of the ARR Team to cover not just the Linac, but also the complete facility, to the extent that available information allows.

4) Production, Installation, Start-up and Commissioning: Assess the plans for production, assembly, and installation of the accelerator systems and 6 project beamlines and plans for startup and commissioning.

a) Findings

i) While the experience to date with the schedule has been reasonably good, there are evident issues in moving from design into production and an overall tightening of the schedule in a general sense in the accelerator systems area. There are no installation and commissioning activities at this time.

ii) The most pressing schedule problem is the magnet production associated with the storage ring. Only one of the six vendors is performing at the contractual level (Danfysik), and there are issues with the remaining five vendors in varying degrees. To date only 11 elements have been accepted (all first articles) out of the 201 scheduled, and a total of 826 required.

iii) Girders (with production magnets) are scheduled for tunnel installation in April so should production slip past this date then other aspects of the project will be affected.

iv) Only one vendor has demonstrated a production capacity to date.

b) Comments

i) Regarding the magnet production issue the PAC can imagine two possible solutions: make the contracts perform, and/or mitigation. With adequate vendor oversight the most likely outcome is that the contracts produce magnets at a slower rate than desired (at least in the beginning). The worst case would be vendors who are unable to meet the technical specifications under production conditions. Mitigation actions presently under consideration involve establishing parallel production lines with additional vendors and in-house production in the BNL magnet division. Mitigation measures will provide insurance against the worst case scenario but will not regain the short term schedule.

ii) Although nominally on schedule at this time other areas of (potential schedule) concern to the PAC are:

(1) Booster – the final design review is in progress at the time of writing but there are only about 18 months until the completion of the production and installation of the components and 26 months until the completion of commissioning at BNL with the machine components prototyped, fabricated and tested in Russia prior to shipping to BNL.

(2) SRF cavities – the cryomodules are scheduled for installation in 2 years. This is a difficult technology and the contract is not yet placed. It appears to be prudent to plan for the initial commissioning with the PETRA RF system.

(3) Cryogenics – the refrigerator contract is presently still in procurement. The schedule calls for the system to be installed and operational in 2 years.

(4) Vacuum systems – production is just beginning. These are difficult mechanical systems and until production is established the PAC has some concerns.

(5) Insertion devices – Only one (of the six) insertion devices has been placed yet with the schedule requiring devices to be installed and operational in 30 months. Since these elements all involve one-off designs in-house production may be the correct approach.

iii) The project beamlines are less advanced than the accelerator systems but the conceptual designs are stable. The possible issues would seem to involve technical risk associated with the state-of-the-art components but this will take another 12 months or so to become apparent as the detailed component designs emerge.

iv) The PAC heard about the planning for the transition to operations: The process is just getting underway. The formal requirements necessary for facility operations are well understood, and the existing BNL protocols will suffice. This aspect of the project appears well in hand.

v) In a similar fashion to operations, the commissioning requirements are well understood and have been documented as a basis for the planning in this area. The Project has a strong team with an extensive experience base. Applications software development is underway. Possible parallel commissioning scenarios are under investigation.

c) Recommendations

i) All mitigation measures under consideration associated with magnet production should be pursued aggressively as soon as possible.

ii) The Project should review the feasibility of the baseline schedule for the systems discussed above (Booster, SRF cavities, Cryogenics, Vacuum systems, Insertion devices)

5) Risks and contingency spend plan: Are the Project's risks being managed effectively and the contingency adequate for the remaining risks?

a) Findings

i) The project is approximately 48 % complete as of January 2011. The remaining contingency is $127 million which is 30 % of work to go and 36% on uncommitted work to go.

ii) The Early Project finish date is June 2014; the late Project Completion date is June 2015. The current forecast for project completion is March 2014.

iii) There are 15 months of schedule float for CD-4 (41% schedule contingency).

iv) Three weeks of schedule float has been lost over the past 17 months.

v) The project has a Risk management program that is used to identify and manage technical cost and schedule risks.

vi) The Risk Register is routinely reviewed and reflects the most current project information available and the decision making history affecting each item in the registry. There are currently 17 active risks in the register which are estimated to have a potential cost impact of 57 million dollars.

vii) A number of major risks (technical, cost and schedule) have been retired or now have reduced risk ratings.

viii) The contingency spend plan reflects the projects projection of funding that will be required for identified risks.

ix) The contingency spend plan also provides for contingency usage for additional scope items (14 items totaling approximately $62M dollars).

b) Comments

i) The Risk Program is very well organized and managed. It reflects the latest risk assessments and mitigation plans; however, the probability of success for risk mitigation and the potential for residual risks is not obvious.

ii) The Project EAC is being tracked. However, it is not clear at this time if the cost and schedule impacts for the mitigation strategies' are shown as part of the EAC, contained in the project estimate/schedule, or not documented.

iii) Although there appears to be adequate cost and schedule contingency to meet the project objectives by June 2015, there are still many challenges in executing the project. It is very

common for project teams to be overly optimistic in cost and schedule estimates as well as in the assessment of risks and the committee is concerned that the NSLS II project team is being overly optimistic.

iv) Contingency usage should be carefully orchestrated and not used for added scope additions until the project can ensure future risks can be accommodated should they materialize.

c) Recommendations

i) Formally document the probability of success for risk mitigations and the potential for residual risks.

ii) Ensure the estimated cost for risk mitigations are contained in the project estimate or the EAC.

iii) Ensure that the cost and schedule estimates and the impacts of the risks are realistic, in particular in the following challenging areas: storage ring magnets, Linac and Booster, superconducting cavities, cryogenic plant, beamlines, and all installation and commissioning activities.

iv) Continue planning for scope additions and defer the use of contingency for those items until more experience is gained, especially in the area of accelerator component production.

6) Photon Sciences Directorate Portfolio and Planning: Assess the appropriateness of the contingency spend plan and facility transition plan in order to ensure the maximum scientific productivity upon project completion.

a) Findings

i) NSLS II management considers it a very high priority to minimize the "scientific down time" in the transition from NSLS to NSLS-II. With the directed plan to shut down NSLS at the end of FY2014, this places a premium on getting as many world-class beamlines operational on NSLS II as early as possible. To achieve this requires that additional conceptual design and planning begin in the FY 2011 timeframe.

ii) The NEXT Project (MIE) has been established to provide 6 beamlines in addition to the 6 beamlines in the NSLS-II Project itself. CD-0 was approved in May 2010; however, the plan to begin funding this work in FY 2011 has not materialized.

iii) NxtGen refers to the effort to combine selected components from NSLS beamlines with new hardware to constitute new beamlines suitable for NSLS-II. This would result in up to 14 more beamlines. Funding for this activity was planned to come from the NSLS-II operations program, which was to start in FY 2012; however, current guidance is that this funding will not be available until FY 2013.

iv) NSLS-II management proposes to add scope to the Project in FY 2011 which would support the eventual development of additional beamlines at NSLS-II. The amount would be around $5 million.

v) The current estimate for the annual operating cost of the NSLS-II facility, beginning in FY 2016, is $140 million. However, this is based on high level analysis and benchmarking against other facilities rather than detailed estimates and planning.

vi) The project has responded to our request for a detailed plan for the transition to operations with the beginning of a plan – in fact several plans that are aggregated into a facility plan. This plan includes all foreseen instrument development and installation, and will help guide planning for the difficult transitions.

vii) The planning process used in establishing priorities was excellent. It made good use of the Science Advisory Committee, both for community outreach and proposal review.

viii) The response of the user community was outstanding, a testament to the need for this facility.

ix) The prioritized list of instruments is appropriate, and will lead to an excellent facility that is responsive to the users' needs.

x) The plan is ambitious, even aggressive, in its attempt to improve the rapid startup of a world class science program.

b) Comments

i) The committee fully supports the high priority for these activities. However, it is undesirable to rely on the NSLS-II Project budget for this work. The budget flexibility that exists during a Continuing Resolution period might allow the work to proceed under an operating account. This should be explored.

ii) It is very important for BNL and DOE to have a common understanding and agreement on the cost of operating this facility. The Project is now sufficiently advanced to support detailed cost estimating.

iii) NSLS-II should consider a detailed facility operations cost estimate and have it reviewed by BES and BHSO, including the participation of other SC laboratories.

iv) Work on the TOPs should continue, and expand to include the need for new metrics and management needs for the operations phase.

v) It will be essential to continue the involvement of the user community, especially if unforeseen delays in accomplishing the goals cause a delay in availability of instruments. We urge the Directorate to maintain continuous lines of communication on the status and progress.

vi) We applaud the ambition of the vision involved in the planning. It is essential that NSLS-II ramp up its scientific activities at a rate far more rapid than has occurred at other facilities.

c) Recommendations

i) We recommend that project scope options, including additional beamlines, continue to be evaluated while contingency usage experience is gained. Risks such as arise from possible significant delays in accelerator component production should be mitigated prior to adopting any plan for significant project scope additions.

Appendix A

Charge to the NSLS-II Project Advisory Committee

February 8-9, 2011

During the year 2010, the NSLS-II project made an excellent progress on construction of the Conventional Facilities and production of components for the Accelerator Systems. Three DOE Lehman reviews were held in 2010 and all concluded satisfactory assessments for the Project's performance. The Preliminary Design of the six project beamlines was completed and reviewed and an Accelerator Systems Advisory Committee meeting and a Conventional Facilities Advisory Committee meeting were also held in October 2010.

The Project will be over 45% complete while maintaining the baseline parameters with reasonable cost and schedule contingencies available. The project has continued to analyze remaining risks and update plans to add scope beyond the baseline to maximize the scientific productivity of the facility.

The planning for beamlines and user capabilities for the entire facility is very important for achieving the maximum scientific productivity as soon after project completion as possible, and for ensuring a smooth transition from NSLS to NSLS-II. The Photon Sciences Directorate, a sponsoring directorate for the NSLS-II Project, executed a comprehensive user community engagement and peer review process to identify, evaluate, and select beamlines (beyond the project scope) to populate the facility. In addition, the Directorate implemented a new organizational structure which enable more cost effective resource planning and improve workforce planning.

The primary goals for 2011 are to continue to keep the Project on schedule and on budget while ensuring safety, to execute assembly and installation of the accelerator systems, and to finalize plans to successfully transition from construction to operations. 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 6 project beamlines and plans for startup and commissioning.

4. Risks and contingency spend plan: Are the Project's risks being managed effectively and the contingency adequate for the remaining risks?
5. Photon Sciences Directorate Portfolio and Planning: Assess the appropriateness of the contingency spend plan and facility transition plan in order to ensure the maximum scientific productivity upon project completion.

A review report is requested to be sent to the BNL Laboratory Director by March 11, 2011.

Appendix B

NSLS-II Project Advisory Committee Meeting

AGENDA

Building 817, Room 4

Tuesday, February 8, 2011

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 Project Performance and Risk Management .....A. Byon
10:10 - 10:25 ESH..... S. Hoey
10:25 - 10:45 Break
10:45 - 11:10 Conventional Facilities .....M. Fallier
11:10 - 11:55 Accelerator Systems..... F. Willeke
11:55 - 12:20 NSLS-II Project Beamlines..... Q. Shen
12:20 - 01:00 Lunch
01:00 - 02:00 Tour
02:00 - 02:20 Break
02:20 - 02:40 Facility Transition to Operations .....E. Johnson
02:40 - 03:00 Authorization Basis Plan..... S. Hoey
03:00 - 03:20 Accelerator Start-up/Test/Commissioning..... F. Willeke
03:20 - 03:40 Beamlines Transition to Operations..... Q. Shen
03:40 - 04:00 Break
04:00 - 06:00 Committee Executive Session
06:00 Adjourn

Wednesday, February 9, 2011

08:00 - 09:00 Photon Sciences Directorate Portfolio and Future Planning.....S. Dierker
09:00 – 12:00 Committee Executive Session
12:00 – 01:00 Closeout
01:00 Adjourn & Lunch to Go

Appendix C

Project Advisory Committee Membership:

Ken Stanfield, Chair, FNAL (retired)	kenstanfield@comcast.net
Gene Desaulniers (retired)	desaulgene@aol.com
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Suzanne Herron, ORNL	herronsa@ornl.gov
Michael Rowe, NIST Center for Neutron Research (retired)	jmrowe@erols.com
Les Price, DOE Oak Ridge (retired)	lasprice@tds.net
Albin Wrulich, Paul Scherrer Institute (PSI) (did not attend)	albin.wrulich.psi.ch