National Synchrotron Light Source II

Project Progress Report

November 2011

NSLS-II site on the morning of November 30. Structural steel erection is underway for Lab–Office Building 5 (right forefront).

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OVERALL ASSESSMENT

The National Synchrotron Light Source II project continued to make excellent progress with satisfactory performance. By the end of November, the project was over 67% complete with about 33% of contingency and management reserve for the remaining Budget At Completion (BAC). The cumulative Schedule Performance Index (SPI) for the overall project is 0.96; the cumulative Cost Performance Index (CPI) is 1.01.

Construction of the ring building continues with beneficial occupancy for pentant 5, the last section of the ring building, being scheduled to occur in January, a month ahead of schedule. Construction of the lab–office buildings (LOBs) is making excellent progress with the erection of structural steel for LOB 5 having begun in November.

Excellent progress continued on the production and delivery of magnets, linac, booster, power supplies, vacuum, RF, and cryogenic systems. Delivery of most linac components was nearly completed; they are being installed upon delivery. The booster components will start to arrive at BNL in December. Magnet production continued to make excellent progress, with over 40% of magnets delivered. The contract for one of the in-vacuum undulators (IVU) was awarded and the final contract for another type of IVU is being finalized. Progress continued in accelerator installation in pentants 1, 2, 3, the RF building, the injector building, and the computer room. Installation of the RF system is nearly complete, and final acceptance of the system will occur in January. Installation of the linac system is on track for the start of commissioning in late February. Six magnet girders were installed in the storage ring, and installation of mechanical and electrical utilities and infrastructure elements continued in pentants 2 and 3.

Good progress continued with the procurement of long-lead-time components for the six Project beamlines. A successful design review of the lead and steel hutches led to an approval for manufacturing of the first hutch.

Activities funded by the American Recovery and Reinvestment Act (ARRA) continue on schedule and on budget.

UPCOMING EVENTS 2011 – 2012

Science Advisory Committee 2011 Beamline Development Proposal Panels:	
Biological and Medical Sciences	Dec 1, 2011
Spectroscopy and Spectromicroscopy	Dec 6, 2011
ALD's Conceptual Design Review for ABBIX Project	Jan 17-18, 2012
Accelerator Systems Advisory Committee	Feb 1-2, 2012
DOE mini-review of NSLS-II Project	Feb 7, 2012
Science Advisory Committee	Mar 15-16, 2012
Project Advisory Committee	Mar 29-30, 2012
DOE Review of NSLS-II Project	Apr 17–19, 2012
DOE Review of NSLS-II Operations	May 16-17, 2012
DOE CD-2 Review of NEXT Project	Jun 5-7, 2012

ACCELERATOR SYSTEMS

Linac. The delivery of the linear accelerator ("linac," Fig. 1) was nearly completed in November. Accelerating structures, beam focusing elements, pumps, buncher systems, modulators, and electronics and control equipment have all been delivered and installed, leaving only a few items like waveguides, cable trays and cables, and the front end to be delivered and installed in December.

Figure 1. Almost completed NSLS-II linac at the end of November 2011.

Booster ring. The production of the booster components at Budker Institute proceeded well. Most dipole yokes are completed, and seven combined-function focusing dipole magnets are now ready for shipping. A first container with magnet stands was shipped during November and will arrive in December. The booster main power supplies (Fig. 2) are being assembled and tested at Danfysik. Shipment of the first unit is expected in January 2012.

Figure 2. Assembled booster synchrotron power supply for the combined-function focusing dipole magnet chain. Shown are the IGBT-based switching units.

Storage ring magnets. Magnet production proceeded well with most vendors. Danfysik completed the hundredth sextupole (out of 169) during November; they are well on track for producing 14 magnets per month. The production of quadrupole and sextupole magnets at Buckley is going very well and there is a considerable stock of completed and accepted magnets available for girder installation. Dipole magnet production at Buckley has now started and first production units were received. The magnet production at

Budker Institutes continues to go very well, with about three-fourths of the entire production (120 magnets) completed. Everson TESLA continues to produce corrector magnets. They also have redesigned the skew quadrupole coil, which is part of the thirty 100 mm corrector magnets set. Sextupole production at IHEP still suffers somewhat from QA problems. IHEP changed a successful, approved procedure and produced a few poor-quality magnets which had to be rejected. TESLA recovered from a problem in coil production, modifying the potting mold to improve coil potting. They have nearly completed two additional potting molds to catch up with coil production. The first magnets for the transfer line (TL) from the linac to the booster (LTB) have been received.

Mechanical engineering and mechanical utilities. Most floor plates (702 out of 870) for girders are now at hand. About two-thirds (103 of the 150) magnet girders were completed in November, from which 63 girders have been delivered, limited by available space in Bldg. 902. Seven of the ninety magnet/girders have been loaded with high-precision aligned magnets and vacuum equipment. A total of 180 cooling water manifolds for the girder are planned; 107 were received in November. For the front ends, manufacturing drawings for the fast shutter, controller units, and photon shutter were released. All stands for the "day-one" masks and the photon shutters were received. The manufacture of safety shutter stands is complete and the stands are being painted. Finite element analysis was performed to ensure that synchrotron radiation protection is sufficient for all front end components.

Forty percent of the de-ionized (DI) water piping in the tunnel and the injector and RF buildings is complete. The DI water pump skid systems are 25% complete (Fig. 4).

Figure 3. DI pump skid of the RF equipment in the Cryo-Compressor Building.

Vacuum systems. All S4A and S5A chambers have been completed and are being vacuum tested. Four long cell chambers were assembled, baked, and vacuum certified in November, bringing the total available chambers to 113. All 100 RF bellow housings are in house. The inconel springs and stainless sleeves are being silver plated. The C26G4 and C26G6 girders (#5 and #6 multipole girders) and the C25G3 girder were successfully vacuum-equipped and conditioned. The brazing development of fast corrector chambers continues. Layouts of straight sections were detailed; short drift pipes will use the S4A chamber cross section, including those for the injection straight section. All beam pipes for the LTB TL have been fabricated. The detailed design for the damping wiggler chamber has been worked out. All gate valves for the injector and for front ends were received and are being evaluated. The order for the remaining 190 RF shielded bellows was submitted. The first article stick-, crotch-, and flange-absorbers were received and have been evaluated. Production orders for these absorbers were submitted. The crotch openings for project beam lines are being verified by the synchrotron radiation protection taskforce. Three mobile power centers for bake-out were delivered. The programmable logic controller (PLC) for the LTB TL vacuum installation was completed at Budker Institute, and the prototype storage ring PLC has been completed by a local vendor.

RF system. Transmitter system components have been delivered; installation is in progress, with completion planned in December and final acceptance planned for January 2012. The design of the superconducting cavity is proceeding. Design of the external higher order mode coupler has begun for the completed superconducting 3rd harmonics cavity system. The RF group has generated engineering designs and decisions needed to start production of the cryogenic plant. This includes the dimensions of the quench gas relief line from the superconducting cavity cryogenic module. Production of the cryogenic system has started.

Insertion devices. Acceptance tests for the integrated field measurement system were performed; the conclusion is that the flip coil performance met the specifications, while the moving coil case requires tuning. The contract for construction of the in-vacuum undulator IVU21 for the SRX beamline was awarded; final contract negotiations are underway. Final contract negotiation for the IVU20 construction contract is nearing. The RFP for the IVU22 (IXS beamline) has been published. The three-pole-wiggler design has been updated for a different format of permanent magnetic blocks. The modified material will be available from construction spares of the damping wigglers. This measure saves $130k in permanent material costs. The ID group performed tests on permanent magnets made of Pr-Fe-B. The baking test (max. 100°C for 2 hours) resulted in very small field change (<0.2% p-p). These materials could be used in a cryogenic version of IVU22 and, if all expectations are verified, will provide a 40% performance increase for this device.

Accelerator installation in the RF Building progressed well. The second klystron tube, circulator, and loads for the RF transmitter have been installed (Fig. 4). The RF transmitter vendor is in the process of installing the cabling and water connections. The installation of DI piping and

pump skids is scheduled to be completed on Dec 23. The Controls group is in the process of installing their equipment in the computer room, where there is now AC power.

Figure 4. Nearly completed RF transmitter installation.

I**njector building** activities concentrate on completing installation of the linac with the goal of starting commissioning with beam in February 2012. The linac structures and the beam dump stands have been grouted. The shielding was installed for the LTB TL wall penetration. Various magnets, diagnostic elements, and shielding systems were installed in the LTB TL (Fig. 5). The installation in the linac tunnel of cable trays and safety system cables is complete.

Figure 5. Linac magnet stand installed in the injector building.

Termination of cables and internal wiring of the safety system electronics has started. The beam instrumentation cables for the LTB TL are all in place, and the magnet and vacuum cable pulling has started. Meanwhile, cable tray installation work has started in the booster tunnel. The injector control room furniture has been assembled.

Magnet girder installation in pentant 1 is proceeding (Fig. 6). Installation procedures and fixtures were upgraded to use air casters on rubber mats through the utility building. Six girders were installed in the storage ring. Drawings for girder positioning fixtures were released to Central Shops for manufacturing. The water group started to connect the girders to DI water headers in the tunnel. The installation of power supplies proceeded well, and installation and wiring of the personnel protection system (PPS) is 60% complete.

In pentant 2 (P2), three-fourths of the racks are now connected to the process chilled water system. The control manifolds for this installation are 25% complete. The DI piping installation in P2 is complete, excluding hydrostatic pressure testing, insulation, and labeling. The installation of the rack shelving and brackets is complete and the installation of power supplies is in process.

In pentant 3, the cable tray installation, including grounding and cable dividers, is complete. Installation of the uninterruptible power supplies is 50% complete.

Figure 6. Girders in pentant 1 tunnel.

EXPERIMENTAL FACILITIES

Work continues on various procurement packages for the long-lead-time beamline optical components. Hutch work continues after the design review held at BNL in mid November for both the lead and steel hutches. The Contractor has approval to proceed with the manufacture of the first items.

IXS. The specification and SOW documents for the KB Mirror System have passed final review and are ready for approval. Good progress was made on the specification document for the first optical enclosure package. The team has begun engineering design of the IXS spectrometer and the analyzer crystal optics, based on the latest results from the CDW-CDW optics testing.

In crystal optics R&D, a mechanism designed to improve the energy scanning capability of the 4-bounce optics has been fabricated and assembled. It will be tested during the beamtime scheduled for January 2012 at SPring-8.

CHX. The CHX optics package bids that arrived in late November are being evaluated.

The CHX team has started work for an in-house conceptual design of a 15 m-long, small-angle x-ray scattering (SAXS) table. The table's unique capabilities include a wide accessible scattering wavevector range. There also will be capabilities for simultaneous in-situ combined SAXS and wide-angle scattering (WAXS).

CSX. Procurement packages for the toroidal mirrors, monochromators, and M3A mirror are being finalized. The next procurement packages will be for the remaining optics components and the beamline diagnostics.

HXN. The contract for the HXN beamline components has been signed by BSA and the supplier. October's MLL nanofocusing work revealed that thin MLL sections (~7 microns thick) led to severe bending of the MLL optics, preventing achievement of the resolution target. To avoid this outcome, a new method fixes the MLL optic onto a thin CVD diamond plate. The optics fabrication group will collaborate with the HXN group to implement the new method in December. The HXN team made significant progress in analyzing data from the nanofocusing experiment. Adopting a new algorithm, the team successfully reconstructed differential phase contrast images from solid oxide fuel cell samples. This work appears to be the highest resolution phase-contrast imaging achieved to date using an x-ray scanning probe.

XPD. The Source Selection Board met in November for final scoring and "best value" selection of the five proposals received in October for the XPD Double Laue Monochromator RFP. Final drafts for the XPD vertical focusing mirror RFP have been completed.

SRX. The optics package proposals will be received in mid December. The endstation design is in progress. The KB mirror procurement will soon be released to bidders.

Optical metrology. Fabrication of the gantry for the Nano-Radian Surface Profiler is progressing well and its delivery is expected to be on schedule at the end of January 2012. Most components for the first optical head have been ordered (penta-prism, polarizing beam splitter, and high resolution autocollimator). The mechanical design of the stitching platform using the 4-inch FIZEAU interferometer is finished, and mechanical parts are in fabrication.

CONVENTIONAL FACILITIES

Construction of conventional facilities continued to make excellent progress during November. Ring building pentant 4 will be ready for beneficial occupancy in mid December, leaving pentant 5 the last section remaining for completion. Construction of all five LOBs is making rapid progress, with erection of structural steel for the final LOB (#5) begun at the end of November (Fig. 7). A milestone of sorts has been reached now that the workforce for LOB construction exceeds that of the ring building, indicating the ramp-down in construction activity for the ring and near-peak activity for the LOBs. Both the ring building and LOB construction contracts continue to be ahead of schedule.

Figure 7. Structural steel work on LOB 5 commences late in November.

The ring building contractor continues work toward early phased turnover of the balance of the ring building for beneficial occupancy. Work in pentant 4 is now completed except for system start-up and checkout. Pentant 5 work is nearing completion and will be energized and undergo calibration and start-up in late December. Pentant 5 is expected to be turned over in January, a month earlier than scheduled.

Operations readiness reviews were conducted in November to enable process cooling water system operation. Additional system start-ups and operational checks will continue for the next few months as systems are accepted from the contractor and are placed into an operational mode to support accelerator component installation and start-up. Completion of punch list work in the occupied areas continues to make good progress

and is being coordinated with accelerator installation activities to prevent disruption or interference.

Site restoration by the ring building contractor was substantially completed during October and November, although some touch-up work may be required next spring before contract closeout. All areas that will not be impacted by ongoing LOB construction have been finish-graded, top soiled, and seeded. All roads and parking lots in the ring building contract scope have had the finished paving course and traffic markings applied. Exterior site lighting is now in place and functional.

Some landscaping along the ring building exterior will be left for completion by the LOB contractor due to on-going construction of the LOBs. These areas will be completed by the autumn of 2012, due to the added scope of LOBs 4 and 5.

The coordination of work between the ring contractor, LOB contractor, and ongoing accelerator installation continues to progress well with minimal interference or disruption.

ENVIRONMENT, SAFETY, AND HEALTH

Beneficial occupancy readiness evaluations (BOREs) continued on schedule. BOREs have been completed for pentants 1, 2, and 3; RF compressor; injection buildings; and the cooling tower. BOREs for pentants 4 (mid December) and 5 (mid January) will complete the ring building turnover from construction to operations. A formal Lessons Learned report for the BORE process is being prepared.

The Booster Safety Assessment Document and Accelerator Safety Envelope underwent an internal Photon Sciences Directorate review and a Lab Safety Committee review. Approval by BHSO is expected in January, approximately one month ahead of schedule. Lessons learned during the development of linac documentation have streamlined this process. Authorization basis documentation for the storage ring is now underway. Progress continues on documentation needed for a successful commissioning ARR, including operational procedures, emergency procedures, and training and qualifications criteria. These tasks are on schedule to be completed in late December. The linac ARR is now scheduled for February 27 – 29, 2012.

While much of the high-risk construction activity for the ring building is complete, increased emphasis is being given to safety as the contractor demobilizes. Historically, this phase of a construction project results in increased injuries and claims. Enhanced communications and job planning are being implemented to minimize this risk.

PROCUREMENT ACTIVITIES

The Request for Proposal (RFP) for the CHX Beamline Optical Components Package was posted on FedBizOps, with proposals due at the end of November. The XPD Beamline Components and the SRX Beamline Optics Components packages were posted on FedBizOps with proposals due in early December. Proposals for the Double Laue Monochromator were received the first week of November. The proposals are in evaluation and award is expected to be made some time in late December. The RFP for the CHX Beamline Diffractometer was released to industry at the end of November. The award for the Spare Klystrons was made in November.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) for the overall project remains at 1.01 and the cumulative Schedule Performance Index (SPI) remains at 0.96, both well within the acceptable range. The project is 67% complete, with 31% of contingency and management reserve, based on EAC work remaining.

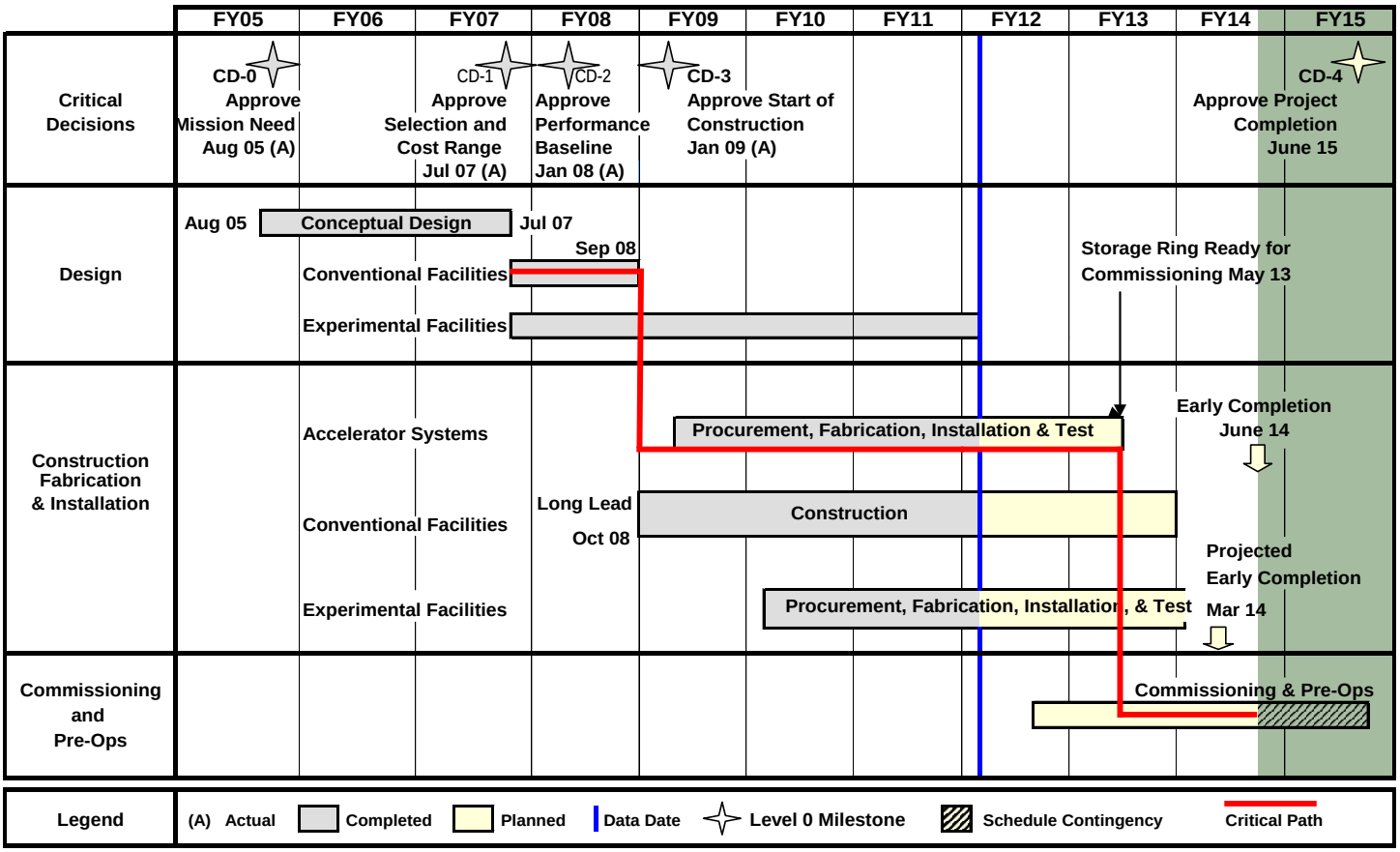
The project current-period SPI of 0.99 is close to plan, due to positive schedule performance in Conventional Facilities, with an SPI of 1.14 ($845K) for the month, and to improved schedule performance in Accelerator Systems, with an SPI of 0.86 (-$1.3M) due to larger deliveries of storage ring magnets, vacuum chambers, and vacuum valves.

The current-month CPI for the project, 0.94 (-$1.1M), is well understood and had no impact on the cumulative CPI of 1.01. This negative variance is due largely to an accrual reversal in Conventional Construction LOBs. Experimental Facilities continues to perform close to plan on a cumulative basis for both cost and schedule.

The critical path for the project has not changed since last month. The systems on the critical path include 35 mm dipole magnet deliveries; pentant 5 girder assembly, installation, survey, and alignment; subsystem test diagnostics; EPU installation; integrated tests; and commissioning of the storage ring. The projected early completion date for the project remains at March 2014. There are 15 months of float between the project early completion milestone and CD-4, with approximately 35% schedule contingency.

The NSLS-II project is being carried out to design and build a world-class user facility for scientific research using synchrotron radiation. The project scope includes the design, construction, and installation of the accelerator hardware, civil construction, and experimental facilities required to produce a new synchrotron light source. It will be highly optimized to deliver ultra-high brightness and flux and exceptional beam stability. These capabilities will enable the study of material properties and functions down to a spatial resolution of 1 nm, energy resolution of 0.1 meV, and with the ultra-high sensitivity necessary to perform spectroscopy on a single atom.

DOE Project Milestone Schedule



Funding Profile

	NSLS-II Funding Profile ($M)											
Funding Type	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	TOTAL
R&D			3.0	20.0	10.0	2.0	0.8					35.8
OPC	1.0	4.8	19.0									24.8
PED			3.0	29.7	27.3							60.0
Construction					216.0	139.0	151.3	151.4	47.2	26.3		731.2
Pre-Ops							0.7	7.7	24.4	22.4	5.0	60.2
Total NSLS-II Project	1.0	4.8	25.0	49.7	253.3	141.0	152.8	159.1	71.6	48.7	5.0	912.0

The NSLS-II Project Progress Report is prepared monthly for submission to the Department of Energy.
This condensed version is available to the public at the NSLS-II website in PDF format. For questions or comments, contact the editor, Kathleen Robinson, at krobinson@bnl.gov,
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