

National Synchrotron Light Source II

Project Progress Report

May 2011



Structural steel delineates the first Lab-Office Building.

report due date:
June 20, 2011

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OVERALL ASSESSMENT

The National Synchrotron Light Source II project made excellent progress in May and maintained satisfactory cost and schedule performance. The project is 53% complete, with over 31% of contingency and management reserve for the remaining cost to go. The cumulative cost and schedule indices are 1.03 and 0.96 respectively, both well within the acceptable range.

Construction of the ring building and Lab-Office Buildings (LOBs) continues to be on track. The Beneficial Occupancy Readiness Evaluation (BORE) for the RF building was successfully completed and pre-BORE walkthroughs for pentant 2 and the injection building are being conducted. Interior finish work and start-up and commissioning of systems in pentant 2 are progressing on track for beneficial occupancy in late June. The steel erection for LOB 1 is complete and work on the building envelope and interior structure has started. The erection of LOB 2 steel is in progress.

Accelerator Systems made excellent progress, resulting in its monthly schedule performance index of 0.98 in May. Installation of the Accelerator Systems in pentant 1 is quickly ramping up, involving electrical infrastructure such as racks, cables, UPS and PPS, and the placement of high-precision floor plates for the girder installation in the storage ring by the mechanical group. Production activities at the vendors for the linac, booster, RF transmitter, and damping wigglers continue to progress on schedule. The Linac Commissioning Safety Assessment Document and Accelerator Safety Envelope have been completed and submitted to BHSO for approval. Magnet production continues to improve. All magnet types except for the dipoles and large-aperture sextupoles are in full production. To date, 112 magnets (about 14% of the entire production) have been delivered.

Progress continues on preparation of the major procurement packages for the six “project” beamlines. Proposals for lead hutches have been received and the preparation of optics procurement packages is progressing as scheduled.

The projected early NSLS-II completion date of March 2014 stands, but the critical path has slightly changed, now going through the 35 mm dipole magnet deliveries, girder assembly and installation, and integrated tests and commissioning of the storage ring. Activities funded by the American Recovery and Reinvestment Act (ARRA) continue to be on schedule and on budget.

UPCOMING EVENTS

2011

HXN Beamline Advisory Team (BAT) meeting	June 1
DOE Review of NSLS-II Project	June 21–23
ALD Conceptual Design Review of NEXT project	June 28–29
Top-Off Safety Review	July 18–19
Vacuum Systems Review	July 18–19
Beamline Development Materials Diffraction Suite workshop	July 18–20
Loss Control Monitoring (LCM) System Review	July 25–26
DOE NEXT Project CD-1 Review	Aug 30–Sep 1

ACCELERATOR SYSTEMS

Installation. Installation of accelerator components in the NSLS-II ring building is ramping up (Fig. 1).



Figure 1. Accelerator installation staging area, pentant 1 experimental floor.

By the end of May, all electronics racks had been installed on the mezzanine of pentant 1 (Fig. 2), UPS and PPS cabinets were installed, and the pulling of cables for AC power and DC magnets had begun. The mechanical group had started to place high-precision floor plates for the storage ring girders. ~65% of the electronic racks were on hand by the end of May.



Figure 2. Electronics racks being installed on the mezzanine of pentant 1.

Accelerator physics. A loss scraper/loss monitor arrangement prepared in the recent scheduled NSLS shutdown was tested with NSLS beam. The aim of the test was to see if loss rate signals of local NSLS-II loss monitors correlate well with local particle loss at the dedicated scraper. This is an important step for verifying that particle losses occur mainly in the heavily shielded NSLS-II injection area. The successful test was prerequisite for proceeding to manufacture the beam loss control and monitoring system.

Injection system. The linac proceeds well and according to schedule. NSLS-II experts are confirming the Budker Institute

(BINP) booster magnet designs. BINP has made very good progress on the booster; a large fraction of quadrupole and sextupole magnets have been completed (Fig. 3). Four yokes and coil sets for the BD-type combined function magnets have been built. There is excellent progress with vacuum, instrumentation, support structures, and controls. The RFP for the storage ring pulsed magnets was published in late April; offers are due in July.



Figure 3. Booster quadrupole produced at BINP.

Magnets. All magnet types except for the dipoles and large-aperture sextupoles are in full production. After a successful production readiness review at Tesla Engineering on May 18, the start of production was approved. Twenty-two storage ring magnets were delivered in May to BNL (bringing the total of available magnets to 112), and nine magnets have been qualified for installation in the storage ring. The manufacturers have provided laminations for 55 additional magnets, produced 60 magnet yokes, built 56 coil sets, machined 42 yokes, and assembled 44 complete magnets. The second Buckley sextupole has been received. It performs very well and this production line will be started up soon.

Power supply. Most of the power supply components are in production. The first 20% of the power converters have been delivered to BNL.

Vacuum systems. There is excellent progress with vacuum chambers (Fig. 4). Ten chambers were assembled, baked, and vacuum certified this month, bringing the total available chambers to 74. Three S4A chambers were received and inspected, with a total of six S4A chambers available (sufficient for pentant 1). The second production order for S5A chambers was placed with a supplier. The production order for 96 fast corrector chambers was placed with BNL Central Shops. The damping wiggler (DW) vacuum chamber specifications and statement of work (SOW) have been approved. The design of straight-section chambers has started. (These will be replaced later by insertion device vacuum systems.) S4A and S4B chambers were assembled into a G4 magnet girder for magnet alignment. The prototype of the improved RF bellows has been re-installed at APS for beam testing. The design of the LBT bellows is completed. The design of BST bending chambers has re-started. The

programmable logic controller (PLC) chassis layout for injectors is completed and the PLC logic codes are being developed.



Figure 4. Completed vacuum chambers ready for installation.

Full-scale manufacturing of components in industry is proceeding. The order for 100 RF bellows housings was placed. Production of various absorbers has started at several vendors and some will be available in June. The design of the absorbers for DW radiation has started. The order for residual gas analyzers has been placed. The first 42 titanium sublimation pump (TSP) controllers have arrived. A total of 240 TSP cartridges are in-house. Eighteen 200 l/s ion pumps have arrived, as have two RF-shielded gate valves. The all-metal gate valve order is out for quotes. Orders for booster ion pumps, ion pump controllers, vacuum gauges, a residual gas analyzer, and gate valves have been placed. The PLC chassis and parts were ordered for BINP.

Insertion devices. The final manufacturer design review for the damping wiggler was held successfully, and DWs are now in full production. The order for the elliptically polarizing undulator has been placed with KYMA. The preliminary design review was held for the in-vacuum magnetic measurement system (IVMMS). The calibration magnet arrays are ready for acceptance testing at the manufacturer's facility. Procurement documents for the in-vacuum undulator (IVU) have been completed and submitted for approval. The RFP for the SRX-IVU has been issued. The specifications and SOW for the IXS-IVU have been completed and routed for signatures. The final design review for the three-pole wiggler was conducted on May 27. Fabrication will start as soon as ADC, Inc. resolves the remaining issues.

Cryogenic plant. The kickoff meeting for the construction of the cryogenic plant by Linde Cryogenics was held, and remaining issues with the design and the boundary conditions for installation have been clarified successfully.

EXPERIMENTAL FACILITIES

XFD activities in May continued to focus on the technical specifications and SOWs for long-lead-time procurement beamline components, including the larger beamline optics packages. Proposals were received for the lead hutches and evaluations are now being finalized.

The **IXS** team continues to make progress in writing the SOW and specifications for the First Optics Enclosure (FOE) package and the KB mirror system of the beamline. Both sets of documents are scheduled for completion in late June.

In high-resolution crystal optics R&D, improvements are being made to the mechanical stability of the high-precision mobile system for CDW optics, based on test results obtained using the laser interferometer acquired for this purpose.

The **HXN** team completed all documents for the HXN beamline optics package, which is expected to go out in June. A prototype design was completed for the transfocator, which will adjust the focal length of compound refractive lenses.

The construction of the NSLS-II MLL prototype microscope with long-travel flexures (up to 3 mm travel range) was completed and initial tests were successfully performed. After the upgrade interferometers are received from the vendor they will be extensively tested.

The **CHX** team worked on the procurement package for the beamline optics, which includes a horizontally deflecting flat mirror, a cryogenically cooled “pseudo channel-cut” double crystal monochromator, and a double multilayer monochromator. A second procurement package, for a multipurpose “5+2 circle” diffractometer, is also in an advanced state.

The **CSX** beamline will soon have the contract award for the grating substrates, and is working on procurement packages for the remaining optics. The final design of the beamline layout requires the design of non optical components such as diagnostic/monitors for intensity, coherence, or polarization. Other components being designed include masks, apertures, slits, and shutters.

The **XPD** team is focused on the procurement for the double Laue monochromator (the call for tender is now in preparation) and writing the specifications for the Optical Enclosure components.

The **SRX** team has finished writing the SOW for the SRX Optics Package. The specification document and evaluation criteria document are under development.

After detailed discussions with potential vendors about their capabilities and price lines for mirrors, the design for the KBs necessary for high resolution and high flux mode have been finalized. Wavefront propagation calculations have continued, to determine the possible impact of any manufacturing imperfections on overall performance of the SRX beamline.

The **optics fabrication group** continued their development of polishing techniques to obtain highly flat crystals. A crystal polish with approximately 12 km radius of curvature was achieved recently, and efforts to make this level of flatness repeatedly achievable are underway. Mechanical thinning continues on ZP12-3 samples (43-micron-thick multilayer Laue lenses).

CONVENTIONAL FACILITIES

Construction of the ring building and LOBs continues to run slightly ahead of schedule, overall. Activity for both contractors is quite high, as the ring contractor focuses on completion and turnover of building sections and the LOB contractor begins to bring multiple trades onto the site. Most notable is the transformation of the site landscape as the erection of LOB structural steel progresses (Fig. 5).



Figure 5. LOB 1 takes shape and is nearly ready here for the floor pour.

Beneficial occupancy of pentant 1 was taken in March, and the pentant 1 building systems are now being operated and maintained by BNL Facilities & Operations. Accelerator Division installation activities are now well underway in pentant 1. Remaining contractor punchlist work in this area is being controlled under a work permit system to prevent interference with accelerator installation activities. Punchlist work is mainly cosmetic and is being steadily reduced. Some building systems in pentant 1 will require additional balancing and final adjustment when the entire building is completed and full loads are available. Systems required to support experimental operations, such as liquid nitrogen and process cooling water, will be commissioned closer to the time they are needed, to reduce maintenance and operating costs and conserve system warranties.

The next areas slated for beneficial occupancy are the RF building and RF compressor building. All building envelope and interior work is complete and ready for turnover. Some delays were experienced in revising the fire protection water supply piping, so beneficial occupancy will now take place in June. The assembly of the RF cavity shielded test enclosure is now complete. Final interior finish work is underway and will be completed as punchlist work, after beneficial occupancy.

Pentant 2 is the second area slated for beneficial occupancy. Interior finish work and start-up and commissioning of systems is progressing well (Fig. 6) and on track for turnover for beneficial occupancy in late June.

Work on the remaining sections of the ring building continues to progress well. The finished roof system and siding liner panel are now in place up to pentant 5, and

finished exterior paneling is in place up to pentant 4. The injection building enclosure is now nearing completion, enabling interior electric work to progress (Fig. 7).



Figure 6. Painting and finish work are nearly complete on the experimental floor of pentant 2.

Interior mechanical, electrical, and plumbing work is in progress in each of the remaining pentants and service buildings. The work includes HVAC ductwork, equipment placement and installation, fire protection, heating/cooling system piping, compressed air, nitrogen, and other utility services. This work is ahead of schedule in Pentants 3, 4, and 5. Although several early beneficial occupancy dates were impacted by the winter weather, we anticipate completing the later milestones several months early. To date, all structural steel, concrete, and major utility services for the ring building are complete.



Figure 7. Booster tunnel in the injector building, with HVAC and electrical service installed.

Construction of the LOBs is gaining momentum now that all foundations are in place, steel erection for LOB 1 is complete, LOB 2 steel is in progress, and the concrete HXN endstation hut in LOB 3 has been poured (Fig. 8). Preparation of forms for the LOB 1 floor slab are in progress and installation of decking is underway also. Multiple trades will now begin work on the LOB 1 building envelope, plumbing, mechanical systems, and interior structures. The shop drawing submittal and review process for the LOBs is proceeding on schedule, and work planning between contractors for the ring building and the LOBs continues cooperatively and without impact on the pace of either contractor's work.



Figure 8. Concrete form work being stripped from the HXN beamline endstation structure in LOB 3.

Overall, conventional construction is on track to complete the ring building earlier than the April 2012 schedule date, and the base scope LOBs as scheduled, in June 2012.



Figure 9. Work proceeds on the loading dock of pentant 4.

ENVIRONMENT, SAFETY, AND HEALTH (ESH)

The beneficial occupancy readiness evaluation (BORE) for phase 2, which includes the RF and compressor building, was conducted on May 25. Twenty-two pre-occupancy findings were identified and are being addressed; occupancy is expected by mid June. Pre-BORE walkthroughs are being conducted with subject matter experts for Phases 3 and 4, which include pentant 2 and the injection building. The actual BOREs are scheduled for June and July.

The Linac Commissioning Safety Assessment Document and Accelerator Safety Envelope have been completed. They were reviewed by the BNL ESH Committee on April 12. All comments were adequately resolved and the documents have been submitted to DOE's Brookhaven Site Office for review and approval. Approval of these documents is critical for commissioning the linac and is expected shortly.

A procurement contract was awarded on May 5 for 55 area radiation monitors, with deliveries beginning in January of 2012. The early procurement of three area monitors was issued for linac commissioning, scheduled for late CY 11. These units have been received and performance tested, and are ready for installation.

Radiological analysis of top-off operation has been completed. The results are peer reviewed and published in *Nuclear Instruments and Methods A*. Based on the analysis, top-off interlock options are recommended to the top-off task force. An external review of top-off operation and interlock options is planned on July 18–19.

PROCUREMENT ACTIVITIES

Proposals for the lead hutches were received on May 17 and have been distributed to the responsible Source Selection Board for evaluation. Award is expected in late June. Request for Proposals for the CHX and HXV Beamline Components and the Storage Ring In-Vacuum Undulator will be posted on FedBizOps within the next two to four weeks. Recent awards made were for the Elliptical Polarizing Undulator and Area Monitoring Components.



Figure 10. Painted rail on a stretch of mezzanine.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) is 1.03 and the cumulative Schedule Performance Index (SPI) is 0.96, both well within the acceptable range. The project is 55% complete, with 31% of contingency and management reserve remaining, based on EAC work remaining. The project current-month CPI is 1.23, yellow status; the project current-month SPI is 0.98, green status.

The project cumulative SPI has remained constant since February at 0.96, due to strong positive performance in Accelerator Systems (0.98 SPI [-\$136K for May]) and Conventional Facilities construction (0.98 SPI [-\$140K for May]). The current-period CPI of 1.23 is due to positive cost variances in both CF and AS, resulting from some accruals not being processed within Accelerator. Experimental Facilities continues to perform close to plan for both cost and schedule.

The critical path for the project has changed since last month, now running through the 35 mm dipole magnet deliveries; girder assembly, installation, survey, and alignment in pentant 5; 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 31% schedule contingency.

RECENTLY HIRED

Jeffrey Aguilar – GEM Fellow, XFD

Jamel Alexander – GEM Fellow, XFD

Jan-Paul Alleyne – Coop Engineer, ASD

Arman Arkilic – Student Assistant, ASD

Irish Britt – GEM Fellow, PSD

Julian Corona – GEM Fellow, XFD

Vernon Cutting – Student Assistant, XFD

Kevin Davis – GEM Fellow, ASD

Niaja Farve – GEM Fellow, XFD

Ping He – Associate Physicist, Insertion Devices, ASD

Tequisha Hendrickson – GEM Fellow, CFD

Eileen Hernandez – GEM Fellow, ASD

Eric Huey – GEM Fellow, XFD

Joseph Jackson – GEM Fellow, CFD

Rashad Johnson – Student Assistant, ASD

Amber Liverpool – Student Assistant, ASD

Rafael Lozano – GEM Fellow, XFD

Celest Okoli – GEM Fellow, ASD

Nicholas Risi – Mechanical Technician, ASD

William Valet – Mechanical Engineer, Mechanical Engineering, ASD

