

# National Synchrotron Light Source II

## Project Progress Report

November 2010



Sunrise, November 30, shortly before the workers arrive.

report due date:  
December 20, 2010

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## OVERALL ASSESSMENT

The National Synchrotron Light Source II project continued to maintain excellent technical progress with satisfactory cost and schedule performance. The project is 44% complete with 30% of contingency and management reserve for the remaining cost to go. The cumulative schedule index has improved to 1.00 from 0.99 in October and the cumulative cost index is 1.02. The current-month schedule variance is positive due to continued positive schedule performance in the ring building construction and improvements in schedule performance by Accelerator Systems.

The DOE Independent Project Review (IPR) was conducted by the Office of Science on November 15-17. The committee concluded that the project has made impressive progress but cautioned the potential schedule risk from the delayed magnet delivery. The committee endorsed the schedule mitigation plan being executed by the Project for the magnet production but noted that ongoing vigilance will be needed.

Construction of the ring building and central chilled water plant expansion continues to be slightly ahead of schedule and on track for beneficial occupancy in early 2011. With growing workforce at the ring building construction site, the project continued to proactively manage both ring building and Lab-Office Building (LOB) contracts to ensure that sitewide safety goals are met.

Excellent progress for Accelerator Systems was made in production of girders, vacuum chambers, vacuum pumps, linac, and electrical utility components. The contract for the damping wiggler was awarded and most of the contracts for the power supply systems were awarded. Magnet production continues to make slow progress, and potential mitigation plans for the schedule delays are being implemented. Although the overall project schedule has not been impacted by the challenges encountered in magnet production, unless the production rates start to pick up within the next couple of months, it will be difficult to hold to the currently projected early completion date of February 2014.

Substantial progress was made in the procurement of long-lead-time beamline components such as hutches and optical systems. The engineering design of endstations and R&D activities continued to advance at good pace.

The early completion date of February 2014 and the critical path for the project remain the same. Activities funded by the American Recovery and Reinvestment Act (ARRA) are also on schedule and on budget.

## UPCOMING EVENTS

**2010– 2011**

Storage Ring Transmitter Final Design Review	Nov 30 – Dec 2
BSA Annual EVMS Self-Assessment Review	Dec 7–9
DOE Review of NSLS Operations	Dec 15–17
Coherent Soft X-ray (CSX) Beamline Design Review	Jan 2011
Production Readiness Review (PRR) for BINP Magnets	Jan 12–13
Project Advisory Committee (PAC) meeting	Feb 9–11
Science Advisory Committee (SAC) Review	Apr 4–5

## ACCELERATOR SYSTEMS

With healthy progress in a number of areas, the accelerator schedule performance index in November was positive in a number of areas such as the linac, SR electrical utilities, vacuum pumps, and insertion device measurement facility.

**Accelerator physics.** A number of studies are being conducted to ensure that the safety envelop and performance envelop are being maintained for any changes made in the final designs and specifications. All updates made in production magnet specifications are analyzed before such changes are granted. The effect on dynamic aperture of installing a superconducting wiggler in the downstream portion of a short straight section is being studied, and calculations of the beam impedance and shunt impedance of the strip-line kickers used for transverse instability feedback systems also have been carried out. Scenarios involving the possibility of synchrotron radiation during adverse events have been studied, and top-off safety is being reassessed. An analysis and update of the corresponding requirements for the Equipment Protection System have been carried out. Incorporation of a femto-slicing beamline in the storage ring lattice was studied. Progress was made on the development of a parallel computer code for simulating coupled bunch instabilities.

**Storage ring magnets.** Mass production of symmetric sextupoles has started at Danfysik (Fig. 1). At the end of November, fourteen symmetric sextupoles had been completed. There are no issues with the Danfysik production.



Figure 1: Thirteen of the 14 NSLS-II sextupole magnets produced by Danfysik.

At IHEP, machining of the quadrupole yoke is ramping up. All three first articles produced by IHEP have been accepted by BNL. A quadrupole produced by BINP was received and magnet measurements at BNL confirmed satisfactory field quality, but the magnet failed the reproducibility test. This field reproducibility issue is not quite completely solved but appears to be substantially improved in the second magnet produced and tested at BINP. A quadrupole of type C' has been assembled, measured, and chamfered at BINP. Final tests have been performed on a quadrupole magnet type D, and the type E quadrupole was measured and chamfered at

Tesla. At Buckley, the assembly of the first 90mm dipole was completed and magnetic measurements have been performed. Production of the second iteration on the large-aperture quadrupole and sextupole magnets at Buckley also made good progress.

Preparations for magnet girder integration have made good progress with a successful alignment test using available production magnets. The new jaw-alignment fixture was also successfully tested and travelers for magnet acceptance and alignment procedures have been prepared.

Technical and management oversight for magnet production has been strengthened with additional staff assignments and hiring of consultants who will be located near Buckley and BINP. A number of actions have been taken to mitigate the potentially serious schedule risk. Possible actions include redirecting production activities to second vendors or build-to-print contracts, and further optimization of schedule durations for magnet-girder integration and girder installation and testing in the storage ring.

**Insertion devices.** The contract for the production of the damping wigglers was awarded to Danfysik on Nov. 9. The EPU procurement has been opened for tender and the contract for the In-Vacuum-Measurement-System is almost ready to be awarded. The Hall probe bench was finally delivered and the C-frame for the calibration arrays was reworked by the manufacturer and is being reassembled. The clean room is completed and the as-built drawings have been issued. Three vendors for the 4m Vacuum-Vessel-Seal-Test system have been accepted for technical evaluations. A comprehensive report and presentation on a study of the thermal performance of IVU cooling was completed and the procurement specification is being written. Supporting drawings for the technical specification for the IVU are being completed and the request for proposal for the production of the baseline 3-pole wiggler unit was published. The acceptance test for the Helmholtz coil system was carried out at the manufacturer's facility.

**Injector.** Linac production activities are progressing on schedule. A first version of the linac commissioning plan has been worked out and the procurement of the linac frontend test stand is open for tender. The linac beam dynamics with the chopper magnet have been worked out, with a conclusive result for the creation of clean 500MHz bunches in the booster.

The design and production activities for the booster are progressing on schedule. BINP is getting ready to purchase power supplies for the main circuits. Intense interaction of the NSLS-II team with BINP has taken place and many technical questions in conjunction with the final design have been resolved. The plans for the RF straight section are finalized based on the latest lattice information from BINP. The NSLS-II team worked with BINP to work out, optimize, and check the design of the defocusing combined-function magnet.

A compact prototype for the pulsed magnet pulse-forming network has been built and is being tested. After refinement of

the layout, the injection straight section in the storage ring has been completed and procurement documents are now being prepared.

**Vacuum system.** Seven additional multipole vacuum chambers were assembled, baked, vacuum certified, and are now ready for girder integration, making a total of twenty chambers available for magnet-girder-vacuum integration. Additional dipole and multipole extrusions were received, bent, and inspected. The orders of S4A extrusion and first article fabrication were placed. Weld development of S6 chambers at APS was completed and production welding began. Parts for the 90mm dipole pump port weld development were shipped to APS. Delivery and testing of ion pumps and pump controllers continued, with 30% of the pumps and 40% of the ion pump controllers now in house. The request-for-quote (RFQ) for RF-shielded gate valves was released and the orders for the titanium pump power supply and gauge controllers were submitted to the purchasing team. Orders were placed for the all-metal right-angle valves used for instruments and roughing.

**Power supplies and electrical infrastructure.** The main focus with the power supply systems was on procurements. Orders for PSI, PCS, and regulator cards have been placed. Awards for power converters, AC breakers, and chassis have progressed well; orders will be placed by the end of January.

**Mechanical and electrical utilities.** First article equipment enclosures have been received, and acceptance testing was completed satisfactorily. The decision was made to have the building contractor perform the task of installing DI-water piping in the accelerator tunnel.

## EXPERIMENTAL FACILITIES

The Experimental Facilities activities in November focused on finalizing the technical specifications and statements of work for long-lead-time procurement beamline components. For experimental hutches, SOW and specifications documents were completed, and drawings and specification tables for each hutch (Fig. 2) were being generated. The strategy for the hutch procurement is that NSLS-II provides specifications and preliminary designs and the contractor will supply the final designs, seek NSLS-II approval of the design, and fabricate and construct the hutches. Generic cross sections of utility layouts inside and on top of the hutches were completed, and a layout of plumbing utilities for the six project beamlines was produced and reviewed.

For beamline optical systems, draft statements of work started in November and technical specifications were completed or are being generated for all six beamlines. A vendor informational meeting is being planned for early December to communicate the technical requirements for beamline systems before the official start of the long-lead-time procurements.

Endstation designs progressed well in November for several project beamlines. For the hard x-ray nanoprobe, a versatile modular design was adopted to achieve specific functionality

and technical requirements. Currently planned modules include a multilayer Laue lens optic module, a zone plate optic module, and several sample modules for fluorescence and diffraction. Detailed engineering designs for all modules were completed that aim to achieve mutual compatibility with well-defined common coordinates and interfaces.

In experimental R&D, innovative developments were being pursued, including a compact, low power, sub-nm interfero-

meter. A recent test of the new interferometer along with its electronics showed a low noise level of 0.4 nm over the period of 14 hours (Fig. 3). Flexure-based translation and rotation stages were developed in collaboration with APS at Argonne—all using high-stiffness, low power, and vacuum-compatible components.

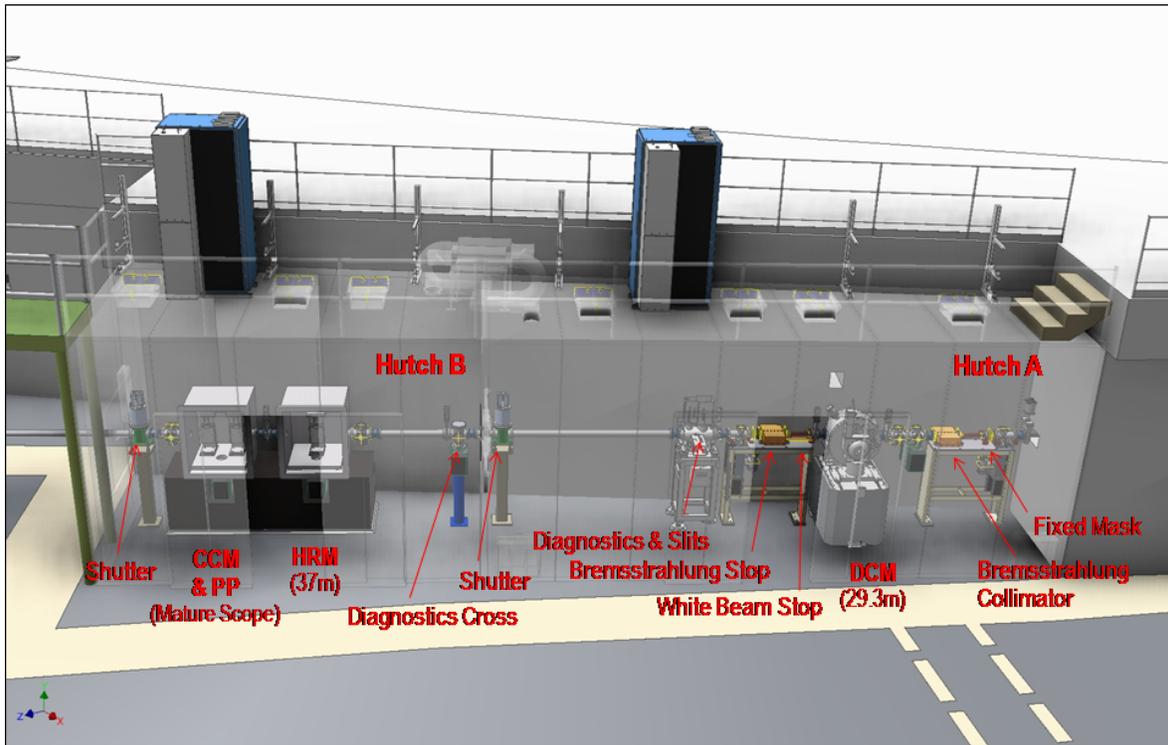


Figure 2: Design of the Inelastic X-ray Scattering (IXS) beamline layout in the first optic enclosure (FOE). Also shown is the detailed design of the FOE, including labyrinths and planned instruments on its roof.

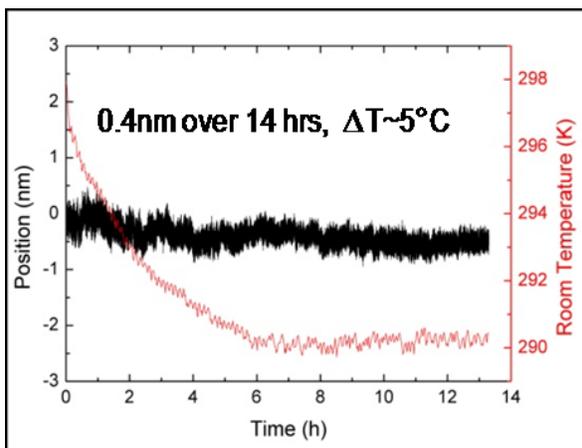


Figure 3: Measured stability and level of noise of a new compact interferometer being developed and tested by the NSLS-II nan positioning group, indicating excellent sub-nm sensitivity.

## CONVENTIONAL FACILITIES

Construction continued to make excellent progress in November, as the project prepares for winter conditions and beneficial occupancy of the first building section in early in 2011. The LOB contractor mobilization is nearly completed and work on the LOBs is getting underway. Underground utility systems are nearly completed and are being readied for startup.

Concrete work for the ring building is now more than 93% complete. The only major remaining items are the open SR tunnel section in pentant 5 (Fig. 4) and floor slabs in the booster building.



Figure 4: Standing on the finished tunnel slab in pentant five, workers prepare forms for the final section of tunnel walls to be completed.

In preparation for winter weather, most of the base course paving of roadways was installed before the asphalt plants close in mid December. This will enable more effective snow removal and help keep dirt out of the facility as interior finish work gets underway. Final grading of earth berms in the interior courtyard is underway (Fig. 5), now that underground utility work in this area is nearly complete.

Excellent progress was made on installation of mechanical systems in service building 1 and the cooling tower building. These systems are being readied for startup and acceptance testing, needed for the beneficial occupancy of Pentant 1. In preparation for the startup of permanent power in December, cable installation is progressing rapidly in the ductbank sections, unit substations, 480V switchgear, and to the installed mechanical equipment. Installation of the building envelope continues to progress as colder weather approaches, and interior building systems need to be installed. Temporary dividing walls are being installed in pentant 1 to isolate the first beneficial occupancy area from the areas still under construction. Temporary heat will be started up in December to enable finish work in Pentant 1. The interior liner panel, insulation, and exterior wall panel continue to be installed around the ring building, and wall panel installation is now underway in pentant 4.

The roof in pentant 1 is complete, and installation of the finished standing seam panel continues to progress to pentant 2 and adjacent pentant 5 in the area of the RF building

interface. The roof insulation and sealing membrane have now progressed to pentant 5. Steel for the injection building is in place and decking for the equipment area has been installed, enabling the concrete deck to be poured in December. The booster tunnel concrete and waterproofing are now complete, the earth berm has been placed on the tunnel, and all retaining walls are in place. Interior painting of the tunnel is complete and electrical fit-out is underway.

Interior mechanical, electrical, and plumbing (MEP) work continues to make rapid progress. Major HVAC equipment items, including air handlers for the experimental floor and storage ring, have been installed up to pentant 4. Fire protection headers and return air ductwork are now installed from pentant 1 into pentant 4. Electrical conduit and lighting in the storage ring tunnel are now complete from pentant 1 through pentant 4. Work continues on all piping, HVAC, and electrical systems throughout the ring building complex.

The chilled water plant expansion is now well into the equipment startup and testing phase. Permanent power is now available to the expanded portion of the plant, and individual equipment items are being tested and commissioned. The newly installed systems are expected to be fully operational by February, several months earlier than they will be needed. The chilled water piping installation is completed and is ready to convey chilled water to the NSLS-II site from the central chilled water plant. Final restoration of the area disturbed by the installation will be completed in December.

The electrical substation expansion is also nearing completion. The switchgear and cabling work is done and permanent power is available to be sent to the NSLS-II site when the ring building contractor is ready for it in December. Installation of the 20MVA transformer is nearly complete except for some punchlist items needed before start-up. The main 20MVA transformer will be available by January 2011, over one year earlier than needed.

Mobilization of the LOB contractor is nearly complete, and extensive planning and coordination have taken place with the ring building contractor and the NSLS-II Construction Management team. The LOB contractor has installed field offices and placed construction fencing on the site. All approvals are in place for the contractor to begin construction. Concrete and steel submittals are progressing well and the contractor has begun work for the foundations. Submittals for concrete, anchor bolts, and foundation plans have been approved. Submittals for structural steel and other long-lead items are being prepared. Several iterations of the detailed contractor LOB construction schedule are being reviewed. Bidding of the HXN beamline endstation will be incorporated in the LOB contract, as it will be completed with construction of LOB-3. LOB construction continues on track for completion a year earlier than the original baseline.



Figure 5: The mound of earth is the berm encasing the booster tunnel.

## COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) is 1.02 and the cumulative Schedule Performance Index (SPI) improved to 1.00, both well within the acceptable range. The project is 44% complete, with 30% of contingency and management reserve for remaining cost to go. The conventional construction schedule progress continues to be very positive, with approximately \$12.8 million worth of work performed in November.

Progress during November in most areas of the project was ahead or on schedule and close to budget. The current-month CPI is 1.03, green status, and the current-month SPI is 1.16 yellow status (but positive). This current-month schedule variance is positive due to continued positive schedule performance in the ring building construction and in Accelerator Systems for November. The current-month accelerator schedule performance was positive due primarily to positive schedule performance in the linac, SR electrical utilities, vacuum pumps, and the insertion device measurement facility.

The critical path for the project remains the same in November, passing through accelerator magnet first article production; girder assembly, installation, survey, and alignment; then accelerator installation, testing, and commissioning. Ring building construction, magnet production, and vacuum chambers/components are within two to three months of the critical path, and the projected early completion date continues to be February 2014.

## RECENT HIRES

Erik Feldman – Mechanical Engineer, Beamline Engineering, XFD

Chaminda Kodituwakku – Assistant Physicist, IXS Beamline, XFD

## ENVIRONMENT, SAFETY, AND HEALTH (ESH)

The Fire Hazards Analysis (FHA) internal review was completed and no significant issues were identified. The FHA will be completed as scheduled by January 2011. The FHA is an important supporting document for the Authorization Basis Documentation package, which is currently under development to support the commissioning phase of NSLS-II.

The supplementary shielding designs for linac beam dumps, energy selector slits, and bending magnets are finished and fabrication drawings are being prepared. The ratchet wall lead collimator design was also finalized and the supplementary shielding design is in progress for the booster enclosure.

The ring building prime contractor (Torcon) has submitted an application for preliminary review for the DOE Voluntary Protection Program (VPP). The VPP recognize employers and workers who have implemented effective safety and health management systems and maintain injury and illness rates below national Bureau of Labor Statistics averages for their respective industries. In this program, management, labor, and OSHA work cooperatively and proactively to prevent fatalities, injuries, and illnesses through a system focused on hazard prevention and control, worksite analysis, training, and management commitment and worker involvement. To participate, employers must submit an application to DOE and undergo a rigorous onsite evaluation by a team of safety and health professionals. Union support is required for applicants represented by a bargaining unit. Successful achievement of DOE VPP status is integrated into the safety incentive established for the ring building contract.



Figure 6: A year ago, this space was a bare field.

