National Synchrotron Light Source II

Project Progress Report

June 2011

The first Lab-Office Building shines in the foreground, with LOB 2 taking shape to the east.

report due date:
July 20, 2011, corrected Aug. 8, 2011

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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 56% complete, with over 27% of contingency and management reserve for the remaining cost to go. The cumulative cost and schedule indices are 1.02 and 0.96 respectively, both well within the acceptable range.

The DOE Independent Project Review (IPR) was conducted by the Office of Science on June 21–23. The committee concluded that the project has made impressive progress on all fronts but advised ongoing vigilance be maintained for the magnet delivery schedule. Based on the project performance to date, the committee recommended exercising the option for two Lab–Office Building (LOB) shells to be built. With DOE approval, the LOB contract was modified at the end of June to include two additional LOB shells.

Construction of the ring building and LOBs continues to make excellent progress. Beneficial occupancy for the RF building was taken in early June, and pre-readiness evaluation walkthroughs for pentant 2 and the injection building are being conducted in anticipation of the full evaluation in August. Enclosure of the entire ring building is expected by the end of August and the ring building is expected to be mostly completed several months early. The steel erection for LOBs 1 and 2 is complete, and work on the building envelope and interior structure is progressing.

Production activities for the Accelerator Systems continue to progress at the manufacturers' facilities. The current period schedule performance index for the Accelerator Systems was 0.70, due to slight delivery delays of vacuum, power supplies, and other produced components that have no impact on overall schedule, in addition to magnet production delivery delays. Magnet production continues to improve. All magnet types except for the 35 mm dipoles are in full production. By June 30, about 30% of the magnet production was complete.

Progress continues on the major procurement packages for the six beamlines, and evaluation of the lead and steel hutch procurements was completed.

The projected early NSLS-II completion date remains at March 2014 and the critical path goes 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

Top-Off Safety Review	July 18–19
Vacuum Systems Review	July 18–19
Beamline Development Materials Diffraction Suite workshop	July 18–20
Preliminary Design Review of the Superconducting RF Cavity	July 22
Loss Control Monitoring (LCM) System Review	July 25–26
DOE NEXT Project CD-1 Review	Aug 30–Sep 1

ACCELERATOR SYSTEMS

Magnets. Full magnet production has been released for six of the seven production lines: all quadrupole, sextupole, and corrector magnets and the large-aperture dipole are in full production. The remaining magnets to be released for production are the 35 mm dipoles. The supplier has produced an improved stacking fixture that will be tested in early July. By the end of June about 30% of the storage ring magnet production was complete (including work on partially completed magnets).

Girder integration. The first magnet girder has been fully integrated with precision aligned magnets, support systems, all the vacuum components, water cooling manifolds, and diagnostic devices. This first girder has been installed in the accelerator tunnel. A second and third girder have been equipped with magnets and precision alignment is in progress.

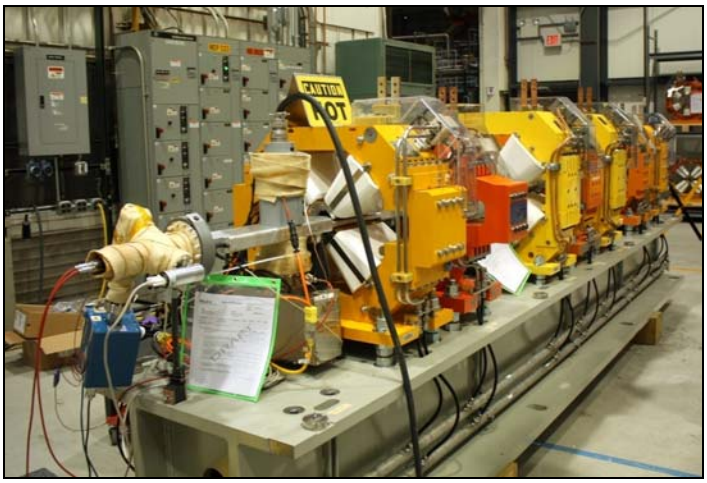


Figure 1. First fully integrated magnet girder, during final vacuum chamber conditioning process.

Vacuum systems. Eight chambers were assembled, baked, and vacuum certified this month, bringing the number of available chambers to 82. The DW chamber RFP has been submitted to the procurement team for review and processing. Two S5A short aluminum chambers were made by BNL Central Shops. The layout of Day-1 S1 chambers with diagnostics and ID components was generated for review. The first G4 girder chambers were successfully baked in the 902 Annex. One S2O chamber was assembled into an S2 girder.

Ten stick absorbers were successfully brazed by the supplier. An internal review was held for the design of DW absorbers. A first article RGA was received and is being tested. Ten percent of the vacuum gauge controllers were received. A total of 270 TSP cartridges were received and the remaining 30 units were shipped by the manufacturer. All 200 ion pump controllers were received. The all-metal gate valve order has been placed. Installation of IPC, TSPC, and VGC has started on the mezzanine in cells 27 and 28. The order for LBT bellows was placed. The detailed vacuum layout of the BSR transport line has started.

Injection systems. The linac production activities are still on track. The first RF 5.2 m traveling wave accelerating

structure has been brazed and is ready for the soldering of water cooling channels. The new low-temp braze oven was installed at the supplier and is undergoing tests. The external water cooling channels will be brazed onto the structure the third week of July. The linac front end (LFE) was successfully tested and has been delivered to the manufacturer for final integration prior to shipping to BNL at the end of July. The 500 MHz second harmonic buncher is in the second braze cycle and will be ready for integration with the LFE the third week of July. Discussions with the manufacturer have resulted in an agreement to start installation on September 6.

The booster work has progressed well. BF and BD magnets were assembled. The production of quadrupole and sextupole magnets is well advanced. Vacuum, power supply, and support system components have been produced and the first magnet girders are being assembled.

RF systems. The booster cavity is in the process of disassembly for cleaning of the coupler prior to final assembly and coupling calibration. The final design of the booster RF transmitter by the manufacturer (Thomson) has been approved and it is in production. The IOT tube has been successfully built and the output cavity is in manufacturing. The circulator and loads have been ordered. The RF group has access to the RF building and installation work can begin.

The cryogenic interface of the storage ring superconducting RF cavity has been completed and has been agreed to by AES, Linde, and BNL. The taper geometry, sliding joint, and inter-cavity spool piece are moving forward in design. Long-lead items are identified. The gaseous He vent line has been increased to 3 inches to meet the ASME code. A cool-down procedure and a pressure relief assessment have been produced and are being reviewed by both Linde and AES. The preliminary design review is on July 22.

The cryogenic system design is moving forward, with significant progress in identifying LN2 consumption for pipe sizing, pressure drops along the liquid and gaseous He lines, and pressure drops across control valves for control loop analysis. The LN2 system Specs and SOW as well as the drawing package for the procurement are complete.

A problem with the production of the storage ring RF transmitter klystron occurred: the coupler ceramics cracked during brazing. There should be no overall schedule delay for the RF transmitter. The klystron supply unit (KSU; Fig. 2) has been completed and successfully tested at the factory, and both units will be shipped in July. This is the main component of the system and includes the main 540KVA cathode supply, filament and mod-anode supply, and controls and interlocks.

Significant progress on the digital cavity controller has been accomplished and work continues, to finish the booster ramp functionality and tuner error signal-to-tuner controller interface. The blocks for these functions were in included in the controller, but interconnections to trigger inputs and the tuner error output are not yet implemented.

Figure 2. Completed components of the storage ring RF transmitter systems at the manufacturer's facility.

Multipole and corrector power supplies. Production of the power supply controller (PSC) electronics at the manufacturer is progressing. About half of the production transition boards have been received, and the first production units of the PSC main boards have been received. Considerable effort is being spent to set up testing systems for all the incoming PSC boards. The hardware for the test system is complete but some software and travelers still need work. Forty percent of the production units of the PSC chassis have been delivered, and all units needed for pentant 1 are ready for installation.

The first article production of the power supply regulators is complete. All have been successfully tested, and a release to full production is imminent.

The first batch of production power supply interface chassis has been received. A testing system for these incoming components has been constructed.

The layout for the DC corrector power amplifier electronics is completed. The preproduction units have been manufactured and testing has begun. The mechanical design of the units also is completed. Procurement package drawings are being finalized. The engineering design for the fast corrector power amplifier has been finished and the board is in PCB layout. Long-lead items for both amplifiers are being ordered. Both of these designs will be built to print.

One-wire temperature sensor testing at NSLS has led to an effort for an alternative design-based, radiation-resistant thermistor that will interface to a one-wire ADC (analog to digital converter) circuit. A test circuit has been built and installed in NSLS. Preliminary results from the thermistor design continue to look very good. Engineering is complete regarding the requirements for using this design in high-radiation areas such as the storage ring. The new interface boards are in the final design phase. The first articles of the one-wire interface chassis have been delivered and tested and the manufacturer has approval to start production.

The first delivery of production power converters has been received. First units are being installed in racks in pendant 1.

A change order to the contract for the AC input power modules and mounting hardware has been finalized. This change order captured the changes needed for the first articles and to advance deliveries of some components so installation work in pentant 1 can proceed. Some parts were already received and used in the installation of power converters in pentant 1.

Electrical utilities. The manufacturer has accelerated the deliveries of equipment enclosures and, to date, 80 % of all racks have been received. All racks in pendant 1 have been installed in their final positions. Installation is accelerating and 50% of all power supply cables in pentant 1 are in place. The design of the AC power cable tray for the transmitters in the RF building is completed. The cable tray has been ordered, along with the main wall switches. A significant fraction (45%) of the regular temperature control units for controlling the rack temperature has been delivered and units continue to arrive. The quantity of uninterruptable power supplies (UPS) that have been delivered will be enough for four pentants. All UPS units in pendant 1 have been installed.

Installation. Floor plates for magnet girders have been installed in three of six cells of pentant 1, the AC cabling for the racks and the DC cabling for magnets is almost completed in pentant 1, and the first fully completed magnet girder has been installed (Fig. 3).

Figure 3. Installation progress of Accelerator components in the ring building.

EXPERIMENTAL FACILITIES

XFD activities in June continued to focus on the technical specifications and SOWs for long-lead-time procurement beamline components, including the larger beamline optics packages. Evaluation of the lead and steel hutch procurements was completed. Work on the motion controllers contract continues, with the preliminary design review (PDR) scheduled for July.

The **IXS** team continues preparation of the specifications for the first optics enclosure (FOE) and the KB mirror system of the beamline, while the SOWs for both procurement packages are being reviewed.

In high-resolution crystal optics R&D, the IXS team has carried out a detailed mono-beam topography study of the crystals obtained from commercial vendors as well as those fabricated in-house in collaboration with ESRF. These studies have shown consistent quality in lattice homogeneity to the level of 10^{-5}, but indicate that further improvement of characterization capability is required to ensure that crystals meet requirements.

The **HXN** team completed all documents for the HXN beamline optics package that will go out in July. Good progress was made with a prototype design of the transfocator that uses Be compound refractive lenses (Be CRLs), and optical nano-metrology tests were completed on six Be CRLs that were procured for prototype development purposes. Measurements showed the RMS surface roughness is about 100 nm and the radius curvature variation is less than 1% along the cylindrical axis of all six lenses. For HXN microscope development, the preliminary design of the MLL module was finalized, and preliminary design of the vacuum enclosure has begun. Design work has begun on the exit Be window—an important component that will determine the angular range of the diffracted x-ray beam from the sample. The second version of the MLL prototype microscope was finalized. This will be used for nanofocusing experiments at

other synchrotrons for continuing development of the MLL optics and early science applications.

The **CHX** team continued work with the procurement team on beamline optics and diffractometer procurement packages, now near completion. The beamline project was presented in detail at the recent NSLS-II DOE review and received favorable comments from the reviewers.

The **CSX** team is working with procurement staff on the statement of work and specifications document for three internally water-cooled mirrors that form part of the beamline optics package.

The **XPD** beamline components procurement package now includes all white beam and monochromatic beam components (safety, beam transport and conditioning, diagnostics, high heat load) located in the FOE and in the endstation enclosure (hutch C), except for the optical components (mirror and monochromator). The status of the XPD beamline (design, procurement plans and schedule, risk management) was presented to the Office of Science status review of the NSLS-II project on June 22. The review committee recommended focusing on high flux mode experiments during the early stages of operations, thus allowing more time for developing and refining the x-ray optics that will be necessary for the high-resolution mode to produce high quality data.

The **SRX** team has finished writing the technical specs and evaluation criteria for the SRX Optics Package and is now preparing the technical documentation for the KB mirror optics package. In parallel, work on the sample stages continues. Several potential stage vendors have been ruled out after several rounds of technical discussions with them. Either the mechanical stability perpendicular to the axis of movement was not sufficiently small, or thermally induced movements and drifts are possible due to their choice of motors. The stage design for both modes, high resolution and high flux, is being finalized with the few vendors who could meet the requirements.

The **optical metrology group** continued to work with the procurement group on the Nanoradian Measuring System (NMS). The contract award for the base system is expected in July and the group is working to procure the optical component and the autocollimator. The next steps will be to focus on the control software for the NMS, which will require extensive effort. Much effort also been spent updating the temperature stabilization of the optical metrology laboratory; this work is still in progress. The final design of the Stitching platform using the ZYGO 4-inch interferometer is nearly done and some components have been purchased. Optical measurements on an internally cooled silicon mirror have been made in collaboration with the CSX beamline.

The **optics fabrication group** reduced surface quality degradation of silicon due to HF/HNO3 by etching within an ultrasonic agitator. C crystals were fabricated for the IXS experiment held this month at SPring-8. A new 43 micron-thick MLL was successfully grown with 5% nitrogen reactive sputtering and appears to exhibit reduced film stress. Mechanical thinning to less than 20 microns of ZP12-3 samples (43-micron-thick multilayer Laue lenses) was completed in time for the HXN experiment this month at Diamond.

CONVENTIONAL FACILITIES

Construction of the ring building and LOBs continues to make excellent progress and remains ahead of schedule. The activity level is high, as the ring building contractor continues to prepare sections of the building for turnover and the LOB contractor transitions from steel erection to interior build-out of the LOBs.

Beneficial occupancy was taken in early June for the RF building and RF compressor building. Accelerator Division installation activity is now underway in this area, as well as in pentant 1, which was occupied in March. Limited contractor punchlist work remains in these areas and is being coordinated under a work permit system.

The next area slated for occupancy is pentant 2. All interior finishes and system installation and commissioning were completed in June. However, technical issues with the fire alarm communications network have delayed turnover of this space until July.

Beneficial occupancy of the injection building will be completed in two phases. The first phase, planned for early August, will turn over the linac and linac klystron gallery areas. This early turnover will enable work by the linac supplier to proceed as currently scheduled, beginning in mid-August. The balance of the injection building will be turned over in late August, several months in advance of the planned start of booster supplier installation activity.

Work on the remaining sections of the ring building continues to progress well. The finished roof system and siding liner panels are now in place into pentant 5 (Fig. 4), and finished exterior paneling is in place up to pentant 4. Enclosure of the building is expected by the end of August.

Figure 4. Final section of liner paneling installed on the ring bldg. (on pentant 5).

Interior mechanical and electrical work is well advanced throughout pentants 3 and 4 and into pentant 5 (Fig. 5). The work includes HVAC ductwork; equipment placement and installation; fire protection; heating/cooling system piping; and compressed air, nitrogen, and other utility services. This

work is ahead of schedule in pentants 3, 4, and 5. Additional paving, finished grading, and seeding of the entire site is planned for August and September. Completion of the overall ring building contract is expected several months early.

Figure 5. Interior progress in pentant 5, the last to be finished.

LOB construction activity is accelerating, now that structural steel is complete for LOBs 1 and 2 and is beginning for LOB 3. The LOB 1 floor slabs are now done, and roof decking is nearly complete. Interior stud wall partitions and mechanical and electrical work are now underway. Preparations to pour floor slabs for LOB 2 are underway and the installation of roof decking has just begun. The HXN endstation concrete hutch is now complete, and the erection of structural steel will begin shortly. Now that multiple trades and subcontractors are at work, the number of workers at the LOB worksites has increased substantially. The coordination of work between the ring building and LOB contractors continues to be cooperative and without any issues. Recent approval of added scope to construct the shells of LOBs 4 and 5 is being integrated in the work plans and schedules of the contractors.

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.

PROCUREMENT ACTIVITIES

The Laboratory Office Building Option that was included in the Torcon Ring Building Contract was exercised on June 28. This option includes the construction of two complete building shells, for LOBs 4 and 5.

Proposals for the steel and lead hutches were received and evaluated. Selection of the successful offeror is complete and award will be made by the end of July.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) is 1.02 and the cumulative Schedule Performance Index (SPI) remains at 0.96, both well within the acceptable range. The project is 56% complete, with 27% of contingency and management reserve remaining, based on EAC work remaining. The project current-month CPI is 0.94, green status; the project current-month SPI is 0.87, yellow status.

The project current-period SPI of 0.87 is due to negative schedule performance in Accelerator Systems (0.70 SPI [-$2.9M in June]), due mostly to continued magnet production delivery delays, and vacuum and power supply and other accelerator material delivery delays. 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 31% schedule contingency.

ENVIRONMENT, SAFETY, AND HEALTH (ESH)

The beneficial occupancy readiness evaluation (BORE) for phase 4, which includes pentant 2, will be conducted in early July. The actual BORE is scheduled for August, to support the installation of injection equipment.

The Linac Commissioning Safety Assessment Document and Accelerator Safety Envelope have been completed, reviewed, and approved by BHSO. These documents are now posted on the Photon Sciences web site.

The Accelerator Readiness Review (ARR) committee has been selected and all committee members are now on board. The Chair of the committee will visit NSLS-II in August in preparation for the ARR review of the linac, which will be held at the end of the calendar year. Several groups are working on documentation necessary for a successful commissioning ARR, including operational procedures, emergency procedures, and training and qualifications criteria.

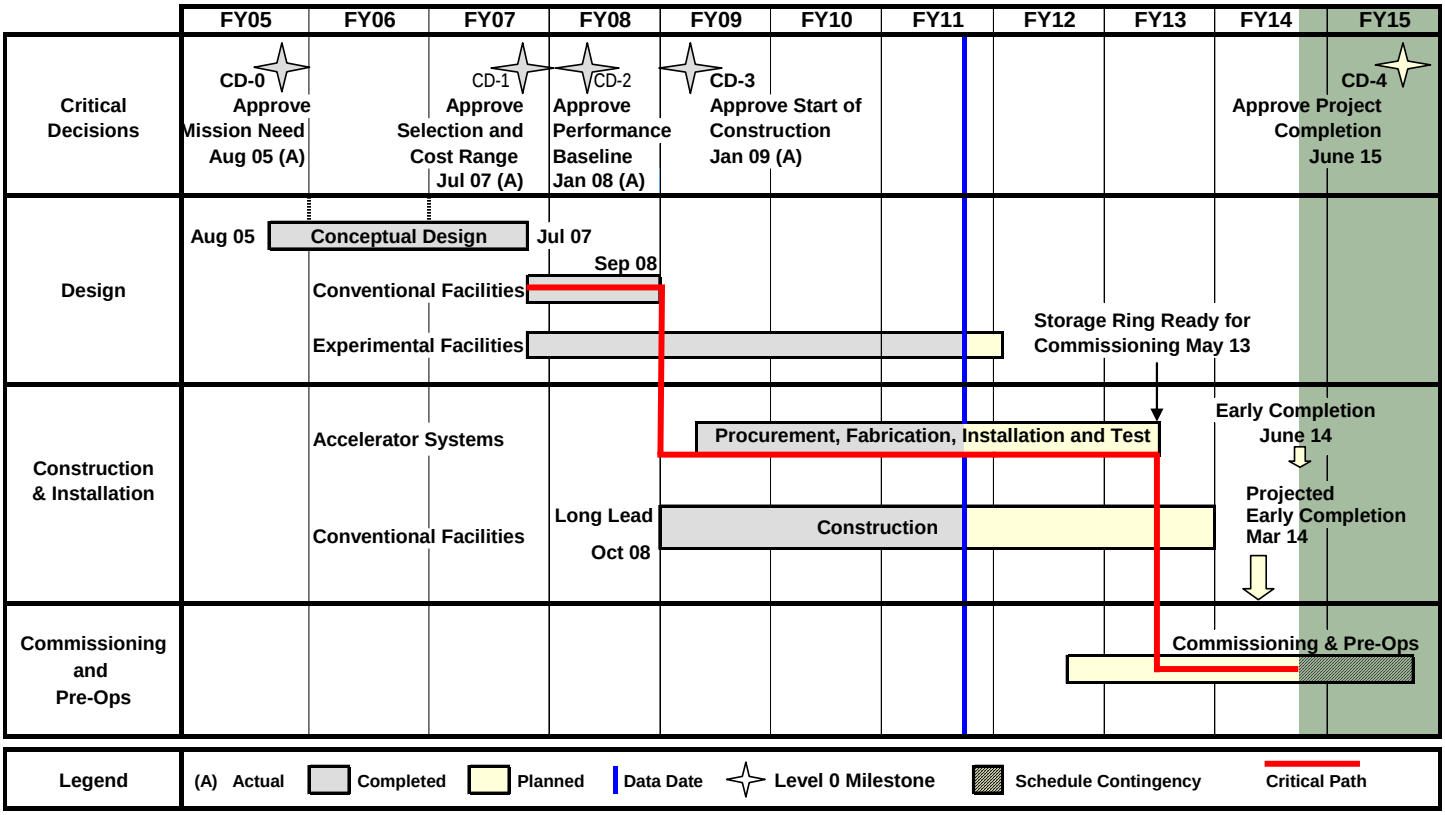
A paper on the radiological considerations of NSLS-II shielding calculations has been prepared and submitted for journal publication.

RECENTLY HIRED

John Almond – Mechanical Technician, ASD
Brendon Benish – Mechanical Designer Job-Shopper, ASD
Kazimierz Gofron – Controls Engineer, ASD
David Levy – Electrical Technician, XFD
Ricky Mercado – Vacuum Technician Job-Shopper, ASD
Benjamin Seidman – Sr. Office Services Assistant, CFD

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,
or via mail at: Room 37, Bldg 830M, Brookhaven National Laboratory, Upton, NY 11973.