National Synchrotron Light Source II

Project Progress Report

March 2011

Much of the progress in March was indoors.

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Steve Dierker
NSLS-II Project Director

Brookhaven National Laboratory
Upton, New York 11973

BROOKHAVEN
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OVERALL ASSESSMENT

The National Synchrotron Light Source II project continues to make good progress while maintaining a reasonable level of cost and schedule contingencies. At the end of March, the project is 52% complete, with over 32% 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. During the month of March the project accomplished three major milestones, including over 50% completion of the project, beneficial occupancy of the first section of the ring building, and integration of the first magnet-girder assembly. A small celebration event was held in pentant 1 of the ring building.

Construction of conventional facilities continues to make excellent progress. The beneficial occupancy of pentant 1 on March 15 met a major project milestone and enabled mobilization for installing accelerator components. Work on the remaining sections of the ring building continues well. The Lab–Office Building (LOB) work moved ahead, with concrete foundations completed for LOBs 1 and 2 and steel fabrication progressing as scheduled. Substantial completion of all major utility construction, including chilled water plant expansion, chilled water piping, and main substation expansion, enables all major utility services to be delivered in full capacity to NSLS-II as needed. With beneficial occupancy of the first pentant, Accelerator Systems mounted survey monuments in the tunnel and set up staging areas and storage cages on the experimental floor area. Progress continued with successful delivery of most production components. Magnet production continues to slowly improve, necessitating that the schedule mitigation plan be carefully analyzed and cautiously implemented. The current-month negative schedule variance of $1.3M for the overall project is mainly due to delayed delivery of production magnets, and to lagging status reports on some accelerator components from production vendors. Close attention is being paid to the elements that contributed to the negative schedule variance.

Excellent progress continues on the final designs of six beamlines, and the preparation of procurement packages and R&D activities continues to advance at good pace.

The projected early completion date of March 2014 and the critical path remain the same. Activities funded by the American Recovery and Reinvestment Act (ARRA) continue to be on schedule and on budget.

UPCOMING EVENTS 2011

Science Advisory Committee (SAC) meeting	Apr 4–5
Earned Value Management System (EVMS) training	Apr 13–14
Trends in Structural Biology Beamline (BL) workshop	Apr 28–29
High-energy X-ray Micro-mapping/Structural Engineering BL workshop	May 6
Medical Imaging and Radiation Therapy BL workshop	May 9
Accelerator Systems Advisory Committee (ASAC) meeting	May 10–11
HXN Beamline Advisory Team (BAT) meeting	June 1
DOE Review of NSLS-II Project	June 21–23
Conceptual Design Review of NEXT project	June 28–29
DOE NEXT Project CD-1 Review	Aug 30–Sep1

ACCELERATOR SYSTEMS

After beneficial occupancy of the first pentant of the NSLS-II ring building, preparations began for installing accelerator components in the accelerator tunnel and on the mezzanine. Accelerator crews were able to mount survey monuments in the tunnel after the building contractor completed sealing the concrete floor and while DI water and cable trays were being installed. A large area of the experimental floor now stages equipment awaiting installation, and cages provide safe storage of tools and equipment.

Magnets. A fully equipped magnet girder with magnets and vacuum and diagnostic components has been assembled and transported to the NSLS-II ring building for checks (Fig. 1).

Figure 1. First fully equipped magnet girder, in front of the NSLS-II ring building.

Delivery of quadrupole and sextupole magnets from every vendor has improved. Production at Budker Institute of Nuclear Physics (BINP) has been authorized for all four types of quadrupoles. All first-article magnets have been received; their quality ranges from very good to acceptable. BINP has produced the yokes for forty-six quadrupole magnets, more than one-third of the production. The rate will be at least three magnets per week.

The production of quadrupole yokes has been authorized at Tesla Engineering in the UK. Full production will begin after remaining issues with the precision milling are completely resolved. Production of sextupole magnets at Danfysik in Denmark has been proceeding well, although an issue with drift of the integrated field strength necessitated a pause while a resolution was sought.

The IHEP design for the large aperture magnets as a second vendor has been accepted by the project and IHEP has begun producing first-article magnets. They are working to build up a second production line to provide additional schedule safety.

The first deliveries of production corrector magnets have been received. A total of 71 correctors have been received, from which 48 magnets have been accepted.

Linac and booster procurements are progressing well, with all major linac components in full production. The

booster team at BINP has started to manufacture production tooling and first-article accelerator components (Fig. 2).

Figure 2. Production of the NSLS-II booster has started at BINP.

Power supplies and electrical utilities. The main power supply is now ready for procurement. First-article printed circuit boards for the power supply controller have been received and tested. The full production of these components has started. All first articles of the power converter units were delivered to BNL and are being tested. Testing of the1800 DCCTs is completed and they are ready for installation. One-wire temperature sensors are being tested at the NSLS x-ray ring, providing valuable input for the final choice of sensors to be procured for NSLS-II.

All power supply output cables and power supply instrumentation are in a cargo container outside the ring building. All high-current cable that was not UL listed has passed the flame spread test required by the Fire Protection engineer, and cable has been approved by the Lab Electrical Safety Committee for installation.

Nearly half of the equipment enclosures (43% of the 575 racks) had been delivered by the end of March and the first set of racks was rigged on the mezzanine. Installation of the cable tray in the tunnel and mezzanine began, with no technical issues. Also delivered was the AC power connection cable for most power connections on the storage ring mezzanine and in the injector service building. The first articles for the standard temperature control chassis have been delivered. All universal power supplies needed for the first and second pentants are in hand and ready for installation.

Insertion devices. Preliminary review of the manufacturer's design of the NSLS-II damping wiggler was carried out as planned. A few issues were resolved, and specifications have been updated. The manufacturer for the EPU has been selected and the contract documents are being finalized. The design for the In-Vacuum Measurement System has been well advanced and the conceptual design report is being prepared. A pulsed wire measurement was performed on the calibration arrays of the magnet field measurement system. Procurement documents for the SRX-IVU are completed and the RFP process has begun. A layout model of the 3 m IVU-22 has been developed. Confirmation of the location of the first device must be obtained. The manufacturer of the three-pole wiggler has completed a first iteration of the design.

RF. The passive superconducting cavity needed for bunch length control was completed by the manufacturer. The cryostat is ready for delivery to BNL (Fig. 3), where the external higher order mode dampers will be installed before the cavity is ready for installation in the storage ring tunnel.

Figure 3. Passive third-harmonic superconducting cavity for bunch lengthening, ready at the vendor for delivery to BNL.

Instrumentation. Successful tests of the NSLS-II beam position monitor electronics were performed at the Advanced Light Source at LBL. The test confirms that the electronics meet the demanding NSLS-II specification for resolution and long-term stability of 200 nm.

EXPERIMENTAL FACILITIES

XFD activities in March continued to focus on the technical specifications and statements of work (SOW) for long-lead-time procurement beamline components, including the larger beamline optics packages.

The **IXS** team continues to work on the specifications and SOW for the FOE package and the KB mirror system. Recent progress in beamline final design and high-resolution optics R&D was presented and reviewed at the 5th Beamline Advisory Team (BAT) meeting, on March 16. Further discussions focused on the choice between the 4-bounce and the CDDW scheme for achieving baseline scope, and the

decision criteria, including resolution, efficiency, and the sharpness of the resolution function tails.

The **HXN** team successfully carried out x-ray fluorescence microscopy measurements on Ni/YSZ solid oxide fuel cell samples in a recent R&D experiment at the APS beamline 26-ID. The Ni electrodes of ~500 nm produced a fluorescence count rate of ~10,000 cts/s using a 2D focused beam of ~25 nm. In nanopositioning R&D, the HXN team quantified heat generation from different types of commercial piezo stages, to identify candidate stages for the HXN microscope. Minimizing the thermal gradient around the sample and x-ray optics is critical for ensuring high positioning/scanning stability of the x-ray microscope. The investigation identified a set of stages that are suitable for the HXN microscope and helped determine methods to reduce heat generation.

The **CHX** team worked toward finalizing the beamline optics procurement package, which includes a horizontally deflecting flat mirror, a cryogenically cooled "pseudo channel-cut" double crystal monochromator, and a double multilayer monochromator. All the instruments push the state of the art for mechanical stability toward 50 nrad (rms) on a wide range of time scales, to take full advantage of the coherence properties of the NSLS-II source in studies of dynamics with x-ray photon correlation spectroscopy.

The first instrument designed and prototyped for the CHX beamline was tested at the 32-ID beamline at APS. A Si kinoform lens was designed to achieve a 3.5 m focal length at 10 keV. A 4 μm focal spot was achieved (Fig. 4).

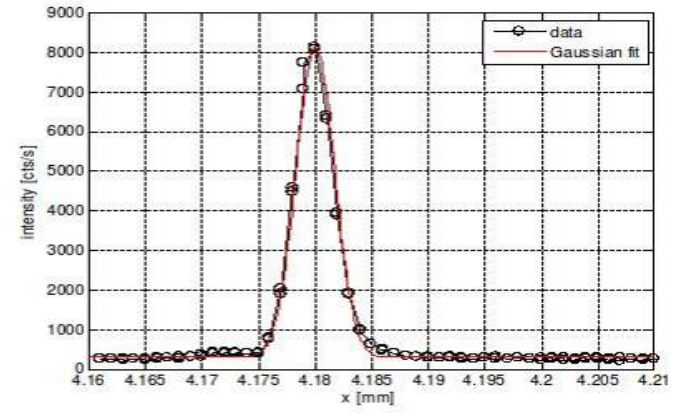


Figure 4. A 4 μm focal spot (graph) was achieved with a Si kinoform lens (photo) designed to focus a 10 keV beam at f=3.5 m.

For the **CSX** beamline, the package for the gratings is ready to go to procurement and the gratings substrates package is well underway. The SOW for the toroidal mirrors is being written. A successful BAT meeting supported finalizing the design of the non-optical components. Finally, the team has initiated measurements to investigate better coatings for the optics, to avoid contamination in spectroscopy measurements.

Discussions regarding beamline controls and detectors are continuing for the X-ray Powder Diffraction (**XPD**) project beamline. The 3D CAD drawing of the fit-out of XPD end-station C accommodates different operation modes with various detection schemes and a wide range of commercial and custom-designed sample environments.

The **optics fabrication** group received ESH approval for the crystal orientation system in lab E7 of the Optics R&D labs. Silicon etchant mixtures for production of a slow, smooth etch are being rate tested. Surface flatness preservation during lapping is being studied. Initial periodic multilayer reflectivity measurements show good interface characteristics.

The **optical metrology** team finalized specifications for the nano-radian slope measuring gantry and the main components for the optical head. Major components for the Fizeau stitching platform are being sourced.

CONVENTIONAL FACILITIES

Figure 5. The pentant 1 electrical mezzanine, ready for the installation of accelerator systems equipment.

Overall progress in constructing the conventional facilities continues slightly ahead of schedule. March brought a significant CF milestone as the project took beneficial occupancy of the first section of the ring building, pentant 1. Though temperatures were below average there was no snow, and overall construction activity ramped up again for both the ring building and LOB contracts. The smaller contracts for utility systems are now all functional; only punchlist work remains at the chilled water plant expansion project.

All requirements for beneficial occupancy of pentant 1 were completed by March 14 and the project officially took over this section of the building to enable ASD to begin mobilizing for the start of accelerator installation (Fig. 5). Some contractor work continues in the area to resolve punchlist

work and install cable trays and deionized cooling water piping.

Access for contractors to work in the area is being controlled under a work permit system. Building systems in pentant 1 have been commissioned and are now in operation, but some additional balancing and final adjustment will be required later when the entire building is done 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.

Figure 6. RF cavity Test Area shield blocks staged for installation.

The next areas slated for beneficial occupancy are the RF building and RF compressor building, which are on track for availability in early May. Enclosure of those buildings is nearly complete, interior finish work is progressing well, the electrical service in the buildings is energized, and HVAC systems are being readied for commissioning.

Figure 7. Removable shield wall being installed in the tunnel from service building 1 to the storage ring tunnel.

Work on the remaining sections of the ring continues to progress well. The finished roof system and siding liner panel are now in place through pentant 3, and finished exterior paneling is in place through most of pentant 2. The injection building enclosure is lagging somewhat, but the contractor is mobilizing extra crews to make up time lost to weather.

Figure 8. Exterior siding is completed on service building 1.

Interior mechanical, electrical, and plumbing are 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. Although several early beneficial occupancy dates were impacted by the winter weather, we anticipate completing the later milestones several months early, and before they could be impacted by next winter. All significant concrete work is now done, with placement of the last section of Experimental floor.

Figure 9. Air handling unit for pentant 1, in service building 1.

Another CF milestone is the substantial completion of all major utility construction packages. The chilled water plant expansion is now substantially complete, as the two chillers were commissioned at the end of March and are now available to produce chilled water when needed. With the completion of the 20 MVa main substation expansion last month and the completion of the Chilled Water Piping

connection last November, all major utility services are now available to provide full capacity to NSLS-II as needed. This contract is scheduled for closeout in May.

LOB construction continues to make excellent progress. Foundations for LOBs 1 and 2 are now completed. Structural steel shop drawings have all been reviewed, and fabrication of steel is progressing on schedule. The shop drawing submittal and review process for the LOBs is now well underway and proceeding on schedule. Work planning between the ring building and LOB contractors continues cooperatively and without impact on the pace of each contractor's work..

ENVIRONMENT, SAFETY, AND HEALTH (ESH)

The beneficial occupancy readiness evaluation (BORE) for phase I was conducted and all pre-occupancy items have been closed out. ASD staff took occupancy on March 14 to begin installing accelerator equipment.

The Linac Commissioning Safety Assessment Document and Accelerator Safety Envelope have been completed. They will be reviewed by the BNL ESH Committee on April 12. Following the resolution of any comments, the documents will be submitted to DOE's Brookhaven Site Office for review and approval. Approval of these documents is a critical step in the process of commissioning the linac.

Engineering designs based on the shielding calculations for different booster shielding components have been completed. Final shielding designs for the beam dump, shadow shields, and safety shutter are available and ready for procurement. A standard shielding nomenclature document has been prepared for NSLS-II. A paper, "Radiation safety implications of top-off operation at synchrotron light sources," has been accepted for publication in the journal *Nuclear Instruments and Methods A.*

PROCUREMENT ACTIVITIES

The RF Cavity was awarded to AES, Inc., a small business located in Medford, NY. The 3-Pole Wiggler was awarded to ADC, Inc., a small business located in Lansing, NY. The motion controllers were awarded to Delta-Tau, a small business located in Chatsworth, California. The proposals for the EPU are in final evaluation; award is expected in April. Requests for Proposals (RFPs) for the lead and steel beamline enclosures are being finalized. The RFPs will be posted on FedBizOps within the next two to four weeks.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) is 1.02 and the cumulative Schedule Performance Index (SPI) is 0.96, both well within the acceptable range. The project is 52% complete, with 32% of contingency and management reserve remaining, based on EAC work remaining. The project current-month CPI is 0.99, green status; the project current-month SPI is 0.93, also green status.

The project cumulative SPI remained constant from February at 0.96, due to a strong positive value for CF construction (current-month SPI of 1.14, +$1M). This positive value was offset by the ASD current-month SPI of 0.75 (-$2.3M, for a cumulative AS schedule variance of negative $19.4M, SPI 0.84). The ASD current-month negative schedule variance was due to late placement of the cryo plant procurement, lagging linac status reporting, late delivery of magnets and vacuum chambers, and delays in completing the final design of the damping wiggler. Experimental Facilities continues to perform close to plan for both cost and schedule.

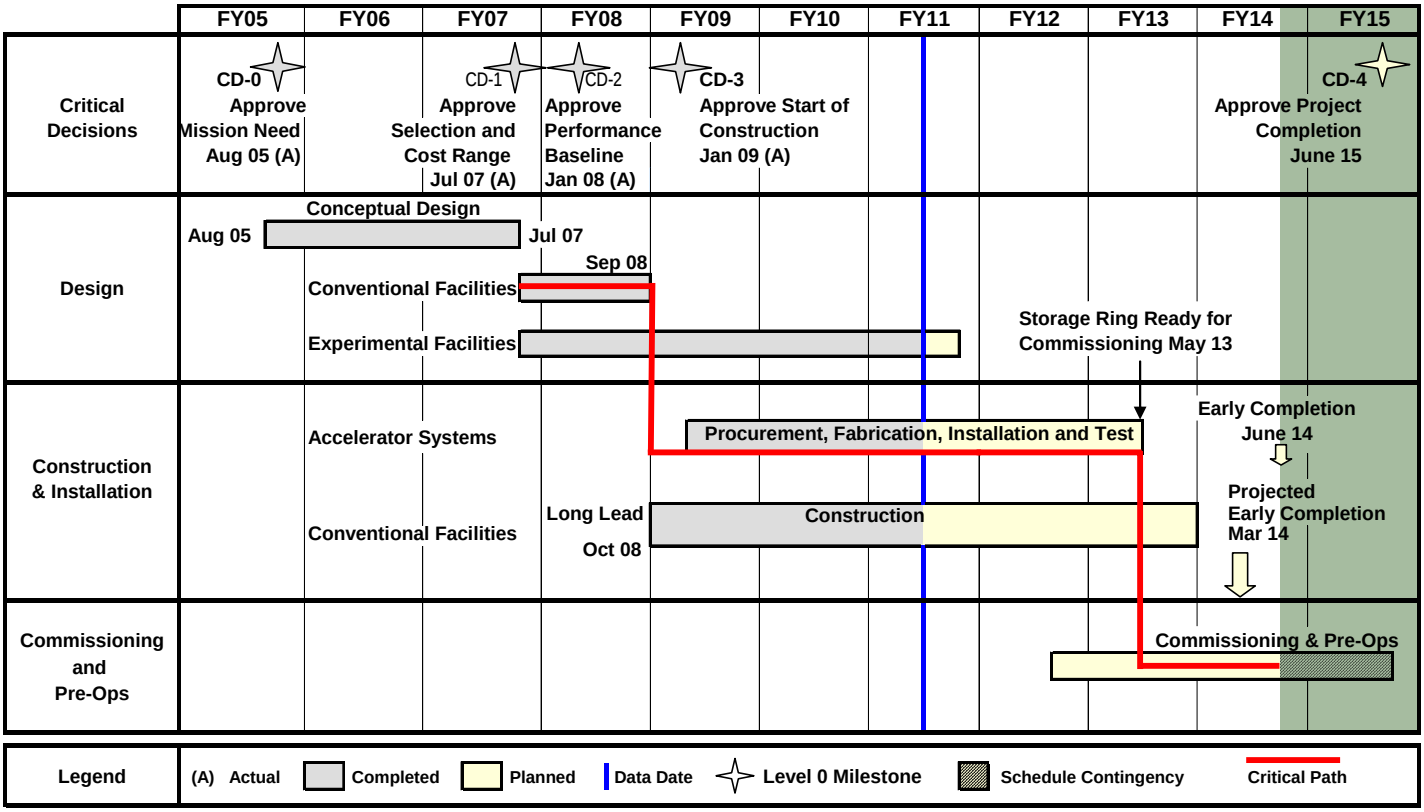
The critical path for the project (see p. 7) remains the same as last month and includes RF cavity procurement lead-time to delivery, as well as delivery of the storage ring production magnets. The critical path runs through accelerator magnet deliveries; RF cavity contract award and fabrication; girder assembly, installation, survey, and alignment; then accelerator installation, integrated testing, and commissioning. The projected early completion date for the project is March 2014. There are 15 months of float between the project early completion milestone and CD4, with approximately 29% schedule contingency.

RECENTLY HIRED

Guillermo Aparicio – Mechanical Tech, Mechnical Engineering, ASD
Robert Hoade – Mechanical Tech, Mechanical Engineering, ASD
Jeffrey Hoogsteden – Mechanical Tech, Mechanical Engineering, ASD
Juan Zhou – Materials Science Associate, Optics Fabrication, XFD

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)											
Topic	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	151.6	151.4	46.9	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	153.1	159.1	71.3	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.