# National Synchrotron Light Source II

# Project Progress Report

## January 2012

Setting sun highlights the progress as of January 31.

report due date:
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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 contingency. At the end of January the project was more than 70% complete, with over 35% 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, both well within the acceptable range.

Excellent progress continues with construction of the ring building and all five lab–office buildings (LOBs). The last section of the ring building is on track to be completed in mid-February; contract closeout will follow. Rapid progress is being made on all five LOBs; the contractor workforce is at peak level. With all trades at work in each LOB, extra care is being paid to safety and coordination. LOB 1 is on track for beneficial occupancy in early summer.

Integrated testing and preparations for the Accelerator Readiness Review (ARR) of the linac are underway. Excellent progress continued in the production and installation of magnets, booster, power supplies, vacuum, RF, and cryogenic systems. Booster installation activities ramped up, and second and third shipments of the booster components with fully equipped magnet girders are en route from BINP to BNL. Over 70% of magnet production work is completed and more than 50% of magnets have been delivered. The magnet–girder integration is into two-shift mode and is nearing the goal of two fully integrated girders completed per week. Installation and acceptance testing of accelerator subsystems continue healthy progress in pentants 1, 2, 3, the RF building, the injector building, and the computer room. The first of 30 storage ring cells, comprising five girders, has been completed and integrated testing for the cell has begun.

Good progress continued with procurement activities for the six Project beamlines and preparation for the utilities that are required before hutches and beamline components can be installed. Activities funded by the American Recovery and Reinvestment Act (ARRA) continue on schedule and budget.

### UPCOMING EVENTS 2012

| | |
|---|---|
| Accelerator Readiness Review (ARR) | Feb 27–29 |
| Installation Retreat | Mar 13 |
| Science Advisory Committee (SAC) | Mar 15–16 |
| Final Design Review (FDR) meetings, IXS and CSX Hutches | Mar 20–21 |
| Project Advisory Committee (PAC) | Mar 29–30 |
| HXN Beamline Advisory Team (BAT) Meeting - TBD | Apr or May |
| Review of High Level Application Programs for NSLS-II | Apr 4-6 |
| Magnet Production Lessons Learned Workshop | Apr 11-13 |
| DOE Review of NSLS-II Project | Apr 17–19 |
| 7th Bi-Annual CW and High Average RF Workshop | May 8-11 |
| CHX BAT meeting | May 10 |
| DOE Review of NSLS-II Pre-Operations Budget | May 14–16 |
| Assoc. Lab Director (ALD)'s Prelim. Design Review, ABBIX | Jun 26-27 |
| ALD's Preliminary Design Review of NEXT Project | July 17-19 |
| DOE CD-2 Review of NEXT Project | Sep 11-13 |

## ACCELERATOR SYSTEMS

**Installation.** Installation progressed very well in January. The overall installation rate has caught up with the schedule. Fifteen magnet girders were transported to the accelerator tunnel, and the first of 30 accelerator cells has been completed with all five girders (Fig. 1).

Figure 1. First completed storage ring cell.

The mechanical utilities for the RF, for the injector, and for pentant 1 have been completed (Fig. 2). Installation is complete and integrated testing is in progress for the linac and the utilities transfer line with diagnostic magnet vacuum and power supplies as well as vendor-supplied systems.

Figure 2. Completed de-ionized water skid for pentant 1 magnet and absorber cooling.

**Storage ring magnets.** Magnet production continues to go well, with no technical issues. Both the 100 mm and 156 mm corrector productions are complete. Overall, the magnet

production is about 70% complete. More than 50% of the magnets have been received. All manufacturers are on track to complete multipole production in September and dipole production in December.

**Magnet girder integration.** The magnet–girder–vacuum integration process is sufficiently mature for routine operations now. Since mid January, the precision alignment is performed in two shifts. The girder completion rate is nearing the anticipated two girders per week, which will allow completion of the girder installation in the fall of 2012.

**Linac.** Linac installation is complete and integrated testing is in progress. Preparations for the Accelerator Readiness Review on Feb 26–29 are well advanced.

**Booster.** The booster area is being prepared for the installation of magnet girders. Production of components at BINP proceeds well. The second shipping container with five fully equipped magnet girders will arrive by mid February. The third container with seven magnet girders has left port.

**Power supplies and electrical utilities.** The manufacturer's preliminary design of the main power supplies is complete and most of the long lead items have been ordered. The production of power supply controllers (PSC) continued, with 83 % of the main boards received. Main boards are being tested on the production test fixture; test results are recorded in the traveler. Testing of the PSC components needed for cell 25 is completed and components have been assembled in their chassis. Ninety percent of the regulator chassis for all multipole and corrector power supplies have been built and delivered onsite. The issue with regulator board production has been overcome and the production rate has reached anticipated values. Three percent of the production has been received and tested. The production for the power supply interface (PSI) is complete. However, the PSI boards have an error requiring correction on all of the cards. Testing is underway on the pre-production power amplifier units for the corrector power supplies. The first pre-production fast corrector power amplifier has been built and testing has begun. Preliminary results show the amplifier meets all requirements. The interface chassis of the one-wire temperature measurement system have been delivered. The fifth and last delivery of production power converters was received this month. The production for the AC input power modules is completed: we have received deliveries for all components, shelves, hardware, and power modules. All low-precision temperature control chassis units have been delivered. A test procedure and traveler were created and all units have been tested. We now have all universal power supply units for the project, as well as all the booster power supply output cables.

**Vacuum systems.** Thirteen cell chambers were assembled and vacuum certified in January 2012. One hundred thirty multipole and dipole chambers (90%) are complete. Most dipole chambers were relocated to B740 for dipole girder assembly. Six multipole chamber girder assemblies were completed and conditioned for good vacuum ($10^{-10}$ mbar) at the 902 Annex, bringing the total to 13. The cell 25 vacuum assembly was completed and pumpdown started. Bending chamber drift pipes and appendage vacuum components were installed at LTB Phase I.

Eight RF gate valves were received, bringing the total available to 18. Production orders for stick and flange absorbers were placed with suppliers, although some fabrication issues are still being resolved. The final design of the damping wiggler absorbers is waiting for the updated power density analysis under worst-case beam deviation. We have received more than 80% of the vacuum gauge controllers, 60% of the TSP controllers, and 60% of the RGA systems.

**RF systems.** The 90 kW Inductive Output Tube transmitter for the booster is complete. Testing of the fully installed storage ring transmitter has begun. A successful design review was conducted with AES on the superconducting 500 MHz cavity. The final design review for the cryogenic liquid helium plant was conducted.

**Insertion devices.** The production of damping wigglers is well underway. Machined components of the magnet assembly parts have made headway. The structural frames and magnet girders have made good progress at Norte-Mecanica in Spain. The final design review for the EPU is scheduled for mid February. The manufacturer has received all the permanent magnets, which are of good quality. With the integrated field measurement system, it was found that improved grounding and cable selection could reduce the overall noise. Conceptual Design Reviews for the IVU and IVU21 were conducted January 30, 2012. Paperwork for the canting magnet Request for Proposals (RFP) is 95% complete. Four proposals for IVU22 have been received and evaluation is in progress.

## EXPERIMENTAL FACILITIES

XFD procurement work continues, with many packages for the beamline optical components now about to be awarded, in evaluation, or released to bidders. Hutch work continues, with the final design review (FDR) for the second batch of hutches completed in January. Manufacture of the first hutches, for CSX and HXN, was completed in January and delivery will occur in early March. The utilities required for the beamlines will be installed as soon as the hutches are completed. Currently, staff are working on the component specifications for the utilities. The mock-up of a section of wall was completed.

**IXS**. The RFP for the KB Mirror System has been released. The proposal deadline is set for March 21. The specifications and statements of work (SOW) documents for the first optical enclosure package are nearly completed. The team also began the final design of the Be-CRL assembly, the HRM, and the Analyzer system for the spectrometer, incorporating the latest results from the optics R&D.

In crystal optics R&D, the IXS team completed another successful run at SPring-8 in January, testing the new 4B HRM mechanism using the trapezoid flexure (Fig. 3). This

allowed us to scan the 4B HRM energy with the required angular resolution.

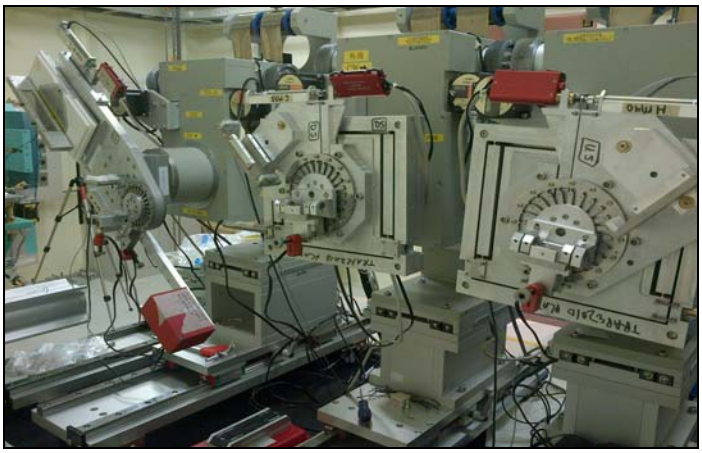


Figure 3. The 4B HRM with the CDW analyzer setup used by the IXS team at SPring-8.

The total energy resolution, combining the 4B HRM and the CDW analyzer estimated from the rocking curve width of the D crystal, was 1.1 meV (Fig. 4). This is very close to the design value expected. The energy resolution of the 4B HRM was estimated to be ~0.9 meV after de-convoluting the contribution of the CDW analyzer.

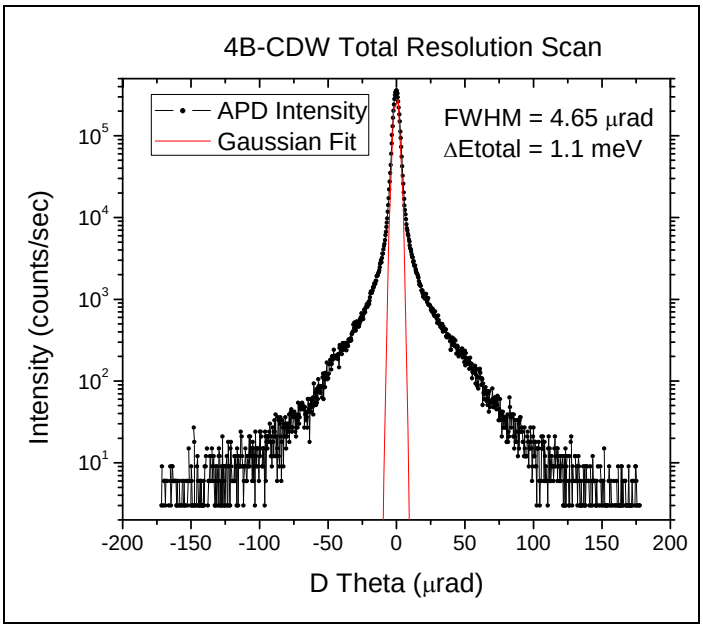



Figure 4. CDW analyzer D crystal rocking curve measuring the total rocking curve width with the 4B HRM. The total energy resolution estimated based on the width was 1.1 meV.

**CHX.** The CHX team has worked on the best value evaluation of the CHX optics package, and anticipates a contract award date of March 1. Two proposals were received in response to the CHX diffractometer RFP and are currently being evaluated.

With the information included in these packages, the CHX team has worked on updating the schedule and costing for the baseline plan, and is on track for an on-budget and on-schedule delivery.

The CHX team has advanced with the in-house conceptual design of the 15 m-long small angle x-ray scattering (SAXS) table. It features several unique capabilities, including capabilities for simultaneous in-situ combined SAXS and wide angle x-ray scattering (WAXS), and a wide accessible scattering wavevector range: up to ~1 $Å^{-1}$ at 15 m from the sample, and up to ~3 $Å^{-1}$ at 5 m from the sample.

**CSX**. Procurement packages for the toroidal mirrors and monochromators are finalized and ready to send out for proposals. The M3-A mirror package is being finalized, together with packages for the M1-A and M3-B mechanics and the M3-B mirror. The next group of packages will focus on slits and diagnostic components for both branches. Vacuum analysis for the beamline and the differential pump, x-ray tracing for the front end and beamline, and finite element analysis on the white beam apertures are still "work in progress" for future procurements.

**HXN.** The HXN team is making progress in the beamline component design, working closely with FMB-Oxford. The final optical parameters for two mirrors have been finalized and the mirrors have been ordered for polishing. The project manager of FMB-Oxford visited NSLS-II to address the details of the vacuum, electrical, and utilities, in order to meet all requirements for the preliminary design review scheduled for the fourth week of February. In addition, the HXN team started to evaluate the preliminary design of the major beamline components.

**XPD.** Two contracts being finalized are for the Double Laue Monochromator (DLM) and the beamline components. The RFP for the XPD vertical focusing mirror was released on January 20, with a proposal return date of February 20. The FDR of the lead hutches took place on January 24. The writeup of the SOW and specification documents for the XPD diffractometer is in progress. The XPD staff is exploring a collaboration with COMPRES (Consortium for Materials Properties Research in Earth Sciences) for the implementation of high-pressure equipment and fast ramp-up plans for the XPD science program. The XPD beamline will use the concept that underlies the sagittally bent DLM of the NSLS-X17B1 beamline. Therefore, in January we measured the Instrumental Resolution Function at the X17B1 beamline, as this information will benefit our modeling of the expected performance of XPD.

**SRX.** The four proposals for design, construction, and installation of the SRX optics components package have been evaluated. An apparent successful offeror has been identified and contract negotiations are underway. The proposals for the KB mirror system RFP are expected in mid February. A BAT meeting was convened regarding the status of the beamline and endstation procurements. Potential early science experiments have been discussed with the BAT, which strongly supports the plans of the SRX team to organize a workshop focusing on these experiments for September 2012.

**Optical metrology.** The ELCOMAT autocollimator and the pentraprism should be on site in late February, and the two gantries are expected before the end of March. Work is progressing on the stitching platform.

**Optics fabrication.** The IXS group achieved good results at their recent SPring-8 beamtime with the 4-bounce monochromator crystal set that was produced by our Optics Fabrication Group (OFG) last October. Efforts now are being focused on understanding what is needed to produce high quality thin crystals (c-crystals) for use in both transmission and reflection geometry.

Multi-Lau Lens (MLL) fabrication efforts continue to focus on sectioning. Several lenses that were sectioned by RIE-FIB were investigated by the HXN group with TXM and were found to contain what appears to be "density" fluctuation with an angular offset through the multilayer stack. Initial thoughts are that these striations are due to the focused ion beam sectioning process, so several experiments are being conducted by Evans Analytical Group (involving several different sectioning procedures) as well as by OFG staff at the CFN to understand the cause of these defects. An MLL (43 micron) is currently undergoing manual sectioning into a wedge geometry for HXN to use in the March beamtime.

## CONVENTIONAL FACILITIES

Conventional construction continued to make excellent progress during January, aided by moderate winter conditions that enabled nearly unimpeded work on the LOB concrete, steel, and building envelopes. Rapid progress continues to be made on each of the five LOBs as the contractor workforce nears its peak level. Pentant 5, the last section of the ring building, is on track for achieving beneficial occupancy in mid February. Remaining work on the ring building is limited to interior and exterior finishes, system commissioning, punchlist work, and some sitework later this spring.

The ring building contractor is nearing completion of all major work scope. Pentant 5 is nearing completion with the startup of electrical and mechanical systems in progress, and finalization of architectural finishes underway. The lobby is complete and awaiting final testing of the elevator and HVAC system. With the substantial completion of pentant 5 in February 2012, all major contract work for the ring building will be completed. Remaining work will include resolution of all punchlist items, completion of system commissioning and operator training, delivery of remaining operations and as-built documents, and some final sitework that could not be completed during winter conditions. Following completion of all physical work at the site, demobilization and contract closeout will commence.

All five LOBs continue to make excellent progress. Temporary enclosure of LOB 1 is complete, enabling the use of temporary heat to allow interior finish work to proceed. The roof is complete, glazing is installed, and exterior siding installation is underway. Mechanical, electrical, and architectural finish work is progressing well in the interior spaces and mechanical mezzanine.

LOB 3 is the next most advanced, with the envelope sheathing complete and exterior siding installation underway. Installation of interior partitions, mechanical, and electrical are progressing rapidly.

LOB 2 follows, with roofing completed and sheathing and glazing nearly done. LOB 4 steel and concrete are complete, and interior partition work, mechanical, and electrical work are now in progress. LOB 5 steel and concrete are now complete, with decking and roofing in progress.

The LOB workforce is at peak activity, with all trades working to varying degrees in each LOB. The coordination of work between the ring building and LOB contractors with ongoing accelerator installation continues to progress well, with minimal interference or disruption. Any work performed by the contractors in occupied areas is managed by a work permit system, to ensure safety of the workers and minimize potential disruption of ongoing accelerator installation work.

## ENVIRONMENT, SAFETY, AND HEALTH

Beneficial occupancy readiness evaluations (BOREs) have been completed for pentants 1, 2, 3, and 4; RF compressor; injection buildings; and the cooling tower. The final BORE for pentant 5 (mid February) 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 review by the Lab Safety Committee. Approval by BHSO is expected in March. 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 January. The linac ARR is now scheduled for February 27–29, 2012. A web site has been established for the ARR team, giving them access to documentation necessary for the review.

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. The construction of the ring building is expected to be complete in February, with the conclusion of the pentant 5 BORE. A much smaller crew will be completing those punch list items.

## NEWLY HIRED

David Petry – QA Engineer, Quality Assurance Office

Xiaojing Huang – Postdoc Research Associate, HXN

## PROCUREMENT ACTIVITIES

The RFP for the EPU Vacuum Chambers was posted on FedBizOps in January, with proposals due in late February. Proposals for the CHX Beamline Optical Components, XPD Beamline Components, SRX Beamline Optics Components, and Double Laue Monochromator are in the final stages of evaluation, and awards will be made mid to late February through early March. The proposals for the CHX Beamline Diffractometer have been received and are in evaluation. Award is expected in early March.

## COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) for the overall project is 1.01 and cumulative Schedule Performance Index (SPI) remains at 0.96, both well within the acceptable range. The project is 70% complete, with 32% of contingency and management reserve, based on EAC work remaining.

The project current period schedule variance is yellow, with a current-month SPI of 0.87 (-$2.3 M) due to a slight negative schedule performance from Conventional Construction (standard equipment and LOBs) and Accelerator Systems (injec tion system, controls, and insertion devices). Accelerator Systems has an SPI of 0.85 (-$1.276 M) this month, due primarily to late deliveries of transport magnets and vacuum chambers. Conventional construction had a slight negative schedule variance (relative to the size of the Conventional Facilities budget) for the month of January 2012, with an SPI of 0.88 (-$729K) due to minor current-period delays in standard equipment and the LOBs (although they are cumulatively ahead of schedule).

Experimental Facilities (XFD) variance for the month was negative for schedule performance, with a current SPI of 0.77 (-$221 K) due to delays in motion controller delivery, hutch design/fabrication, and beamline procurement. Their CPI for the month is 2.01, with a cost variance of $367 K due to accruals not entered for hutch fabrication and the CSX beamline. However, the XFD cost and schedule performance continues to be green on a cumulative basis: SPI 0.95 (-$1,055 K), CPI 1.03 ($485 K).

The critical path for the project has not changed since last month. Activities on the critical path include 35 mm dipole magnet deliveries; pentant 5 girder assembly, bakeout, and installation; P5 connect PS & instrumentation, cables survey, and alignment; subsystem test diagnostics; EPU installation; integrated tests; and commissioning of the storage ring. There are 14 months of float between the project early completion milestone and CD-4, with approximately 34% schedule contingency.

## PHOTO GALLERY

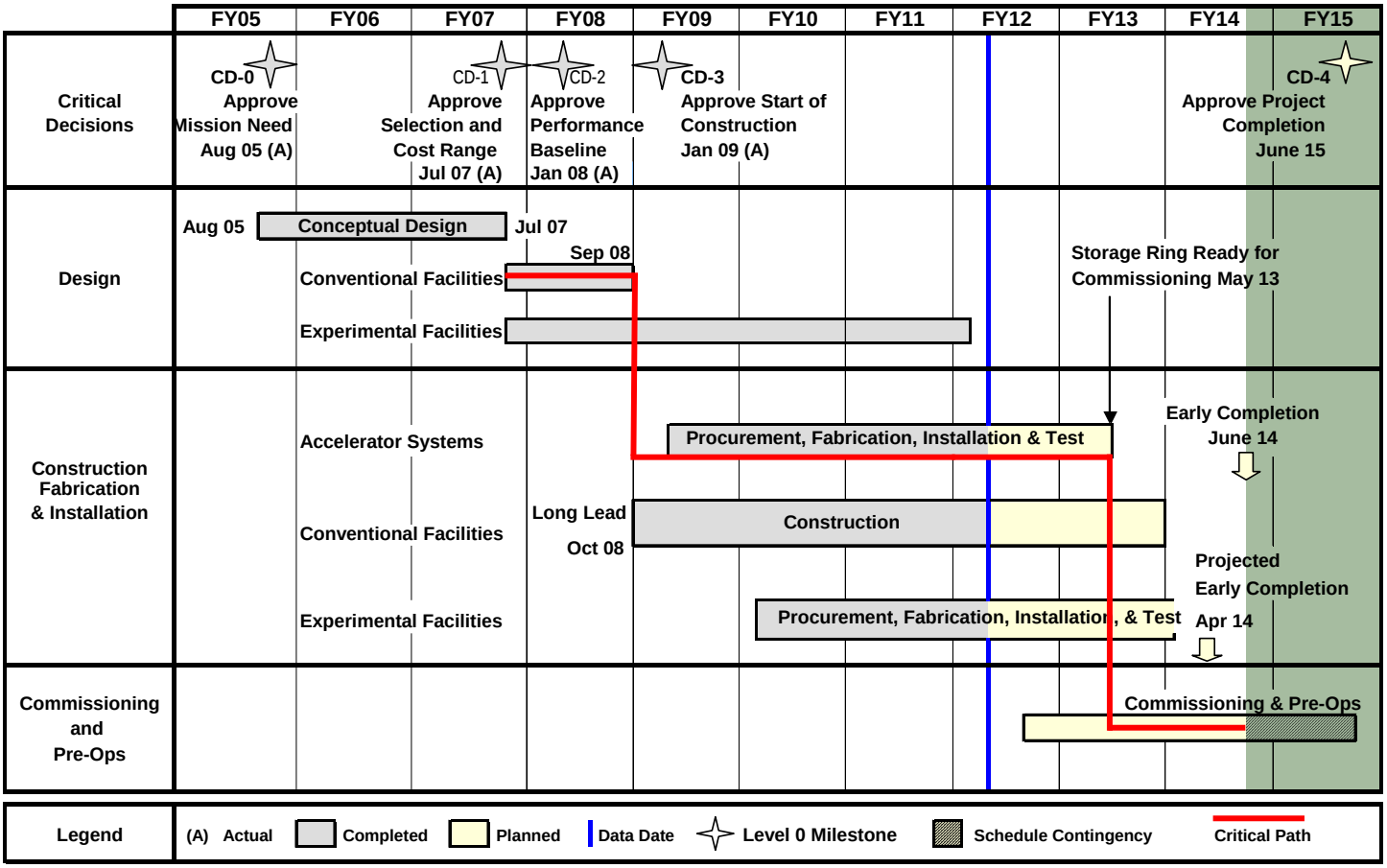
Figure 5. Chilled water to de-ionized water heat exchanges in the Cooling Tower Building.

Figure 6. Primary water circulating pumps, also in the Cooling Tower Building.

Figure 7. Vehicle tunnel with street lighting and traffic light installed, viewed from the inner courtyard.

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.