National Synchrotron Light Source II

Project Progress Report

April 2012

All appears quiet on April 30, with most construction activity occurring inside.

report due date:
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OVERALL ASSESSMENT

The National Synchrotron Light Source II project continued to make excellent progress with satisfactory cost and schedule performance. The project was 76% complete with 41% of contingency and management reserve for the remaining Budget at Completion (BAC). The cumulative cost and schedule indices are 1.0 and 0.95, respectively, both well within the acceptable range.

The DOE Independent Project Review (IPR) was conducted by the Office of Science on April 17–19. The committee concluded that the project has made impressive progress on all fronts and has been properly managed for its successful execution. The committee also concurred with the priorities and timeline of the proposed contingency spend plan.

The overall conventional construction continued to be on budget and slightly ahead of schedule. The ring building contractor has completed basic contract work and has started the contract closeout process. All five of the lab–office buildings (LOBs) continued to make good progress.

Linac commissioning is proceeding on schedule and has met its commissioning goals. Healthy progress continued in the production and installation of magnets, booster, vacuum, RF, power supplies, and cryogenic systems, resulting in a positive schedule variance of $0.5M (SPI of 1.08) in April. Magnet production and magnet–girder integration and installation continued to meet goals. In total, 39 magnet girders are now installed in the storage ring tunnel. Half of the 44 booster magnet-girders were delivered and nine of them were installed in the tunnel. The production of damping wigglers and the design and procurement of other insertion devices continued to be on track.

Good progress continued with procurement work for the six Project beamlines, preparation for the utilities needed for hutch installation, and optical metrology.

The latest schedule update has reduced the total schedule float between the projected early completion date and CD-4 milestone date from 14 months to 12 months. This shift resulted from a stretched-out power supply delivery schedule. The critical path for the project now runs through the power supply delivery and installation rather than magnet delivery. A schedule recovery plan for the power supply delivery and installation is being formulated. The schedule refinement will continue over the next few months.

Activities funded by the American Recovery and Reinvestment Act (ARRA) continue to be on schedule and on budget.

UPCOMING EVENTS

7th Bi-Annual CW and High Average RF Workshop	May 8-11
CHX BAT Meeting	May 10
HXN BAT Meeting	May 11
XPD BAT Meeting	May 11
DOE Review of NSLS-II Pre-Operations Budget	May 14–16
HXN Final Design Review	May 29–30

ACCELERATOR SYSTEMS

Accelerator physics. An external review of top-off safety has been held to review the top-off analysis and proposed measures of monitoring and interlocking set values of magnets and injected beam parameters. The review was quite successful. No major issues have been raised.

Linac commissioning progressed well. The design energy has been demonstrated. Start-up and shutdown procedures for the linac have been developed. Beam diagnostics equipment in the linac-to-booster transfer line (LtBTL) was commissioned successfully. A three-screen method and a quadrupole scan program for emittance measurement were developed. The energy spread measurements were calibrated and the energy jitter was adjusted to be within the specified range (0.5%). Multi-bunch mode with 15 nC of charge in 160–300 ns bunch trains was demonstrated. Initial tests on beam loading compensation were performed. Radiation dose measurements outside the linac vault suggest a need for supplementary shielding and expansion of the fenced-off area on the booster berm. Commissioning proceeds on schedule.

Booster. Twenty-two booster magnet-girders, 50% of the total 44 needed, are on site. All delivered girders were tested (electrical, vacuum, water, and survey) and are ready for installation. Water pipes on the girder were changed from flexible hoses to stainless steel piping. The girder transportation dolly is complete and the first three girders were installed in arcs 1 and 2. Cable pulling is complete in these arcs for the on-the-wall trays. BINP visitors are onsite and working closely with BNL staff on the booster installation. Final tests of the power supply for combined function focusing dipole magnets at Danfysik are underway; the first unit arrived on site at the end of April.

Pulsed magnets. The final design review of the storage ring injection septum was held and the design was approved.

Vacuum systems. All the long chambers for Day-1 straight sections have been machined and shipped to APS for welding. Three chambers were completed and received. Eight multipole girders and one dipole girder were completed, baked at the 902 Annex, and installed in the tunnel. Two first-article exit pipes and stands were test-installed successfully at cell 26. At cell 25, the fabrication of water cooling lines has started. The drawings for all booster-to-storage ring transfer line (BtSRTL) drift pipes are being released. Seventeen booster girder chambers were tested; two were found to have electrical shorts to the magnet lamination and need to be repaired.

Optimization of damping wiggler absorbers is completed and the fabrication drawings are being produced. Half of the flange absorbers were received, as were half of the Phase-II RF bellows housings. The delivery of RF gate valves and RGAs continues. Vacuum instrument chassis for the booster and storage ring (SR) pentant 3 (P3) sections have been installed in the racks. Cable termination for the booster is underway. The P2 vacuum cables at the mezzanine have been terminated. The inter-chassis cables for the booster and SR P1 racks have been ordered. The order for assembling SR vacuum programmable logic controllers has been placed. The

interface to the EPICS control system for the LtBTL and cell 25 vacuums has been established.

Power supplies. All outstanding design issues involving the main dipole power supplies have been resolved after the final design review at the end of March. All regulator chassis for the multipole and corrector power supplies are in house; testing is in progress. Automated testing for the power supply interfaces (PSIs) keeps pace, with a goal of one cell (~23 units) worth of PSIs per week. PSIs for cells 24, 25, and 26 have been tested and configured. Twenty-four units (the first articles) of the alignment corrector power amplifiers have been delivered, testing is completed, and full production has begun. The AC input modules for one-half of the storage ring have been modified with the new interface board and have been tested. The installation of shelves, brackets, and power converters in P1 and P2 is ongoing. All the power supply components for cell 25 are completely installed. The cell interconnection cables between racks have been installed and network communication between the racks has been accomplished.

Installation. By the end of April, 22 booster magnet-girders had been received and nine were installed (Fig. 1).

Figure 1. Magnet girders in the booster tunnel.

Plumbing and testing of the remaining girders is in process on the experimental floor. Grouting of the booster arc pedestals is complete. Surveys of the booster straight section pedestals are in process, with drilling to follow. Booster DI and CA valves are being installed in the tunnel. Installation of the interlock conduit for the booster is complete. AC power to the racks and universal power supplies in the injector service area is being tested. The booster RF transmitter installation is in process (Fig. 2), with testing scheduled to start in June.

Figure 2. Booster RF transmitter installation.

In April, seven multipole girders and one dipole girder were transported into the SR tunnel, bringing the total to 34 multipole girders and five dipole girders. Girders are being installed in their final locations (Fig. 3) and auxiliary hardware installation is in process. The diagnostics group finalized cable management in the SR tunnel.

Figure 3. Completed cells 25 and 26 in storage ring pentant 1.

The following installation was performed in P1: Bending and cutting of the vacuum DI water connections (Fig. 4) in cell 25 is in process. Isolation valves for the experimental hutches' DI water in P1 were installed. The functional testing of the service building 1 copper and aluminum DI water pump skids is complete. The klixon cable pulling was completed. Installation of equipment in cells 23, 24, 25, and 26 is in process. All of the cell 26 racks have been powered.

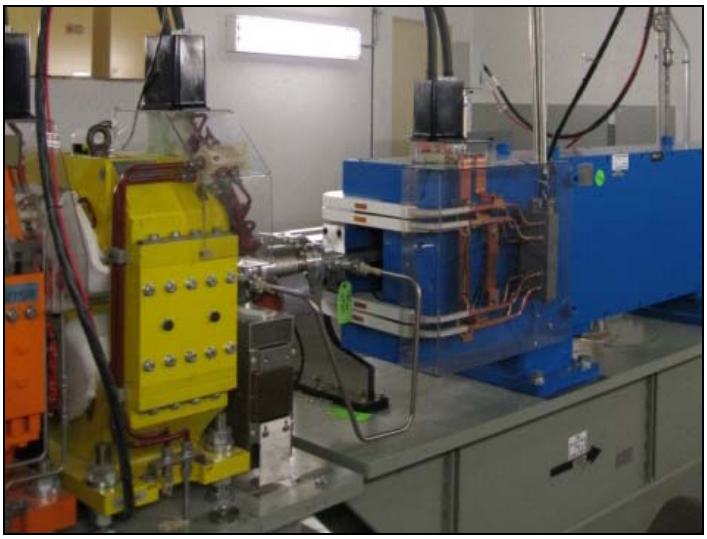


Figure 4. Test installation for the dipole DI water connection.

The following installation work was performed in P2: Interlock conduit was installed in the tunnel and on the mezzanine. Installation of interlock conduit along the ratchet wall is in process (two cells remaining) and then will proceed to the service building. Two cells of dipole cables remain to be pulled, leaving only the safety cables and klaxon cables to be pulled. Rack shelving and equipment installation is in process. Personnel Protection System interlock wiring work is in progress. The vacuum group is testing high-voltage ion pump installations in cell 29 (Fig. 5).

Figure 5. Cell 29.

The following installation work was performed in P3**:** The tie-in of AC cabling from the panels to the racks is in process; installation of interlock conduit is in process. The process chilled water (PCW) piping to the electronic racks is in process. Installation of girder floor plates was completed.

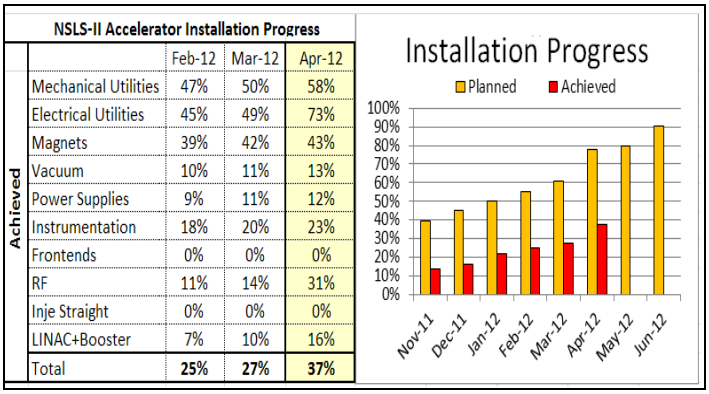
The following installation work was performed in P4**:** Installation of universal power supplies is in process. Girder floor plates are being installed and surveyed. DI water piping in the tunnel was completed.

The following installation work was performed in P5**:** Installation and survey of girder floor plates is in process. DI piping installation is in process and is scheduled to be complete by the end of May.

In the RF building, the first SR RF transmitter has been power tested by the manufacturer. The interlock conduit for the RFR blockhouse is complete, and installation of AC power in the blockhouse is almost complete; additional cable tray work is in process. The terminating of the PPS cables in the blockhouse is in process. The DI piping into the RF blockhouse is scheduled to be completed by mid May. The booster cavities were transported to the RF building.

NSLS-II Accelerator Installation Progress

Achieved	Feb-12	Mar-12	Apr-12
Mechanical Utilities	47%	50%	58%
Electrical Utilities	45%	49%	73%
Magnets	39%	42%	43%
Vacuum	10%	11%	13%
Power Supplies	9%	11%	12%
Instrumentation	18%	20%	23%
Frontends	0%	0%	0%
RF	11%	14%	31%
Inje Straight	0%	0%	0%
LINAC+Booster	7%	10%	16%
Total	**25%**	**27%**	**37%**



Insertion devices. The manufacturer of the damping wiggler received two separate shipments of Permendur poles and permanent magnets of all types (Main, Sides, and four types of Termination magnets) in sufficient quantity to populate more than two DWs. Furthermore, mechanical measurements of all available poles and magnets have been made. Tooling required for module assembly and DW build-up has been fabricated and tested. The design for transport stabilizers for the elliptically polarizing undulator (EPU) has been agreed upon. The contract for the EPU vacuum chamber is ready to be signed.

The final design report for the in-vacuum measurement system (IVMMS) has been submitted. Upon approval, fabrication will begin. The contract for the IVU22 has been signed by the manufacturer. The kickoff meeting will take place May 2.

Experimental Facilities

Procurement activity continued on various XFD procurement packages, with many contracts being awarded. Installation work on the CSX optics hutch is progressing well and will be completed in late May. The HXN hutches are now in manufacture and we anticipate sign-off of the Final Design Review (FDR) for the final hutches in May. We plan to install the beamline utilities as soon as the hutches for each beamline are completed. A design review for the utility systems will be held in June.

IXS. Evaluations of the IXS KB Mirror System proposals are complete and contract negotiations with the identified supplier have begun. A request for proposals for the beamline optics component package was released on April 20; the deadline for proposals is June 4. Specification and statement of work (SOW) documents for the IXS spectrometer are being finalized. The design of the IXS spectrometer was reviewed

during the BAT meeting held on April 30. In further development of high-resolution optics, the IXS team plans to test the entire optical scheme at the upcoming beam time at PETRA III in May. Preparation of equipment was completed and ready for shipping to Petra III in early May.

HXN. The HXN carried out a nanofocusing experiment at the Diamond Light Source (DLS). The team constructed a prototype microscope, capable of manipulating multilayer Laue lenses (MLL) with sufficient motion degrees of freedom. The experiment proved that the MLL prototype microscope performed well. Working closely with scientists at DLS, the team plans to incorporate the instrument into the DLS controls system. The preliminary design of the HXN Beamline Component Package was accepted in early April, meeting a significant milestone of HXN beamline development. During the DLS experiment period, the HXN team visited FMB-O for two days and made significant progress finalizing the detailed design for the mirrors, monochromator, and secondary source aperture. The formal final design review is scheduled at the end of May.

CHX. The contract for the CHX diffractometer was awarded on April 13. Work is progressing well with several in-house design projects, including the 15 m-long small angle scattering detector table and most of the other end station equipment. Immediately following the DOE review, members of the team traveled to APS, where they conducted an experiment on dynamics in protein crystals at the 34-ID beamline. The data are currently being analyzed. Overall, the experiment produced promising results with important potential biophysical applications for the early science program of the CHX beamline and beyond.

CSX. In April, CSX beamline personal began evaluating three packages: toroidal mirrors, monochromators, and bendable mirror. The SOW and specifications for the last large mechanics package for the CXS are being finalized. Seven grating substrates are undergoing metrology.

SRX. Contracts for the SRX Beamline Optical Components Package and the SRX KB Mirror Systems Package have been signed. First meetings with the companies have taken place to start the fabrication process. The tests of sample stages feasible for the SRX end stations have been finished and a list of the best stages for SRX has been created. Discussions about the Maia-Detector and a test experiment at the PETRA-III facility are underway with the Instrumentation Group.

XPD. Weekly teleconference meetings are taking place with the main contractor to follow up on work being done for the XPD DLM and the XPD beamline components. The XPD vertical focusing mirror contract was awarded on April 2 and the kick-off meeting took place on April 25–26. The statement of work and specification for the XPD diffractometer are in the final review and sign-off process.

Optics fabrication. A "windowed" C-crystal has been fabricated using a deterministic computer-controlled polishing (CCP) technique. Although there were some shortcomings in the first two test crystals, they demonstrated that CCP is a promising technique for fabricating thin transmission crystals. Two more conventionally processed C crystals were provided to the IXS group for upcoming beamtime. MLL N43-4-9 (20 nm estimated focal performance) was manually thinned and mounted to a diamond plate for beamtime at DLS. Work to produce a section with RIE/FIB is underway. The latest MLL growth (intended to compensate for minor errors in N43-4-9) exhibited nonlinearity due to an unspecified error. The in-situ laser film stress monitor was aligned to optimize growth conditions for low stress at higher power (350 W) with shorter travel. The combination of higher power and shorter travel should reduce growth time for 45 micron-thick MLLs from 5 days to 1.25 days. Laue crystals fabricated for testing required slicing, edge-etching, hole coring, and masked deposition of Cr/Au on a small region of the crystal.

CONVENTIONAL FACILITIES

Conventional construction continued to make excellent progress during April, as ring building construction is substantially complete and LOB construction is at peak activity. The ring building contractor has completed basic contract work and is working on punchlist items and progressing toward contract closeout. The LOB contractor is working toward beneficial occupancy of LOBs 1, 2, and 3 by the end of June.

With all areas of the ring building now occupied, the ring building contractor has completed all major work scope. All areas slated for the installation of accelerator equipment have been accepted from the contractor and are now being utilized for installation activities or staging and storing equipment and materials as they are readied for installation. The remaining ring building contractor work includes resolution of all punch-list items, completion of system commissioning and operator training, delivery of remaining operations and as-built documents, and final sitework. Following the completion of all physical work at the site, demobilization and contract closeout will commence. It is anticipated that the ring building contractor's site presence will end by July 2012, although they will be available for any warranty work.

Construction of the five LOBs continues to make excellent progress. LOB 1 activity is focused on completion of the exterior siding system, getting mechanical and electrical systems commissioned and ready for operation, and completion of interior finishes in preparation for beneficial occupancy in June (Fig. 6). Office area finishes and flooring work are nearly completed, and building plumbing and HVAC are nearing readiness for operation.

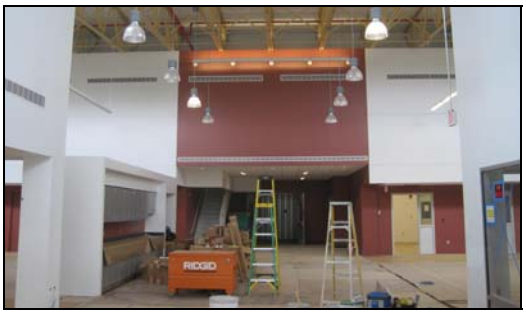


Figure 6. LOB 1 lobby begins to look like a public space.

LOB 3 is slated for full fit-out next and is progressing right on the heels of LOB 1. The building exterior envelope is nearly complete, except for the HXN, area where sheathing is in place and siding installation is just getting underway. Interior finish work is advancing quickly, as drywall and painting are nearing completion and mechanical/electrical/plumbing (MEP) work progresses rapidly.

LOB 2 follows, with roofing, sheathing, and glazing completed and exterior siding nearly complete. Interior partitions and MEP are well advanced. LOB 4 steel and concrete are complete; interior partition work, mechanical, and electrical work are in progress. LOB 5 steel and concrete are complete, with roofing and sheathing in progress and interior partition work just getting underway.

Significant sitework for the LOBs was accomplished in April. The parking lots of all five LOBs have had their base asphalt layer applied and much of the sidewalk and curbing work was completed. Final grading, spreading of top soil, and seeding of areas around the LOBs is now 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.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) for the overall project is 1.0 and the cumulative Schedule Performance Index (SPI) is 0.95, both well within the acceptable range. The project is 76% complete, with 37% of contingency and management reserve, based on EAC work remaining.

The project current period schedule variance is yellow, with a current month SPI of 0.89 (-$1.8M) due to variances in Conventional Construction caused by the completion of work ahead of schedule for the ring building construction and to a small negative schedule variance for LOB 3 of $-639k.

Accelerator Systems schedule performance for the month was 1.08 (green status) with a positive schedule variance of ($462k). The cumulative Accelerator Systems schedule performance has remained the same as last month (0.87 SPI), indicating no additional slip in schedule for Accelerator Systems. This schedule performance improvement is due to the increased number of production magnet deliveries and progress on storage ring components such as beamline front ends.

The cumulative Experimental Facilities Beamlines schedule performance remained relatively constant with a cumulative SPI for Experimental Facilities Beamlines of 0.91, compared to 0.90 in March.

Conventional Construction activities have a negative schedule variance for the month of April 2012, with an SPI of 0.73 (-$2.1M), due primarily to work completed ahead of schedule in the ring building contract in prior months and a small negative schedule variance for LOB 3. However, on a cumulative basis, the LOB schedule performance is on or ahead of schedule and the cumulative Conventional Construction schedule is ahead of schedule with an SPI of 1.01 ($1.7M).

The project-level cumulative cost variance is 1.00 CPI ($2.5M), green status. The current month CPI for the project is green, at 1.02 ($226k).

The critical path for the project has changed from the magnet delivery schedule to the installation of power supplies and instrumentation in the racks. The critical path continues through EPU installation, integrated testing, final survey, and commissioning of the Accelerator Systems. As a result, the projection of the project's early completion date has been revised from April 2014 to June 2014, which is consistent with the Baseline schedule. There are 12 months of float between the project early completion milestone and CD-4, with approximately 32% schedule contingency.

ENVIRONMENT, SAFETY, AND HEALTH

Beneficial occupancy readiness evaluations (BOREs) have been completed for the entire ring building and pre-BOREs have been started to support the reviews for the LOBs, which are expected to be completed at the end of June (LOBs 1–3) and November/December (LOBs 4 and 5). The BORE process will ensure that all life safety and code compliance requirements are in place prior to staff occupying the LOBs. Work to close out the remaining post-occupancy items from the ring building continues and is nearly complete.

Linac commissioning continues since approval to proceed was granted by the local DOE site office on March 26. An additional supplemental shield was installed to lower dose rates in the area of the LtB injection region. Although the dose rates were low, efforts are being made to reduce them further, to permit uncontrolled access to this area, to facilitate booster installation activities.

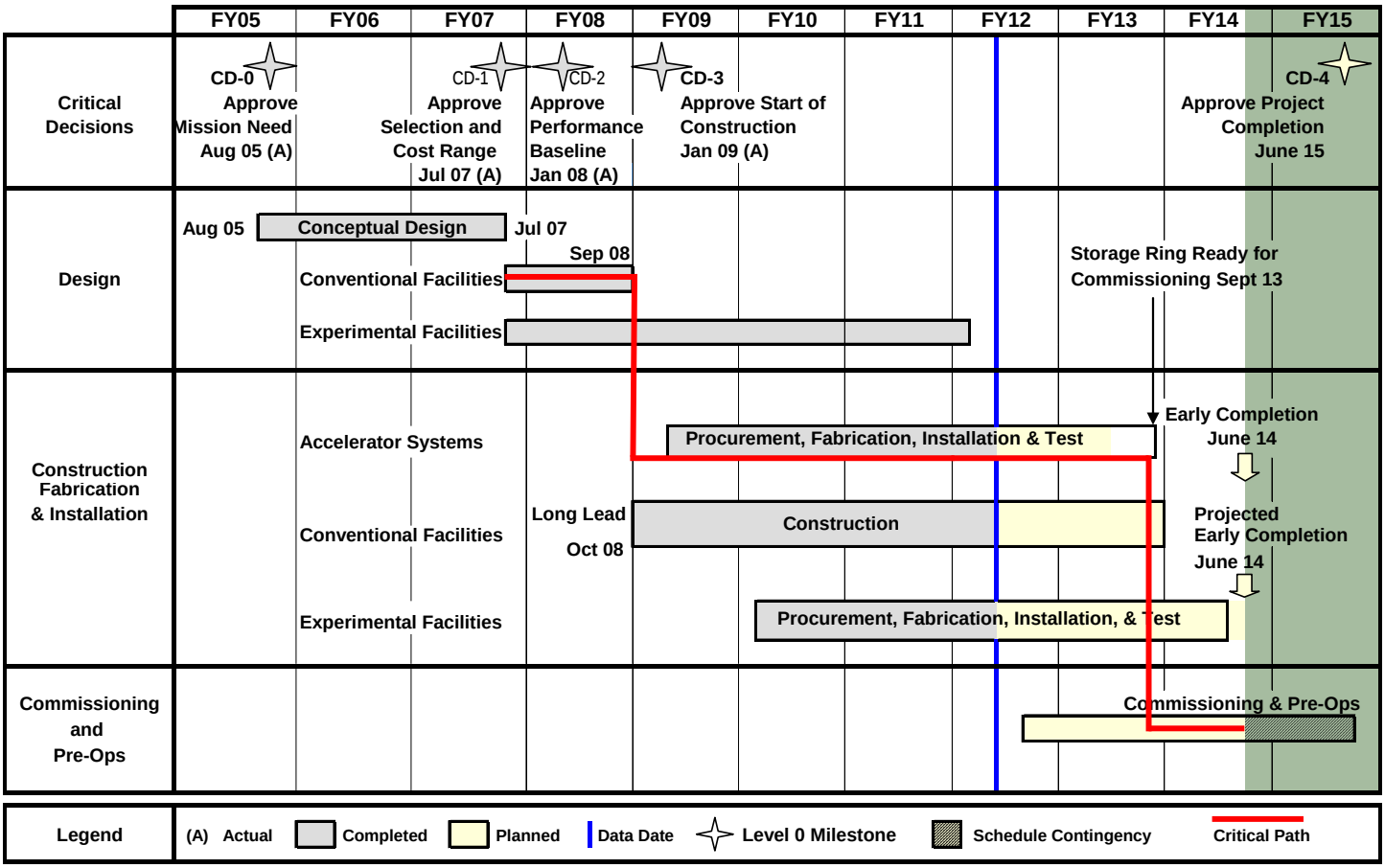
While much of the high-risk construction activity for the ring building is complete, increased emphasis is being given to safety as the contractor demobilizes. Historically, this phase of a construction project results in increased injuries and claims. Enhanced communications and job planning are being implemented to minimize this risk. The construction of the ring building was completed in February, with the conclusion of the pentant 5 BORE. A much smaller crew (~15) will be completing punchlist items through June.

NEWLY HIRED

Konstantine Kaznatcheev – Sr. Physics Associate, Optics Metrology, Experimental Facilities

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 119873.