Project Progress Report

National Synchrotron Light Source II

June 2013 Activity

Early on the last workday in June, hazy with heat, from a vantage point high on BNL's iconic red-and-white stack.

report due date:
July 20, 2013

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OVERALL ASSESSMENT

The National Synchrotron Light Source II Project made satisfactory progress in June with the current-month schedule performance index (SPI) of 0.95 (-$435K). The cumulative cost and schedule indices are 0.99 and 0.97. The project is 86% (89%) complete with 40% (52%) of contingency and management reserve for the remaining EAC (BAC) after the inclusion of the recently approved scope additions for future beamlines. The project has 71% (10 months) of schedule contingency for the remaining duration of 14 months before the projected completion date of August 2014.

Accelerator Systems continued to make good progress on installation of the storage ring and fabrication of remaining components. The monthly SPI for Accelerator Systems in June was 1.03, +$76K, with the cumulative SPI of 0.94. Extended Integrated Testing of the entire injector complex, including transfer lines, continued. Installation of Accelerator Systems is over 90% complete. Delivery and testing of the insertion devices continued, and the installation of front end hardware and infrastructure for the insertion devices are also progressing well.

Experimental Facilities has been ramping up delivery and installation of major beamline components. The monthly SPI for Experimental Facilities expects to fluctuate over next few months, largely driven by the actual delivery dates of these major components. Extended visits to all vendor sites by NSLS-II Project staff continued in order to provide a final push for quality and schedule assurance. Completion of the hutch installation is nearing and utility installation continued. Of HXN beamline components received in 13 crates in May, about 50% had been installed by the end of June. A mirror system for CSX and a focusing mirror and bending system for XPD were also delivered and are being tested and installed.

Based on accelerator installation progress, the production and delivery schedule of insertion devices, and implementation of the Corrective Action Plan from the Linac beam mis-steering event, the project schedule continued to be optimized. Accelerator Systems installation, except for 2~3 IDs will be completed in November 2013. The critical path of the project runs through booster commissioning followed by the SR commissioning and integrated testing of some of beamlines. Near-critical path items include installations of SR power supplies, area monitors, the Personnel Protection System (PPS), cryo systems, and the RF cavity.

The Project will continue to strive to complete all necessary activities to enable initial commissioning of the beamlines with beam by June 2014. Owing to maintaining favorable cost and schedule contingency, the project will continue to be able to invest in additional scope, which will enable the maximum scientific capabilities for NSLS-II as an integrated facility.

UPCOMING EVENTS

DOE Review of NSLS-II Project	July 16–18
DOE CD-2 Review of NEXT Beamlines Project	July 30–Aug 1
NSLS-II First Experiments Workshop	Aug 12–13
BAT meetings for HXN, CSX-1, CSX-2, and SRX beamlines	August
XPD BAT meeting	September

ACCELERATOR SYSTEMS

Vacuum. Six straight sections were successfully baked in June, making a total of 14 straight sections completed. Connecting the water cooling line to header drops in P1 is complete, and for P2 is underway. Design of the RF straight for the 7-cell cavity option is complete. Fabrication will start in July. The layout for additional insertion device straight sections slated to near-future beamlines has started. Three ceramic chambers were received and measured. Two met our specification.

Electrical engineering. The two main dipole power supplies have been delivered and are installed. Control signal testing and electrical test are being done before low-current testing starts. All PSC chassis needed for the injector and storage ring are now installed. PS regulator testing is complete. Testing of the power amplifiers has been completed, as well. The AC powered amplifier supplier has received an updated set of drawings and is working on the first articles. We are expecting the first article in July.

Power supply installation is expected to be completed by the end of July. The installation of tunnel cable tray for the damping wigglers is completed, and installing the AC power for the damping wiggler (DW) control racks has started.

Insertion Devices. Measurement of the first-article DW is completed and the second DW has been received. The traveler and procedure for our acceptance and in-house testing, along with appended reference documents, have been approved for testing of the control system, elevator base, gap drive mechanics, and magnetic measurement. Survey of the floor per our 3D coordinate file, outlining of vacuum stands and DW base plates, anchor drilling, and floor scarification have enabled the start of vacuum stand installation in June.

The elliptically polarizing undulators (EPUs) are ready for shipment. The procurement of the permanent magnet phasing/canting magnet has been released. The IVMMS (in-vacuum magnetic measurement system) was delivered to BNL. Site Acceptance Testing was conducted to ensure the trajectory straightness. The mechanical system of the SRX-IVU is in production.

The lamination steel for the stainless steel-canting magnets arrived at the port of Los Angeles, cleared customs, and was shipped to the laser cutting subcontractor. The first batch of laminations has been laser cut. One sample lamination was received by Everson and was found to have a very smooth, clean cut all around, and almost no noticeable burning of the adhesive coating at the cut edge. Everson approved it and authorized production cutting of the laminations. Also, a first article cooling tube and cooling plate have been assembled. Winding of coils is starting.

Milestone payments for the FDR and PRR of the IXS-IVU have been approved. The permanent magnets are being TiN-coated. Nortemecanica continues to fabricate the structural frame.

Installation. Overall, accelerator installation wass 90% complete at the end of June and continued to make excellent progress for the completion of SR installation by November. Installation of IDs and the front end is also progressing well.

The accelerator schedule for installation and commissioning is being continuously optimized based on the latest information on the remaining production deliveries. For a graphic view, see Table 1 on page 4.

Installation of mechanical utilities. The SB-3 pump skid is now available for use (one pump is operational, as there is an issue with the VFD on the other) and will run to support high-current power supply testing in P3. DI water is now available for the P4 magnets. The installation and pressure testing of the P5 copper DI drops is complete. The P5 copper DI header will be tied-in once the motorized isolation valves are repaired by FW Sims, who are also repairing the P5 copper pump skid and P3 and P5 aluminum pump skids before acceptance testing can be completed. The installation of the P3 aluminum DI drops is complete and of the P4 aluminum DI drops is in process. The installation of the P1 make-up water system for the aluminum skid is 25% complete. Pressure testing of the P3 dipoles is complete. The capillary tubing installation is starting in the SR tunnel and will shift to the mezzanine once the cryo work in that area is complete (Fig. 1).

Figure 1. Cryo system on the lower RF mezzanine1.

Installation of electrical utilities. Wiring to the main dipole power supply is complete. Cable tray installation is complete in cells 18 and 28 and finishing in cell 8. AC work for the damping wiggler racks will start in early July. The tunnel wireless network installation will start in July/Aug.

Installation of IDs. Survey and drilling of the cell 28 DW straight floor is complete. Scarifying that section of floor will begin next. The first DW will be moved to Service Building 5 in late July; the racks will be brought over a week prior, to start the AC tie-in. The second DW is being moved into the magnetic measurement lab. The third DW is in transit.

Installation of front ends. The photon and safety shutters have been installed. The cable pulling documentation is in process and will be complete in mid-July. Vacuum components have been installed in cells 23 and 28, with cell 11 in process. The water hoses will arrive in early July, with installation to follow.

Mechanical installations. The first three fast correctors have been installed in cell 25. The required magnet swap between cells 30 and 1 will take place after P2 high-current testing has been completed.

Survey. The survey team is continuing on EPOCH 6.

Installation of RF systems. The cold box has been rigged to the RF mezzanine and set in position. The cryoduct above the SR mezzanine has been installed. Pump/purge has been performed on all three gaseous helium tanks; contamination was found in one tank that will need to be rectified. The last delivery of cryoduct (for the cavity lines) is scheduled to arrive in late July. Installation of the RF cleanroom structure is complete (Fig. 2), with the sprinkler installation vendor to arrive on July 8. BNL will then tie-in the AC power, smoke detectors, and sprinklers.

Figure 2. RF Cleanroom structure ready for the sprinkler installation.

Installation of PPS. Injector-testing of the linac/booster is complete; certification can start once the radiation monitors and procedures are complete. B-chain programming of pentants 1 and 2 (needed for booster commissioning) is in process. P4 wiring repairs are finished and ready for testing. P5 wiring is complete and repairs are in process (50% complete). Installation of SR tunnel PPS gate extensions is in process.

Vacuum installation. Bakeout of the vacuum straights is continuing. Cells: 27 of 30 are complete. Straights: 15 of 30 are complete. The P1 aluminum cooling lines are complete, excluding cell 23, which should be complete in ~1 week.

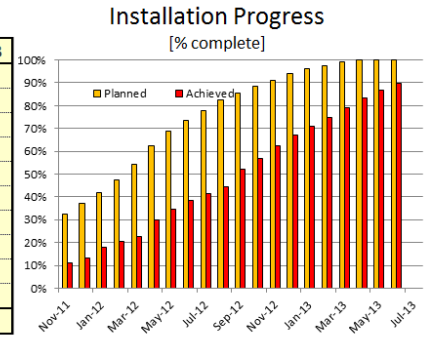
Diagnostics and instrumentation. The pulling of the special diagnostic cables is in process. The special diagnostics are being installed in the tunnel at cells 16 and 30. BPM electronics install and cable termination is finishing in P5.

Electronics/cable pulling. In the storage ring, the wiring of the dipole power supplies is complete. In P2, high-current testing is done, except for some corrector testing scheduled for early July. High-current testing is complete for P3. In P4, low-current testing is ready to start. In P5, power supply installation is in process (cell 20 complete, cells 21 and 22 are in process).

Table 1. NSLS-II Accelerator installation progress at the end of June 2013.

NSLS-II Accelerator Installation Progress

	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13
Mechanical Utilities	38%	39%	60%	61%	62%	68%	73%	74%	78%	80%	88%	91%
Electrical Utilities	69%	72%	75%	80%	85%	91%	95%	96%	99%	99%	100%	100%
Magnets	65%	68%	73%	78%	87%	93%	99%	100%	100%	100%	100%	100%
Vacuum	14%	15%	21%	30%	38%	39%	44%	53%	65%	82%	84%	86%
Power Supplies	22%	27%	30%	36%	43%	48%	54%	65%	70%	81%	87%	95%
Instrumentation	35%	36%	37%	46%	53%	58%	63%	66%	74%	80%	83%	85%
Frontends	0%	0%	0%	1%	2%	6%	6%	11%	15%	23%	32%	34%
RF	33%	35%	38%	40%	45%	47%	49%	52%	57%	59%	64%	75%
Inje Straight	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	4%
LINAC+Booster	42%	55%	74%	82%	92%	95%	96%	97%	97%	99%	100%	100%
Total	**41%**	**45%**	**52%**	**57%**	**63%**	**67%**	**71%**	**75%**	**79%**	**84%**	**87%**	**90%**



EXPERIMENTAL FACILITIES

In June, Experimental Facilities entered a new and exciting phase for the delivery and installation of major beamline components. The first beamline and optical components for three beamlines have been delivered and installed. FMB-Oxford (FMB-O) fabricated many of the HXN beamline components, shipped them to BNL, and installed these components in the First Optics Enclosure, 3-ID-A. These components are aligned and vacuum conditioning has begun. For CSX, Toyama delivered and installed a mirror system for the Coherence branch, and for XPD, WinlightX delivered and installed a large vertically focusing mirror and bending system in 28-ID-A. Factory acceptance testing was completed in June for many of the beamline components for the XPD beamline at the FMB-O factory. NSLS-II engineers were present during these tests to assure compliance with all the component specifications before shipment in July. Most of the remaining procurements concern endstation and experimental instrumentation. The detailed designs for these are nearly complete.

CHX. The contract for the CHX Transfocator System has been awarded to JJ X-Ray, Inc. and the proposals for the SAXS table have been received and are now being evaluated. These are the last two major procurements (RFPs) for the CHX beamline. Plans have been finalized for the Factory Acceptance Test (FAT) of the CHX diffractometer (scheduled on July 29–Aug 2), and the CHX Optical Component Package is advancing according to schedule.

CSX. InSync., Inc. finalized the mirror substrates for the CSX toroidal mirrors and shipped them to FMB-O. December 2013 is the delivery date for toroidal mirror mechanics. The monochromator (Fig. 3) vessels are being tested for vacuum at the factory; the FAT is planned to occur early in August. The metrology report for the monochromators' plane mirrors and the M1A mirrors from InSync was finalized, submitted, and approved. Finally, two gratings from the supplier Shimadzu were received and optically inspected, then transferred to the metrology lab.

For the Coherence branch, the M3A mirror system was installed by Toyama and the mirror was shipped to Spring-8 for metrology characterization. Once metrology measurements are completed in July, the mirror will be shipped to NSLS-II, characterized with our metrology tools in Building 703, and installed at the beamline. The Coherent branch beamline vacuum transport installation is also making great progress.

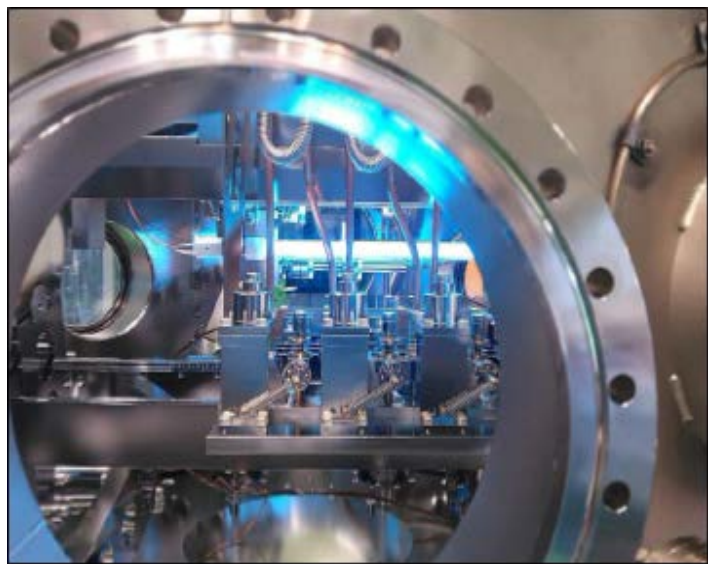


Figure 3. UV lamp for the monochromator gratings switched on.

HXN. We commenced installation of the Phase I HXN Beamline Component Package ($2.58M; Fig. 4) on June 4. Installation required significant coordination of the NSLS-II services such as rigging, surveying, cable termination, mirror metrology measurements, and electrical testing of the installed components. In June, about 50% of the installation work was completed. Commissioning of the BL components without x-rays (so-called 'cold commissioning') will take place in August 2013, after continuing installation work through July.

Figure 4: The HXN Beamline Component Package Installed at 3-ID-A.

IXS. The design, fabrication, and assembly of beamline and endstation components by suppliers for the IXS beamline continue to make solid progress. Figure 5 shows the KB mirror chamber (left) and the granite and steel support frame at the Toyama factory. The other components are being fabricated and are expected to be completed in mid July. The FAT for the mirror chamber and positioning mechanism is now scheduled for August 7–9. The system will be delivered to BNL at the end of September, and installation is scheduled for the first week of October.

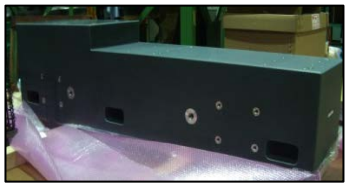


Figure 5. IXS KB Mirror Chambers, support frame and the granite base for the motion mechanism.

The first unit of the Tagma strip detector developed in-house has now been fully assembled and tested. Test data show that the detector meets performance specifications. This detector is a key part of the analyzer system for the IXS spectrometer, allowing for the detection of reflections from individual D crystal segments of the CDW analyzer. Figures 6–8 show the compact sensor board, the integrated detector assembly mounted on the cover plate, and the detector chamber body.

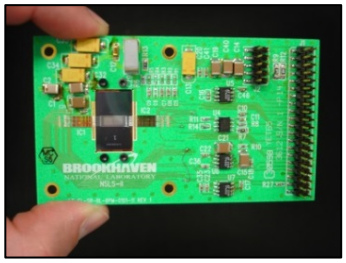


Figure 6 (left). Compact sensor board.

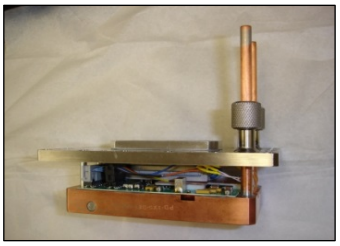


Figure 7. The Tagma strip detector for IXS, developed in house.

Figure 8. Integrated detector assembly mounted on the cover plate.

SRX. Vendors continue to make very good progress in fabricating the components for both large optical packages. Bruker-ASC for the SRX Beamline Optics and WinlightX for the KB Mirror System are working hard to keep their manufacturing schedule, which is closely monitored by the SRX team by weekly teleconferences, visits and continuous discussions. The SRX team has finalized testing of the sample stage for the high-flux setup (Fig. 9) and is now using the data to define the stage for the high-resolution setup. In the frame of collaborations with scientists from BNL, the Beamline Advisory Team and other academic institutions, solutions for complex sample environments have been developed further.

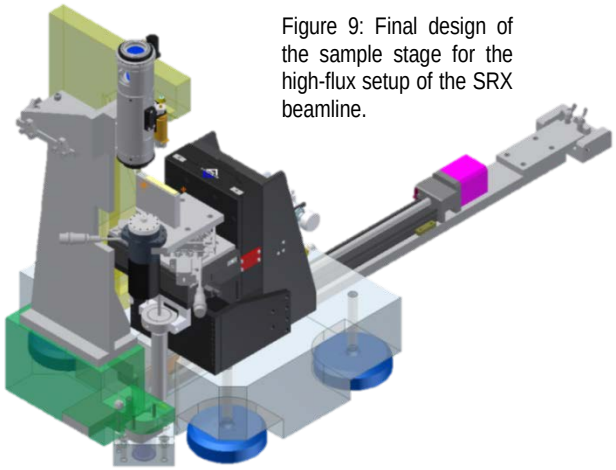


Figure 9: Final design of the sample stage for the high-flux setup of the SRX beamline.

XPD. The FAT for XPD beamline components at FMB-O was held June 10–19, with NSLS-II engineers present. Motions, limit switches, actuator and clash protection switches and encoders were tested and run using our own Delta Tau control system. All reports and documentation are being reviewed and outstanding issues are being addressed, including additional vacuum testing. The fixed aperture mask has been reworked by wire erosion before being sent for brazing. FMB-O plan to ship the components in three packages. The first batch is due at BNL on July 29.

The new design of the bender and foils on Part 1 of the Laue-Laue monochromator is being implemented by FMB-O. Tests on crystal 1 bending and cooling will be performed using an aluminum-bronze dummy and then a silicon wafer. Because the bending mechanism is the same for Parts 1 and 2, the Part 1 drawings had to be completed before Part 2 crystal cage drawings could be released to manufacturing and the material procured. Long-lead items have been bought, but the machined components have been delayed, affecting the overall schedule; the FAT was moved from early September to early October as a result. However, the overall schedule is delayed by only one week. FMB-O will improve the shipping time by collaborating with DSV Air & Sea Ltd. It is expected that the floor plate for the monochromator can be delivered to NSLS-II in advance, for earlier installation.

Installation of one of the world's largest Pt-coated, bendable silicon mirrors for x-rays was completed June 27 (Fig. 10, 11).

Figure 10. Full XPD vertical focusing mirror after installation was completed.

The mirror was delivered on June 17, then the bender and mirror were carefully moved and sent to the NSLS-II metrology laboratory using special rigging procedures, to be reassembled into a single unit and to check compliance with requirements. Measured roughness of the mirror is 0.2 nm rms; the angular rms variation of the surface is less than 0.4 µrad. The XPD mirror is the largest mirror (1,420 mm) in the world to achieve such figures over its entire length.

The instrument was installed in the FOE (Hutch A) of the XPD beamline, where it will reside permanently. The complete system was surveyed on site and positioned in all three directions at the nominal x-ray beam position with extremely tight tolerances. The mirror has been pumped down since then, reaching 1.6×10^{-8} torr in preparation for bake-out.

This mirror is the first optical component delivered at XPD. It will enhance photon flux at the sample and the resolution performance of the measurement.

For the diffractometer, detail drawings for the sample table and camera mount have been completed and fully released for manufacture. The 3-axis spindle assembly design is complete, apart from the details of the limit switches. The linear stage casting is complete.

Clarification of the encoder part numbers delayed the contractor's order process with a subcontractor during April/May. Revised delivery of the rotary encoders to the primary contractor, RPI, is now July 29—a 6-week delay of essential parts; the assembly cannot start without them. RPI is working with the subcontractor to improve the delivery date.

Fabrication of the CdTe detector encountered a severe setback due to inappropriate bonding procedures involving the diode layer and the CMOS layer, which were processed at too high a temperature (120°C). Some detectors that may be salvageable will be tested at ESRF. Another batch of detectors is being prepared (avoiding the high-temperature bonding) and will be tested in July at SOLEIL.

Lead/steel enclosures 28-ID-A, B, and C are completed, checked, and accepted. Enclosure 28-ID-D passed the crane, ventilation air flow system, and door tests and is almost ready for acceptance. The XPD design team has produced a drawing to move stairs initially intended for installation at enclosure 28-ID-A to enclosure 28-ID-D, to improve accessibility. Installation of mechanical utilities is mostly complete at 28-ID-A. Two-inch piping from the storage ring is ready for tie-in. Drawings for the mechanical utilities in hutches B, C, and D have been approved and installation can begin. The exhaust vent pipe from the Bldg. 740 roof deck needs to be tied into the hutch. Electrical power has been turned on in 28-ID-A. Drawings of electrical outlet locations at 28-ID-B, -C, and -D have been approved for installation. A cable study is in progress. PPS conduits are installed.

Scope of supply and specifications for the multi-analyzer crystal x-ray detector are being revised to contain costs and improve delivery time.

The selected supplier for the robotic sample manipulator passed an inspection visit by Project personnel to assess on-site design, manufacturing, and testing capabilities. Documents are being prepared for the contract award.

The XPD x-ray flat panel detector delivered by Perkin Elmer Corp. on June 24 will be assembled and tested at a beamline at the NSLS prior to being used at XPD in one year's time.

Figure 11. The chamber lid being positioned over the mirror system.

NEWLY HIRED

Stephen Moss – Authorization Basis Manager, ES&H Office

John Trunk – Electro-Mechanical Technician, XPD Beamline

COST/SCHEDULE BASELINE STATUS

The current-period schedule variance (SV) for the overall project is (-$435K) with an associated schedule performance index (SPI) of 0.95. The slightly negative schedule variance is primarily driven by delays in delivery of the CSX monochromotor and deliveries associated with the XPD FOE components. The cumulative SV for the project continues to have green status with an SPI of 0.97 (-$25.8M).

The current-month cost performance index (CPI) for the NSLS-II project dipped to 0.78 (-$2.07M), primarily driven by invoices paid in the Conventional Facilities area. The cumulative Project CV (cost variance) continues with green status at 0.99 (-$9.5M).

With the delivery delays of key components, as stated above, Experimental Facilities' cumulative SPI holds at 0.90 (-$5.9M). The cumulative CPI for Experimental Facilities is 0.98 (-$844K).

Conventional Facilities' June SPI dropped to 0.70, but the cumulative SPI continues at 1.0 for the project. The current-month CPI of 0.1 is the direct result of invoices paid for work previously accomplished.

The cumulative CPI continued at 0.95. Accelerator Systems, WBS 1.3, has positive schedule performance for June of $76K and an SPI of 1.03, due to continued positive schedule performance in many areas. The cumulative Accelerator Systems schedule performance is holding at an SPI of 0.94, reducing the cumulative SV to (-$17.5M) and resulting in green status.

Accelerator Pre-Ops, WBS 1.6, had an SPI of 1.26 for the month, largely due to appropriate credit taken for production spares. This contributes to the improved negative schedule variance for Pre-Ops, with an SPI of 0.93, up from 0.91 in May.

The Project is approximately 89% complete as of June 30, with approximately 52.4% remaining contingency/MR on BAC work remaining. The Project EAC is $890,577K and MR/Contingency is approximately 40.3% of EAC work remaining. Project percent complete is 86.1%, based on EAC work remaining.

At the end of June there is approximately $49.9M remaining of Contingency and MR on the Project, based on the PCRs processed and approved through June 15. The remaining MR is $ 4,737K.

The June critical path remains unchanged from May. There are 10 months of float between the Project's early completion milestone and CD-4, with approximately 42% schedule contingency.

ENVIRONMENT, SAFETY, AND HEALTH

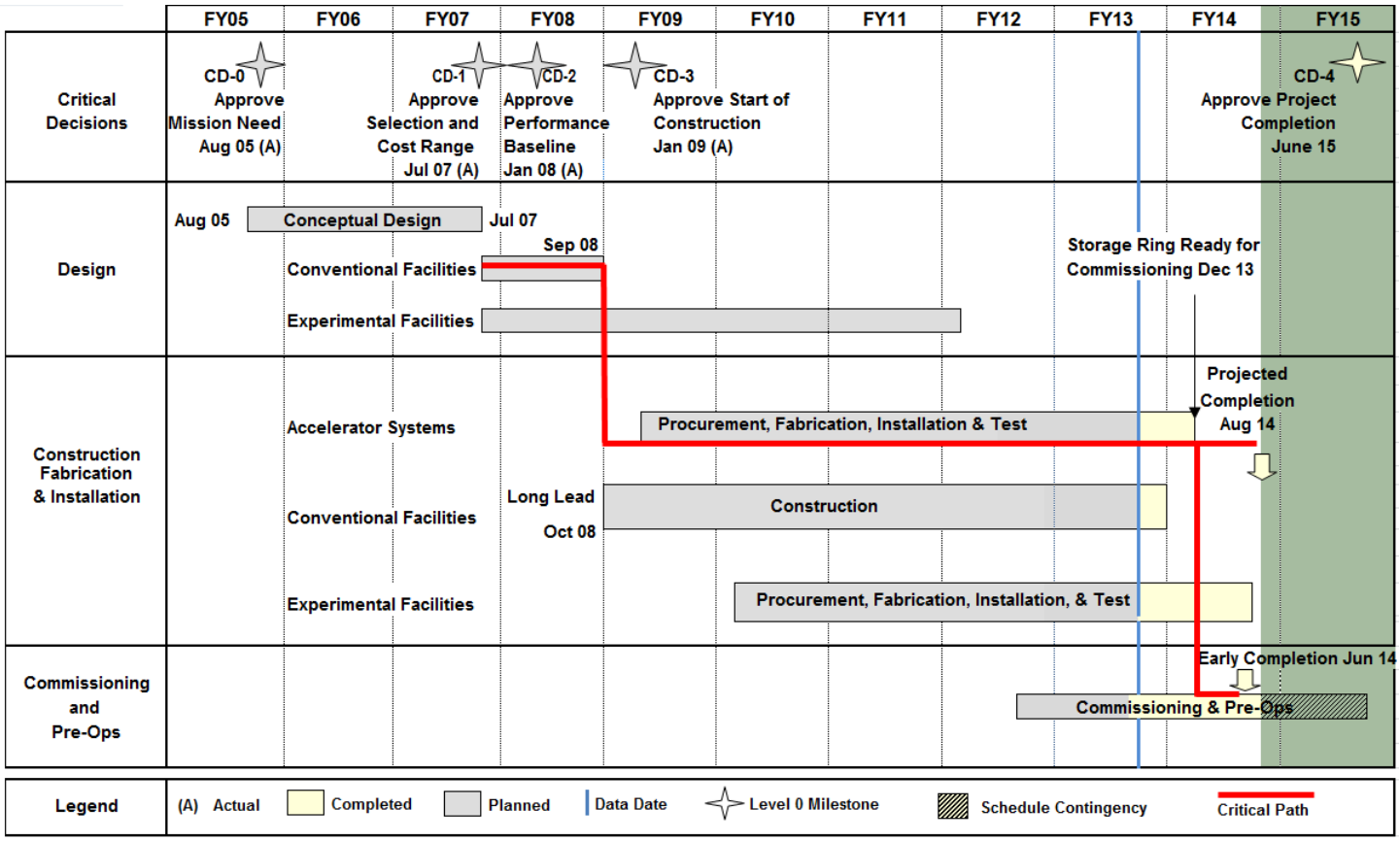
Actions identified in the Corrective Action Plan (CAP) associated with the beam mis-steering event that occurred at the Linac on May 29, 2012 continue to be addressed and are at about 80% complete. Staff are being recruited from other BNL organizations and through contracts to augment existing PS staff, to ensure timely completion of these actions. Accelerator commissioning with beam will not resume until all necessary corrective actions have been satisfactorily implemented and a successful ARR (Accelerator Readiness Review) is conducted. Significant emphasis is being placed on the revision/preparation of the authorization basis documents and procedures necessary to support the Instrument Readiness Review (IRR) and ARR. The new Authorization Basis Manager started effective July 1 and promptly began preparing storage ring documents. The revised Linac documents have been reviewed by the Laboratory ESH Committee (LESHC) and are being finalized by incorporation of the committee's comments. These documents are expected to be delivered to DOE before the end of July. Injector documents are in revision and are expected to be reviewed by the LESHC shortly. Preplanning for the IRR and ARR was performed, including preparation of the Instrument Readiness Plan and identification of potential IRR and ARR participants.

All BOREs (Beneficial Occupancy Readiness Evaluations) for the NSLS-II facility have been completed, and work to close out the remaining post-occupancy items continues. Operational Readiness Evaluations (OREs) are being scheduled for the remaining seven laboratories in LOB 3. These labs are being used to assemble and test beamline components. The BORE and ORE processes ensure that life safety, code compliance, and work planning/controls are in place prior to commencing with laboratory work. Work to complete conventional construction activity punchlist items continues and is nearly complete. Painting of the roof deck in P1 is ongoing to correct a paint delamination issue. The repainting job is approximately 90% complete and is expected to be done by early August. Fireproofing of two columns via the installation of sheet rock enclosures will be performed once the roof deck painting is complete.

Installation of experimental hutches is nearing completion, with 16 of the 18 hutches accepted. The hutches and the experimental facilities will be reviewed using the IRR process. The reviews will be performed to ensure that safety requirements have been met.

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

Funding Type	NSLS-II Funding Profile ($M)											
	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	27.4		60.2
Total NSLS-II Project	1.0	4.8	25.0	49.7	253.3	141.0	152.8	159.1	71.6	53.7		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 Bldg 745, Brookhaven National Laboratory, Upton NY 119873.