National Synchrotron Light Source II

Project Progress Report

July 2012

Mid morning, July 31.

report due date:
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BROOKHAVEN
NATIONAL LABORATORY

OVERALL ASSESSMENT

The National Synchrotron Light Source II Project continued its satisfactory cost and schedule performance, maintaining cumulative cost and schedule indices of 1.0 and 0.95, respectively. At the end of July, the Project was 79% complete with 44% of contingency and management reserve for the remaining Budget at Completion (BAC).

Conventional construction continued to be on budget and on schedule, and construction activity continues to wind down, as the ring building is complete and three of the LOBs are essentially complete. LOBs 4 and 5 are expected to be completed to project scope by the end of this year.

Linac commissioning activities with beam continued to be suspended and will not resume until all corrective actions are satisfactorily implemented and permissions to resume are granted.

The production and delivery of a number of major contracts for magnets, booster, vacuum, and RF systems started to be completed. The production of power supplies, cryogenic systems, superconducting RF cavity, and insertion devices continued to make good progress, although some areas are encountering challenges and schedule delays. Installation of the booster and storage ring continued to meet goals. In total, 74 magnet girders are now installed in the storage ring tunnel and 33 magnet girders are installed in the booster tunnel.

Despite healthy progress in the production and installation of magnet girders systems for the booster and storage ring, the monthly schedule variance in July for the accelerator systems reverted to negative (schedule performance index of 0.81), primarily due to schedule delays seen in vendor performances in other subsystems.

Excellent progress continued with major procurements for beamline components. Of $32.5M major procurement items planned, over 68% of major procurements were awarded to date with an excellent cost performance. A number of successful design reviews for these contracts were conducted in July. Installation of the third hutch has started and installation work for utilities will begin soon.

June 2014 remains the early completion date, with 12 months of schedule float (34% schedule contingency) with respect to the Project's CD-4 milestone date. The schedule refinement for accelerator and beamline installation and the annual project-wide comprehensive Estimate At Completion (EAC) review continued.

Activities funded by ARRA (American Recovery and Reinvestment Act) are now more than 99% complete and continue to be on schedule and on budget.

UPCOMING EVENTS

ALD's Preliminary Design Review of NEXT Project	Aug 7–9
RF Cryogenics, LN2 System, Final Design Review	Aug 29
Final Design Review for XPD Beamline Components	Sep 4–7
DOE CD2 review of NEXT Project	Sep 11–12
NSLS-II Beamline Science Readiness Planning Review	Oct 25–26
DOE mini-Review of NSLS-II Project	Nov 19

ACCELERATOR SYSTEMS

Linac commissioning activities with beam continued to be suspended while an independent investigation of the linac beam miss-steering excursion is being conducted.

Booster. Installation of the **booster arc girders** is close to completion. The last injection and extraction sections of booster are due to arrive around Aug. 8, along with IS and XS girders as well as the RF and diagnostic flags. Remaining spares and 11 NEMA-12 racks are due to be delivered by the end of August. With the exception of one magnet in Arc 2, cables for all dipoles in booster arcs 1, 2, and 3 have been terminated. The electrical group is now focusing on the terminations in Arc 4 and terminating cables in the injector service area. All arc girders have been tested and all arc girder hoses have been fabricated. Assumptions and requirements on supplemental shielding for booster and transfer line components are being reexamined.

Kickers. The injection and extraction kicker pulser and magnets arrived from BINP. A second high-voltage cage in the Pulsed Magnet Laboratory (Bldg. 832) was set up, and high-voltage tests have begun. The first BtSTL dipole is being assembled at Stangenes and should ship by Aug. 10. Magnetic measurements are being carried out on BtSTL quadrupole magnets. Prototype testing of the injection kicker pulser showed the specified values for reproducibility, pulse length, and pulse height. A final design review before production of the last units is being scheduled.

Magnets and girders. The production of 120 quadrupole magnets at BINP has been completed and all magnets were delivered at BNL. The remaining magnet productions are 20 out of 120 (total) TESLA quadrupole magnets, and 11 magnets at Buckley. Ten skew quadrupole correction coils remain to be mounted on the DC correctors. We expect that the entire production of iron yoke magnets will be completed by the end of September and the last magnet will be received in early November, if not sooner. Production of the small air-coil correctors has begun. The magnet girder installation has been completed in Pentant 1 (P1) and the 50% mark for the entire ring has been surpassed (Fig. 1).

Figure 1. Magnet girder installation.

Vacuum. All long straight section chambers were completed at APS. Orders for short straight chambers were placed with the vendor and with BNL Central Shops. Girder chamber testing and installation continue, with all girders for

P1 cells installed and all cell chambers connected. Cell 26 (C26) was successfully baked, and C24 will be baked following the connection of magnet cables. C26 straight section chambers were installed. Booster Arc 1 was pumped down, and Arc 2 chambers were connected.

Vacuum instrumentation and rack installation in P1 and P2 continue, and the termination of cables in P3 has started. All vacuum instruments for booster and transport lines were installed and cables were terminated at the racks. The termination of vacuum cables in the booster tunnel has started. Vacuum programmable logic controllers (PLCs) for the booster and transport line were installed and their wiring and interlock logics verified. The first-article storage ring (SR) PLC was accepted and production of phase I PLCs has started.

All 62 RF gate valves and 10 bending magnet photon shutters were received. All vacuum gauges, RGA and ion pump controllers, and internal components for RF bellows were received. The bending of GlidCop RF fingers progresses slowly. The production of crotch absorbers, undulator absorbers, and damping wiggler absorbers is underway.

Power supplies. Software for the power supply control (PSC) system continues to be tested for errors and functionality. The completed and tested PSC chassis have been installed in cells 23 through 27. The C28 PSC chassis and cards have been tested. The regulator production test system is being used to test the regulator boards, all of which have been delivered. The first production units for the DC corrector power amplifiers have been received, with 70 units now available. The pre-production units of the fast corrector power amplifier have been built and tested. Delivery of the one-wire temperature measurement interface chassis is complete. A test system is finished and a final traveler has been completed. Testing takes less than a day for the three units that are needed for a cell.

Work on cables and cable trays continues in the injector complex. Most cable tray for the booster has been installed; the tray that tops the girder is being installed. All cables for the low-voltage tray have been pulled. Electricians finished work on the instrumentation tray and low-power AC distribution in the RF building. We have finished installing the booster low-current correctors and the quadrupole and DC septum power supplies. This included all BNL supplies, PSCs, and PSIs (power supply interfaces). BINP personal supervised the installation. All corrector power supplies were tested to full load, and the quadrupole and DC septum were tested to low current through a test load supplied by BNL.

RF. Linac commissioning is on hold, pending resolution of the investigation into the beam mis-steer incident. To make best use of the down time we have installed pickup antennas into the high-energy end of traveling wave tanks 3 and 4 and calibrated them. We have characterized klystron 1 output couplers and installed the spare klystron into the klystron 1 position. Site acceptance tests to verify its performance are planned. High-power testing of the spare will begin in August.

The booster transmitter has successfully passed the site acceptance test with flying colors. Thomson has now completed all work on site and the commissioning engineers have departed. RF group system experts continue to operate the transmitter while developing procedures and verifying operating parameters. A discrepancy was found in the reverse power coupler calibration from the circulator. To investigate the problem, we are adding a direction coupler in the output coax run. While waiting for Ethernet drops so we can test with the control system, we initiated local testing from a PC.

The booster cavity was removed from the blockhouse to allow for core drilling of the cryogenic transfer line, then replaced, and connections for water, waveguide, and vacuum were reestablished. Personnel protection system (PPS) interlock testing of the blockhouse was completed and the sweep procedure has been written and approved. The digital controller has been configured for the booster cavity high-power test in the blockhouse and will be used in the high-power testing (Fig. 2). This will be the first test at NSLS-II of the new digital RF controller in the high-power tests. The new firmware modules to be tested include booster ramp functions as well as RF cavity tuner error signals.

Figure 2. Booster cavity prepared for high-power testing.

SR cavity. The contractor AES has revisited the project schedule in light of the delays in design and manufacture of the niobium cavity tooling, flute deep drawing, and other technical delays. The completion date for "Cryomodule Unit One Installation Complete" is set for 17 May 2013, followed by the second module on 3 October, 2013. The cryomodule assembly at Meyer begins the first week of August. There is another delay in delivery of the RF window from Thales, now set for October. This was first scheduled for delivery in April and is now near the critical path for the cavity. Thales has been unresponsive to requests to improve the delivery time. BNL has a spare window on order and will begin to apply pressure to Thales for improving the scheduled deliveries of the AES and BNL windows. BNL and AES have agreed to a collection of additions and subtractions of activities; these have been combined into an Engineering Change to the specification and SOW.

Refrigerator. The cold box and three Kaeser compressors are being readied for shipment to BNL, arriving the week of 17 September. Meanwhile, Conventional Facilities has approved a plan for strengthening the floor of the cryogenic mezzanine in the RF building and issued an Engineering Change Notice (ECN). The valve boxes are in fabrication and the final design of the vacuum-jacketed transfer lines has also started.

Landau cavity. The contract for shipping the cavity to BNL and cold test support is in place. Internal meetings have started in the RF group to prepare for the cold test. Three-dimensional electromagnetic field analysis has shown that the TE110 mode-like fields trapped in the beam pipe could indeed cause the higher losses (lower Q) measured in the first cavity cold test at Niowave. We are in the process of designing a test HOM damper to eliminate this mode for the next cold test here at BNL. In the final installation, the ferrite HOM dampers will perform this function; however, we plan to confirm the cavity Q before then.

Insertion devices. Manufacturing of the first unit of the damping wiggler is complete (Fig. 3). Magnetic measurement and shimming are underway and delivery is planned for August. Manufacturing for the EPU is still ongoing. Several minor manufacturing and design issues have been resolved with the manufacturer. The detailed design for the cold acceptance test for the in-vacuum measurement system is being made. A quote for a spare chamber for the SRX-IVU was obtained and the factory acceptance test is scheduled for September 2012. The vacuum bake-out test for the vacuum vessel seal was successfully completed: no vacuum leaks were observed. The manufacturer of the IVU20 undulator has submitted the Preliminary Design Report. The baking system involving pressurized hot water that is used at facilities elsewhere may not be used here without modifications, due to more stringent BNL safety standards. An alternative solution is being investigated. The Preliminary Design Report for the IVU21 has been submitted by the manufacturer and approved by the project.

Figure 3. First damping wiggler final assembly.

Controls. The Controls group developed remote controls for the booster and storage ring transmitters as well as the master oscillator. Work continues on controls for the LLRF board. Controls for the radiation monitors in the booster and linac areas, including audible alarms in the control rooms, have been tested and commissioned. Work is underway on a new alarm system and displays for the control room, aimed at improving the overall alarm implementation and presentation. A software interlock with the electron gun, to limit total charge per second based on ICT data, has been implemented and commissioned. The group also commissioned Fast Current Transformer flags, an energy slit in the linac, and phase 1 of the LtB transfer line. All network infrastructure for P1 has been provisioned, installed, and tested, and the network infrastructure for vacuum, diagnostics, and power supplies in the injector has been provided. Timing systems for the linac, transfer line, pulse magnet laboratory, injector service building, and P1 in the storage ring were provided. All input-output controllers (IOCs) in P1 were provisioned, installed, and tested. IOCs for the pulse magnet lab and injector service area were provided in support of BINP testing. Services were added to include a network file system, IRMIS data base servers, backup systems, Matlab server, Debian package servers, and a new alarm server.

Installation for the accelerator is currently projected to be completed by June 2013, compared to the baseline schedule of Feb 2013, with the installation of SR power supplies on the critical path. Installation of the injection straight and RF cavity are on the near-critical path.

By the end of July, 33 magnet-girders had been installed in the booster tunnel. Lexan covers for the booster magnets have been modified to provide adequate protection. Installation of power supply components in the racks and terminating of the booster magnet cables are in process. Pulling of the interlock cable in the booster is underway. The Booster beam position monitor cable trays are being installed. Installation and acceptance testing of the booster RF transmitter is complete. A pump skid for the booster ring is being run manned for booster RF transmitter testing.

In the storage ring, 74 magnets/girders (57 multipoles and 17 dipoles) have been installed. EPOCH 4 (fourth check of the survey control throughout the facility) is complete. Setting the girders into their final locations in the SR tunnel and hardware installation are in process.

The headers of the copper-deinonized cooling water system of P1 have been hydrostatically tested and the drops are being flushed. The bellows have been installed in all cells. Bakeout is completed in cells 24–27. Core drilling at the RF straight for the cryo lines is complete. The SR interlock tunnel gates were installed.

The uninterruptible power supplies (UPS) in P2 are now powered and the dipole magnet strobes are installed. Installation and cable termination of the diagnostic equipment is ongoing. Wiring of P2 I/O boxes is complete. Process chilled water (PCW) tie-ins in P3 are complete, but still need flushing and pressure testing. Installation of interlock conduit is in process. The P3 UPSs are now powered, and pulling of the vacuum cables is complete; pulling of the sextupole cables has begun. The hanging of trapezes for the P4 PCW tie-ins has started and AC cabling to racks is in process. The beamline box and cabling installation is complete. In P5, the

floor plate installation is 50% complete and cable pulling and tie-ins for beamline boxes are complete. Racks have been set and secured and installation of the beamline boxes is in process. DI piping installation is complete for the entire ring.

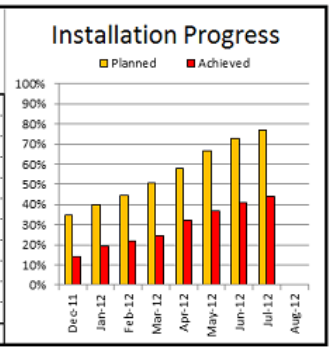
In the **RF Building,** acceptance testing of both SR RF transmitters is now complete. Cable tray installation and cable pulling on the mezzanine are also complete. Testing of the blockhouse PPS was completed and certified. For the booster RF cavity, testing in the blockhouse will begin after the shielding is installed, configuration management of the shielding is in place, and the work plan has been updated.

Table 1 shows an overview of installation progress.

NSLS-II Accelerator Installation Progress

Achieved

	Feb-12	Jun-12	Jul-12
Mechanical Utilities	40%	50%	50%
Electrical Utilities	34%	65%	69%
Magnets	39%	62%	65%
Vacuum	6%	13%	14%
Power Supplies	9%	18%	22%
Instrumentation	22%	38%	43%
Frontends	0%	0%	0%
RF	11%	32%	33%
Inje Straight	0%	0%	0%
LINAC+Booster	7%	36%	46%
Total	**22%**	**41%**	**44%**



Experimental Facilities

During July, work continued with additional procurements, active project management of contracts placed, and the preliminary design review for the XPD Laue monochromator, XPD vertical focusing mirror, CHX diffractometer, and SRX beamline optics. The CSX and HXN optics hutches await modifications to the hutch doors prior to completion. An assessment visit was made to WinlightX, since they have a number of active mirror contracts in progress or pending; the findings were acceptable. The utilities designs and work planning is progressing, and installation work will start as soon as the CSX hutch is handed over and we have the necessary parts in house. The shutters bid will be released to potential bidders as soon as an internal design review is completed. The shielded transport pipe RFP (request for proposal) documentation will follow.

CHX. A contract for a set of three high-precision (sub-micrometer) heavy-load positioners has been placed with Instrument Design Technologies, Ltd. These positioners will be used to accurately follow different offsets of the x-ray beam, with an optic table supporting an entire section of beam conditioning optics in the experimental endstation. The CHX team held several meetings with Bruker-ASC, the contractor for the CHX optics package. These meetings helped with advancing the beamline design—particularly that of the high-stability horizontally deflecting mirror system.

A preliminary design review (PDR) was held July 23 with Huber Gmbh, the contractor for the CHX diffractometer. The PDR report from the vendor was approved a few days later.

CSX. Contracts for the M3A mirror and the toroidal mirrors were awarded. Proposals for the M1A M3B mechanics were received and are being evaluated. Procurement documents for the M3B optics are being prepared.

HXN. The HXN Satellite building is nearly complete, including electrical, HVAC, and the interior work (Fig. 4). For HXN hutch 3-ID-C, the walls, roof, and labyrinths are installed and details of the utilities are being planned.

Figure 4. Installation of the HXN hutch is nearly completed.

In developing the HXN microscope, the team achieved a milestone by fabricating all components of the MLL module and by completing initial assembly. For this phase, the components are fabricated of aluminum instead of the more costly Invar, in order to complete the dimensional check and to validate the baseline stability performance.

IXS. Contract negotiation for the IXS beamline optics component package has concluded and is in final review. Together with the IXS KB mirror system, reviews of both major optics components contracts are now in the final stage and an award is imminent. The RFP for the IXS basic spectrometer mechanism has been released, with proposals due in mid-September. In optics development, preparations are underway for test beamtime at the APS in early August to test the performance of the Montel multilayer collimating mirror as part of the analyzer optics.

SRX. During the PDR meeting at Bruker in Germany, progress was made in the design of the Beamline Optics Package; some beamline component positions have been shifted to optimize performance. The issue of a radiation stop for the empty XFN line has been raised and addressed. In preparation for early science experiments with SRX, a ptychography experiment has been performed at beamline ID-21 at the ESRF.

XPD. Prototype testing for the monochromator showed that Finite Element Analysis (FEA) can simulate the thermal performance of the design with a good degree of accuracy. Also, mechanical tests conducted on the prototype showed that the parasitic motion induced in the crystal bending

mechanism is small and correctable. The first part of the PDR meeting for the XPD monochromator took place at the Contractor's site on July 17. Discussions are underway with Diamond Light Source (DLS) to install the first part of the monochromator next March at DLS beamline I12 for commissioning and testing using a high-power wiggler beam.

The 1420 mm-long silicon ingot (Fig. 5) for the mirror has been delivered to the mirror contractor (WINLIGHT X) and is now ready for cutting/grinding. The PDR meeting for the XPD Vertical Focusing Mirror took place at the Contractor's site on July 27.

Figure 5. WINLIGHTX 1420 mm-long silicon ingot for the XPD mirror.

After receipt of five proposals for the diffractometer, the review kickoff meeting occurred on July 23 and proposals were distributed to the review panel. Technical scoring is scheduled for Aug. 15.

Finally, the EPS and PPS conceptual design and internal progress review took place on July 20.

CONVENTIONAL FACILITIES

Conventional construction continued its excellent progress during July as three of the Lab–Office Buildings are nearing substantial completion and readiness for occupancy, while the ring building punchlist work is drawing down. Items identified during beneficial occupancy reviews for LOBs 1 through 3 are nearing completion and beneficial occupancy is expected during August. The ring building contractor has completed basic contract work and continues to work down remaining punchlist items, moving closer to contract closeout.

With all areas of the ring building now occupied, the ring building contractor has completed the 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 punchlist items, completion of system commissioning and operator training, delivery of remaining operations and as-built documents, and final sitework. Following completion of all physical work at the site, demobilization and contract closeout will commence. The contractor has already partially demobilized, removing most field office trailers to enable final site restoration. It is anticipated that the ring building contractor's site presence will end by October 2012, although they will be continue to be available for any warranty work.

Construction of the five LOBs continues to make excellent progress. Activities in LOBs 1, 2 and 3 are focused on the completion of pre-occupancy items identified during the beneficial occupancy review in late June. Office area finishes and flooring work are completed, laboratory furniture has been installed, and building plumbing and HVAC are ready for operation. Final acceptance of the fire alarm and communication systems is imminent and will enable progression to beneficial occupancy in August. The LOB 3 HXN area, which had previously lagged the LOB 3 progress, is now nearly complete and will undergo a beneficial occupancy review in August.

LOBs 4 and 5 will be completed as enclosed shells for later fit-out and were scheduled for later completion. They are progressing on or ahead of schedule and are now fully enclosed with steel, concrete, and exterior enclosure work complete, and interior HVAC well advanced. Interior partitions and finishes are just getting underway. Completion of the project scope for LOBs 4 and 5 is on track for December 2012, as scheduled.

Sitework for the LOBs and the site overall is nearing completion. All major paving is now in place. With completion of the building exteriors, final site grading, topsoil distribution, and seeding can begin. This is scheduled for late August and September, to coincide with the grass planting season. Final coordination of sitework to be performed by the ring contractor and the LOB contractor is now complete and only execution remains. All sitework is expected to be completed by late October.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) for the Project overall is 1.0 and the cumulative schedule performance index (SPI) is 0.95, both well within the acceptable range. The Project is 79.3% complete, with 43.5% of contingency and management reserve, based on EAC work remaining.

The project's current-period red schedule variance, with a current-month SPI of 0.81 (-$2,016K), is due primarily to vendor schedule delays of various ASD systems. The continued positive performance of deliveries of SR magnets helped offset negative vendor performance for some systems, such as the SR RF. The cumulative ASD schedule performance remained at 0.88.

The cumulative Experimental Facilities (XFD) beamlines' schedule performance continues to be of concern, with a cumulative SPI for the six beamlines of 0.90 (-$3.0M). The negative schedule performance is primarily due to vendor delays for the HXN, CSX, SRX, and XPD hutches, as well as late CSX optics and miscellaneous component deliveries for HXN and SRX.

The Conventional Construction (CFD) schedule performance for July 2012 is green, with a SPI of 0.94 (-$130K), due to work previously completed ahead of schedule in the LOBs and the cumulative CFD schedule, which has been performing ahead of schedule with a performance index of 1.00, $1.0M.

The current-month CPI for the NSLS-II Project is a negative variance of (-$376K). The project-level cumulative cost performance is 1.00, green status.

The critical path for the Project remains the same as last month and goes through 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. The early Project completion date remains at June 2014, which is consistent with the baseline schedule. There are 12 months of float between the Project's early completion milestone and CD-4, with approximately 34% schedule contingency.

NEWLY HIRED

William Brannigan – Electrical Technician – Controls Group, ASD

Joseph Stanisci – Utilities Technician – Mech. Eng. Group, ASD

ENVIRONMENT, SAFETY, AND HEALTH

Beneficial occupancy readiness evaluations have been completed for Lab–Office Buildings, 1, 2, and 3. Pre-start items are being closed out and occupancy is expected in early September. LOBs 4 and 5 will be completed in the late-December time frame. 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.

A beam miss-steering excursion that occurred at the linac on May 29 is under investigation by an external independent team. Linac commissioning activities have been suspended and will not resume until all corrective actions are satisfactorily implemented.

Construction activity continues to wind down, as the ring building is complete and LOBs 1, 2, and 3 are essentially complete. The focus of construction is now at LOBs 4 and 5 and on finished site work. 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.

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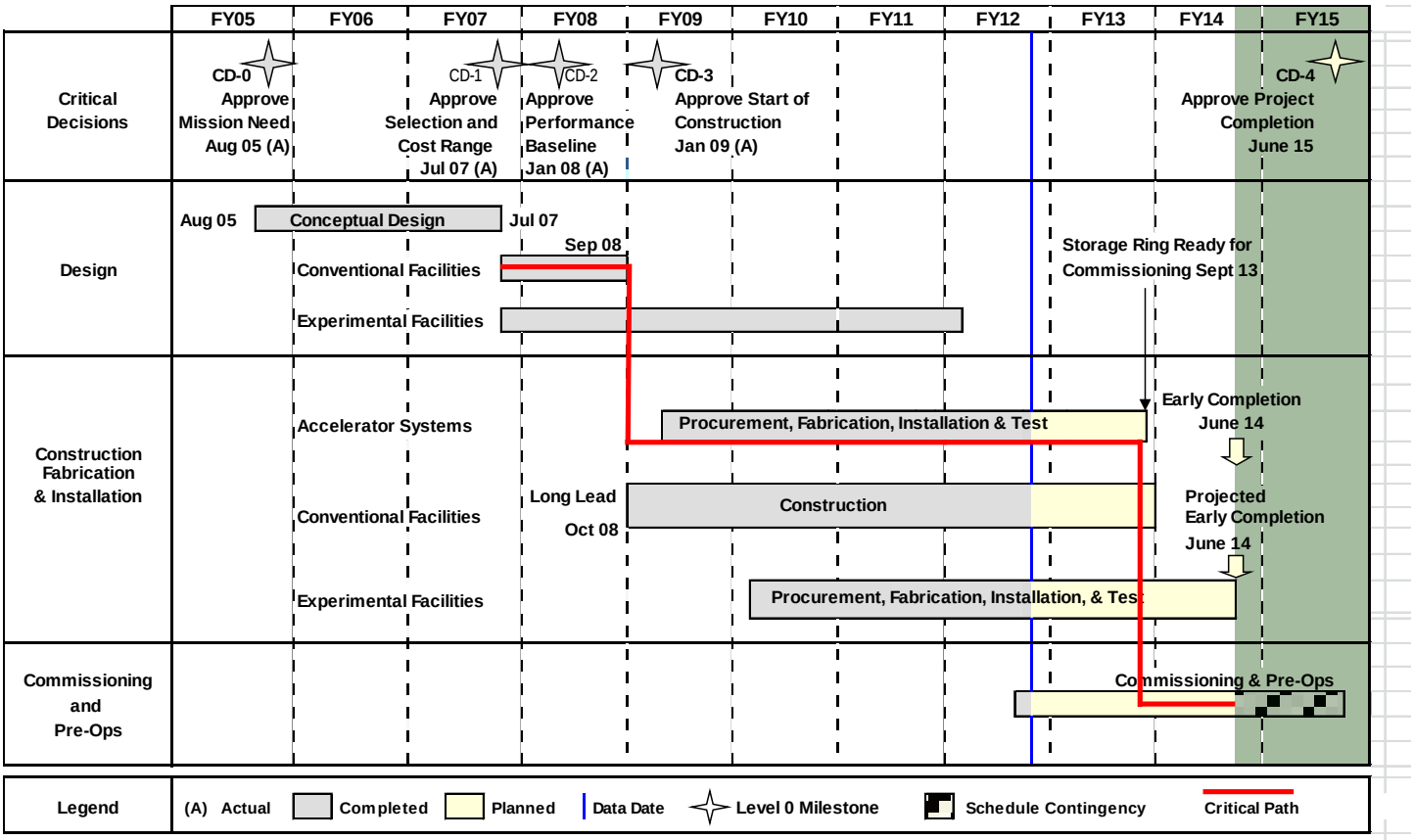
The NSLS-II Project is being carried out to design and build a world-class user facility for scientific research using synchrotron radiation. The project scope includes the design, construction, and installation of the accelerator hardware, civil construction, and experimental facilities required to 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.