National Synchrotron Light Source II

Project Progress Report

March 2012

A crane moves the final bundle of metal roofing panels from a flatbed to the roof of pentant 5, late on the last workday in March.

report due date:
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OVERALL ASSESSMENT

The National Synchrotron Light Source II project continued to maintain excellent technical progress with satisfactory cost and schedule performance. By the end of March, the project was 74% complete with more than 39% 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 Project Advisory Committee meeting was conducted on March 29–30. The committee concluded that the project has had an outstanding year of accomplishment and there is a high probability that the CD-4 milestone schedule will be achieved.

The ring building contractor is now focused on resolving all punchlist items, delivery of the remaining operational and as-built documents, and completion of the remaining site restoration work. All five of the lab-office buildings (LOBs) continued to make good progress, and LOB 1 is on track for beneficial occupancy in early summer.

Linac commissioning with beam has begun, after action items from the Linac Accelerator Readiness Review were closed out. Excellent progress continued in the production and installation of magnets, booster, vacuum, RF, power supplies, and cryogenic systems, resulting in a satisfactory schedule variance for Accelerator Systems. Magnet production and magnet–girder integration continued to meet goals. In total, 548 magnets have been delivered and 31 magnet girders are now installed in the storage ring tunnel. Booster installation activities have ramped up significantly, and the installation of RF systems made good progress. The production of damping wigglers and the design and procurement of other insertion devices are on track.

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

Although a 14-month schedule float between the projected early completion date and the CD-4 milestone has been maintained, the built-in schedule floats within accelerator installation activities and within beamline procurement activities have been substantially reduced. A series of internal schedule reviews were conducted to assess the current status and formulate plans to recover schedule floats. This schedule assessment 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

DOE Review of NSLS-II Project	Apr 17–19
Celebration of Ring Bldg. Completion and Linac Comm. Start	Apr 26
IXS BAT Meeting	Apr 30
7th Bi-Annual CW and High Average RF Workshop	May 8-11
CHX BAT Meeting	May 10
XPD BAT Meeting	May 10-11
DOE Review of NSLS-II Pre-Operations Budget	May 14–16

ACCELERATOR SYSTEMS

Injector installation and commissioning. High-power testing of the linac-to-booster transfer line (LtB TL) pentant 1 (P1) magnets is complete. The linac pump skid is being run-manned (now monitored by the NSLS operators) to provide water for linac commissioning. The linac HV cage has been wired and the installation of leak detection wiring in the linac is also complete. Action items from the Linac Accelerator Readiness Review have been closed out and beam commissioning has begun.

The installation of the cable trays in the booster tunnel is complete, except for the tray that will be installed after the girders are in place. Inspection and rework of the transformers has been performed. All booster cables for quadrupole magnets are in place. The work on de-ionized (DI) water piping in the booster tunnel is completed, as well. The booster arcs have been equipped with the pedestals that will support the magnet girders (Fig. 1).

Figure 1. Booster arcs with complete cable trays, cables, DI-water piping and pedestals for magnet girders.

The booster magnet/girder test area has been established and the work permit approved. The pre-survey of the first four booster magnet/girders is complete and the booster girder transport dolly is complete. The booster RF transmitter installation has made good progress (Fig. 2).

Figure 2. Booster RF transmitter installation in the Injector service bldg.

Storage ring (SR) installation and integrated testing. At the end of March, the SR tunnel contained 27 installed multipole magnet/girders and four dipoles. The vacuum group finished pump-down and leak checking of cell 26. Bakeout of the cell awaits the absorbers, scheduled to arrive in mid April. Layout of the dipole DI drop was approved and is being fabricated. The Service Bldg. 1 pump skid successfully passed its functional test. In cable pulling/electronics work, installation of equipment in cells 25 and 26 is in process; cell 25 magnet cables were terminated in the tunnel.

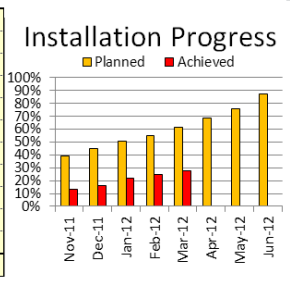
The diagnostics group made good progress in mounting controls equipment in P1and P2 and is terminating cables in P2. Diagnostics cable management in the SR tunnel is being finalized. Figure 3 shows girders in the P1 tunnel.

Figure 3. Girders in SR tunnel, pentant 1.

The installation of girder floor plates in P2 is complete. About 10 magnet/girders have been transported into P2 and P3 where they await survey of top floor plates prior to installation. Chilled water has been connected to the equipment enclosures in P2. The DI water piping in P3 is completed, as is the grounding of cable tray in P4. Equipment enclosures have been staged on the mezzanine in P4. The cable tray for P5 is complete. Floor plate drilling for the entire SR is now complete and installation and survey of girder floor plates is in process. DI piping installation has started in P5. The first SR RF transmitter has been successfully tested by the manufacturer.

	Dec-11	Jan-12	Feb-12	Mar-12
Mechanical Utilities	26%	40%	47%	50%
Electrical Utilities	37%	42%	45%	49%
Magnets	23%	32%	39%	42%
Vacuum	1%	5%	10%	11%
Power Supplies	7%	7%	9%	11%
Instrumentation	11%	14%	18%	20%
Frontends	0%	0%	0%	0%
RF	5%	11%	11%	14%
Inje Straight	0%	0%	0%	0%
LINAC+Booster	0%	4%	7%	10%
Total	13%	16%	22%	25%

Achieved



Mechanical engineering. The Bldg. 902B hoist lift safety potential was improved with the installation of dedicated, balanced lift magnet hoist fixture bars, designed for each magnet's hoist ring location.

To date, 125 of 150 magnet girders are completed and 91 girders have been delivered. The remaining girder and floor plate auxiliary mounting equipment has been received. By the end of March, 27 of the 90 multipole magnet/girders had been assembled and final aligned. A second yaw fixture has been manufactured, which will further speed up girder assembly.

For the beamline front end, ray tracings for the CHX, HXN, IXS, and SRX beamlines were completed. The fast shutter valve was received from VAT. The mask for the XPD front end was released for production. All collimators and Glidcop flange absorbers have been released for production. All front end components are either already at hand or are on order. All Glidcop blocks have been cut to size and are released for machining.

Magnet production proceeded well in March. To date, 548 magnets have been received; 540 have been mechanically inspected, 537 surveyed, 485 magnetically inspected, and 445 accepted. The replacement base plates for Budker magnets have been manufactured. All hardware for 160 Corrector base plates has been received.

Diagnostics and instrumentation. Designs for chassis and mounts for PTC (pilot tone combiner) modules are complete and have been released for production. This includes both the SR and booster ring (BR) designs. Procurement is underway and we have received first articles of both types. The first production versions of the high stability beam position monitor (BPM) stand and vacuum chamber assembly were completed. We plan to produce five more, for a total of six. The first two will be installed for Day 1 in section 1, cell 3 for the HXN beamline. The next four will be installed in cell 1 of sections 10 and 11 (IXS and CSX, respectively). Drawings for the LMR strain relief were released and procurement of a production quantity is complete. Units are installed in the P1 BPM racks. Drawings for primary in-vacuum mirrors for the optical monitors were released and subcomponents are currently being fabricated. The design for the X-BPM invar stand was released. It is essentially a shorter version of the invar FE slit stand. Central shops fabricated a first article for testing purposes. We plan to fabricate the remaining components and adapt the X–Y stage from the FE slit design. Testing will be toward the end of April or early May. Designs for both the BM-A and 3PW diagnostic beamlines are 90% complete. We are preparing for a final design review, after which creation of detailed drawings and procurement of components will begin. Drawings for the 300 mm strip line kickers were released and a first article assembly was produced and tested. The 150 mm strip line design is in progress. Tapered chamber design is complete and released. There are two multi-BPM chamber designs. The version in cell 29 for the tune monitor is being detailed and is expected to be released shortly. The version in cell 16 is undergoing revision to incorporate synchrotron radiation absorbers, per SRP task force requirements.

Cryogenic system. The production of the liquid He plant started after the final design review (FDR) meeting. The quench analysis for the helium vent line has been completed.

RF systems. The linac RF installation is complete and beam tests are underway. The booster transmitter system is complete and is being installed in the injector service bldg. The SR RF transmitter system is complete, installed, and tested, and awaits final acceptance testing. A small RF test load stand is being assembled. Design for the water manifold is complete; material is on order. For the superconducting cavity, ASME consultants were hired to clarify for the safety committee why we do not need to re-run all the destructive tests on weld coupons. The Nb RRR 50 specification document is complete and signed off and will be entered into the controlled document database. Some of the Nb RRR material came in under spec with regard to yield strength. AES is analyzing the problem to determine if this material is still usable. Work is progressing in the blockhouse on a test setup for RF window conditioning.

Vacuum systems. Nine cell chambers were assembled and vacuum certified, bringing the total available chambers to 146. The welding of long straight section chambers has started at APS. The design of the short and narrow chambers for straight sections has begun. Eight multipole girders and two dipole girders were completed and baked at the 902 Annex and installed in the tunnel. Cell 26 was fully assembled and leak checked. The linac and LBT vacuum is running smoothly after one VGC and two IPCs were replaced.

The FDR for the damping wiggler (DW) chambers was held with the manufacturer. Detailed layouts of the injection and RF straights have been reviewed, to develop appropriate flange absorbers for SR protection. Optimization of DW absorbers continues, to minimize the downstream opening. The cooling lines for both aluminum chambers and copper absorbers have been developed for installation in cell 25. The fabrication of BST B1 and B2 bending chambers is completed and being measured. The detailed layout of the BST drift pipes is completed. The layout of Booster–RF straight drift pipes is also completed. The ITR for booster chamber testing is generated for review. RTD locations and cable length have been developed and the cables ordered.

Electrical engineering. The final design review for the main dipole procurement activities was held with the manufacturer, who has ordered all of the long-lead items. The PSC software for the multipole and corrector power supplies is being tested for errors and functionality. We now have 100% of the main PSC boards delivered. The three cell 25 PSC chassis were tested with their network switches and IOC in the Bldg. 902 test racks. PSC components for cell 26 have finished individual testing and are being installed in their chassis in the Bldg. 902 racks. We have all regulator chassis in house. Cell 25 regulator testing and acceptance measurements have been finished. Cell 26 regulators are being worked on. We have received nearly all of the production delivery of PSI chassis, but they need modification to correct an error discovered on the board. We have repaired, tested, and configured PSIs for cells 25 and 26; we are working on cell 24. First articles have been received from the supplier for alignment corrector power amplifiers. After first article approval the production rate should be 80 units a month. The one-wire temperature measurement interface chassis have been delivered. A simple test system is finished and a final traveler has been completed. The production for the AC input power modules, including shelves and other auxiliary hardware, is completed. A small interface circuit needs to be added to prevent false indication of the contactor not being closed.

Insertion devices. The fully assembled first article DW (absent magnets) has had its control system integrated and is undergoing bench testing of the mechanics at Danfysik. The assembled second and third DW were also received and are in the queue at Danfysik. About 15% of permanent magnets (of each type) have been characterized and are currently undergoing sorting. Manufactured components for the structural frames and magnet girders of the five production units progressed well. Cables have been tested and are being routed. Tooling for magnet assembly is complete and is in use to mount measured magnets in keepers. The design for transport stabilizers to be incorporated into the elliptically polarized undulator has been provided to Kyma. Modification of the transition section design around IVU20 is being investigated in order to reduce the geometric impedance contribution from a device. BNL signed the original contract for the IXS in-vacuum undulators on March 30th, 2012.

Experimental Facilities

XFD procurement work continues, with many packages for the beamline optical components now being awarded (~$10M), in evaluation, or released to bidders ($6M). In total, around $15M worth of Experimental Facilities contracts are now placed, almost 50% of the total of the procurements greater than $100k. Manufacture of the CSX hutch is completed and it is expected to arrive on site in early April. The remaining hutches are now being manufactured. Utilities required for the beamlines will be installed as soon as the hutches are completed. Work continues on the specifications and designs for the utilities, as well as the Personnel Protection System.

IXS. The six proposals received for the IXS KB Mirror System are being evaluated. Draft specifications and a statement of work (SOW) for the beamline optics component package have been reviewed by procurement personnel; the request for proposals (RFP) will be released in April. The solicitation for fabricating high-resolution crystal optics for the high-resolution monitor and the analyzer system of the spectrometer was placed with the identified vendor. The project team has made excellent progress in the final design of the spectrometer. Specification and SOW documents are being prepared. The design and procurement of the remaining beamline and spectrometer components are on track.

CHX. The CHX optics package was awarded to Bruker ASC. Following the award, the CHX technical team established contact with the Bruker ASC engineers to organize the contract kick-off meeting. The evaluation of the CHX diffractometer RFP was finalized and a contract award is expected in early April. The CHX team has advanced with

the in-house conceptual design of the 15 m-long small-angle x-ray scattering (SAXS) table and other endstation instrumentation.

CSX. In March the package for the bendable mirror went out for bid. Documents for the M1A and M3B mechanics package, the last of the large CSX packages, are being finalized. Paperwork for the detector, differential pump, and white beam slits are also in preparation. Seven grating substrates have been manufactured and are ready for shipment. Contact has been established with BESSY metrology experts to confirm the specifications before we send out for the grating fabrication. Final details for the hutches are being approved to allow shipment and installation of the FOE hutch.

HXN. The HXN team continued to work closely with FMB-Oxford in developing the design of the beamline components. A team member visited the contractor's site in mid March and addressed some items identified during the preliminary design review. These included revision of the bremsstrahlung and synchrotron ray tracings, and refinement of the design for the monochromator, mirrors, and secondary source aperture. The HXN team accepted the final design of the mirror bender and the mirror cooling interfaces; now the mirror subcontractor can start working on the mirror assembly. All designs for the long-lead-time items are complete.

XPD. The Double Laue Monochromator contract was awarded and the kick-off meeting took place. The Beamline Components contract was also awarded. Five proposals for the design, manufacturing, and installation of the XPD Vertical Focusing Mirror were evaluated. Technical documentation for the XPD diffractometer (including, but not limited to, the SOW and specifications) is being finalized.

XPD staff participated in a BNL workshop to discuss the pressing scientific questions that should be addressed for key advances in the field of batteries and energy storage. XPD capabilities can be leveraged to enable novel approaches for *in-operando* studies of materials for energy storage applications.

SRX. Contract negotiations for the SRX KB Mirror Systems Package have begun. The SRX team is fine-tuning the technical specifications, ensuring high performance of the beamline while accommodating realistic parameters for the supplier. In parallel, the SRX team continued to test stages feasible for the SRX endstations. Testing will be brought to an end early in April. Experiments carried out at X15B of NSLS to prepare for early science studies with the SRX beamline have been successful.

Optical metrology. The ELCOMAT autocollimator has been delivered. The gantry will be installed in laboratory E3 in early May. Discussions are proceeding on moving the existing girder measurement facility from Bldg. 902 to the NSLS-II experimental floor, which would provide an optics metrology facility close to the beamlines.

Optics fabrication. Purchase orders for pitch-polishing consumables, as well as colloidal silica pad polishing, have been placed. A new procedure has been tested during recent work on C-crystal fabrication (300 micron-thick silicon), which has provided a scratch-free surface. Further work on producing a "windowed" C-crystal is underway on two fronts: using an Allied High-Tech CNC micro-polishing system, and reactive ion etching with a nickel hard mask. Two MLLs were grown this month. In one case, early growth gave way to failure, possibly due to fluctuations in the building's HVAC system. The successful crystal appears to show a 35 nm P-V layer placement error over 45 microns of MLL. A simulation by HXN staff resulted in focal performance of approximately 20 nm. A new MLL using compensation feedback from this run is planned.

CONVENTIONAL FACILITIES

Conventional construction continued to make excellent progress during March, as ring building construction nears completion and LOB construction is at peak activity. The ring building contractor is working to complete the final elements of the contract, while the LOB contractor is working toward beneficial occupancy of LOBs 1, 2, and 3 by the end of June.

With turnover of P5 during February, the ring building contractor is nearing completion of 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 materials and equipment 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 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.

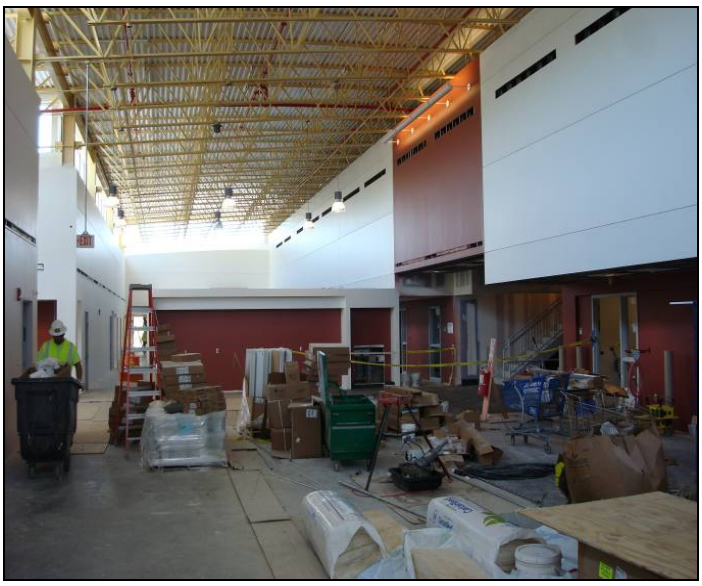


Figure 4. LOB 1 open plan office area.

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 ready for equipment start-up, and completion of interior finishes in preparation for beneficial occupancy in June (Fig. 4). Flooring work is underway (Fig. 5).

Figure 5. Hand work on the flooring installation near a doorway in pentant 1.

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 dry wall and painting are nearing completion (Fig. 6) and mechanical/ electrical/plumbing (MEP) work progresses rapidly.

Figure 6. LOB 3 hallway painted.

LOB 2 follows, with roofing, sheathing, and glazing completed and exterior siding nearly complete. Interior partitions and MEP are now well advanced. LOB 4 steel and concrete are complete; interior partition work, mechanical, and electrical work are now in progress. LOB 5 steel and concrete are now complete, with roofing and sheathing 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 cumulative Schedule Performance Index (SPI) is 0.95, both well within the acceptable range. The project is 74% complete, with 35% of contingency and management reserve, based on EAC work remaining.

The project current period schedule variance is red with a current month SPI of 0.84 (-$2.9M) due to negative variances in Conventional Construction (attributed primarily to negative schedule performance for LOBs 1 and 3 of $1.5M and to early completion of work for the ring building). In addition, Experimental Facilities contributed to the negative project schedule performance with an SPI for the month of 0.53 (-$864K). The negative Experimental schedule performance is due primarily to delays in hutch fabrication and delivery for three of the six beamlines.

Accelerator schedule performance for the month was 0.96 (green status) with only a very small negative schedule variance of $-347K. The cumulative negative Accelerator Systems schedule performance has improved again, trending upward to 0.87 (March) from 0.86 (February). The schedule performance improvement in Accelerator is due to the increased number of production magnet deliveries, and progress on the fabrication and assembly of the storage ring RF cavity.

The cumulative Experimental Facilities Beamlines schedule performance is trending down, due primarily to the beamline procurement late deliveries. There is a cumulative SPI for Experimental Facilities beamlines of 0.90, down from 0.93 in February and 0.96 in December 2011.

Conventional Construction activities have a negative schedule variance for the month of March 2012 with an SPI of 0.76 (-$1.6M), due to current month delays in LOBs 1 and 3. The delay in LOB 1 involves finishing work; in LOB 3 it is HVAC. However, on a cumulative basis, the LOB schedule performance is ahead of schedule. The cumulative Conventional Construction schedule also is ahead, with an SPI of 1.01 ($3.9M).

The project-level cumulative cost variance is 1.00 CPI ($2.3M), green status. The current month CPI for the project is red, at 0.80 (-$3.8M), due primarily to billing and accrual timing within the Accelerator work (SR magnets and damping wiggler insertion devices). 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; connect power supplies and instrumentation; cable 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 36% schedule contingency. The dipole magnet deliveries have been slower than planned, but a workaround schedule has been formulated and incorporated into the current schedule/critical path. These adjustments accelerate deliveries going forward in order to meet the scheduled magnet delivery completion date.

PROCUREMENT ACTIVITIES

The Procurement group has had a very active and successful month. The significant awards made in March include the XPD Beamline Focusing Mirror, CHX Beamline Optical Components, RF LN2 System, and XPD Beamline Components packages. In addition, a number of significant awards are pending with closure expected in the next two to six weeks. These include the SRX KB Mirror System, EPU Vacuum Chambers, IXS In-Vacuum Undulator, IXS KB Mirror System, CSX Beamline Toroidal Mirror System, M3A Optical and Mechanical Components, SRX Beamline Optics, and CSX Monochromator.

NEWLY HIRED

Marco Musardo–Physics Associate, Insertion Devices, Accelerator Div.

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 Lab Office Buildings (LOBs) expected to be complete at the end of June (LOBs 1–3) and 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.

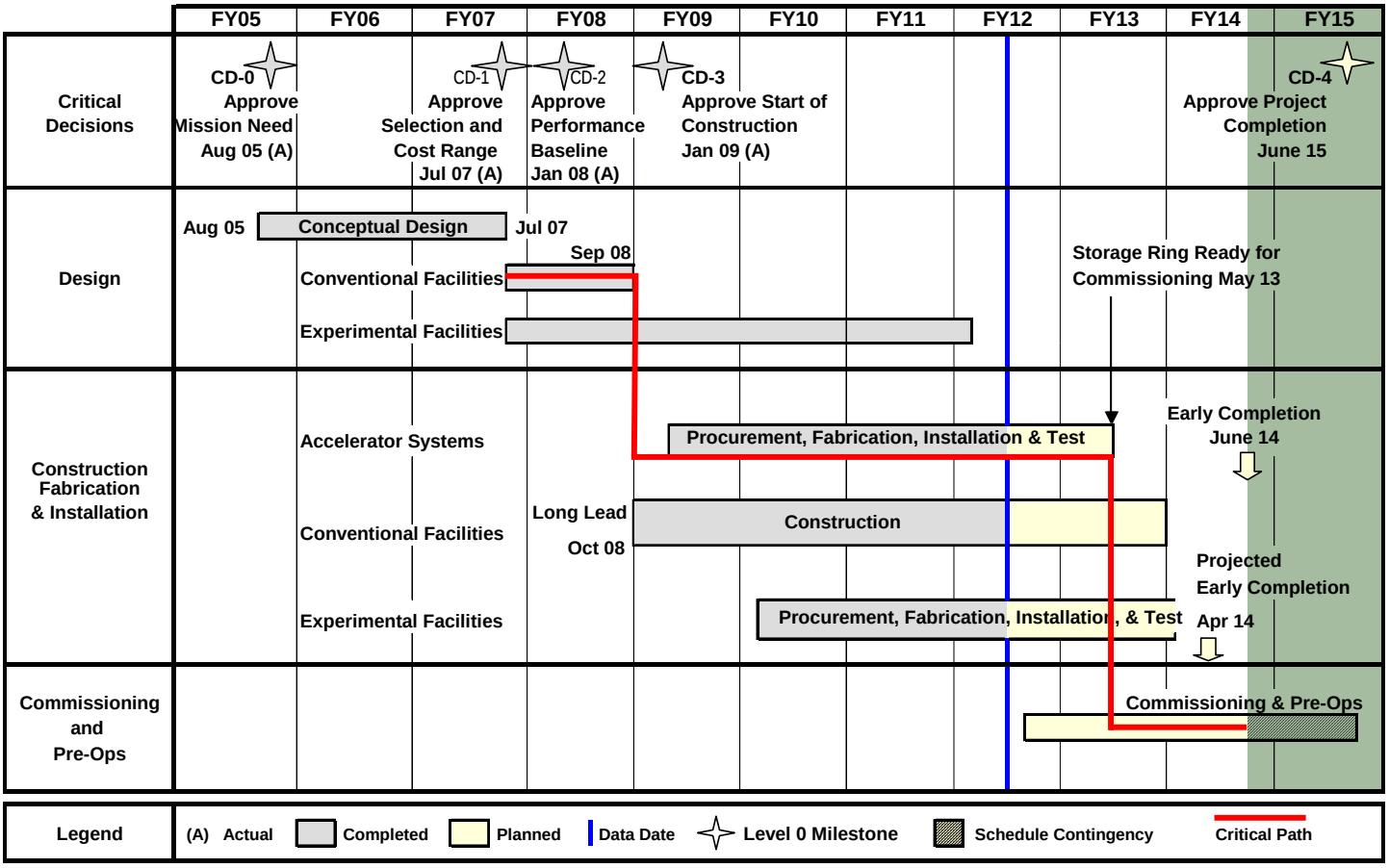
All pre-start items for the linac commissioning were completed and verified by the Accelerator Readiness Review team. Approval to proceed with linac commissioning was granted by BHSO on March 26 and the commissioning process began shortly thereafter. Planning for the Booster Accelerator Readiness Review is underway.

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 (~25) will be completing punchlist items through May.

Figure 7. LOB 2 exterior siding nearing completion.

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.