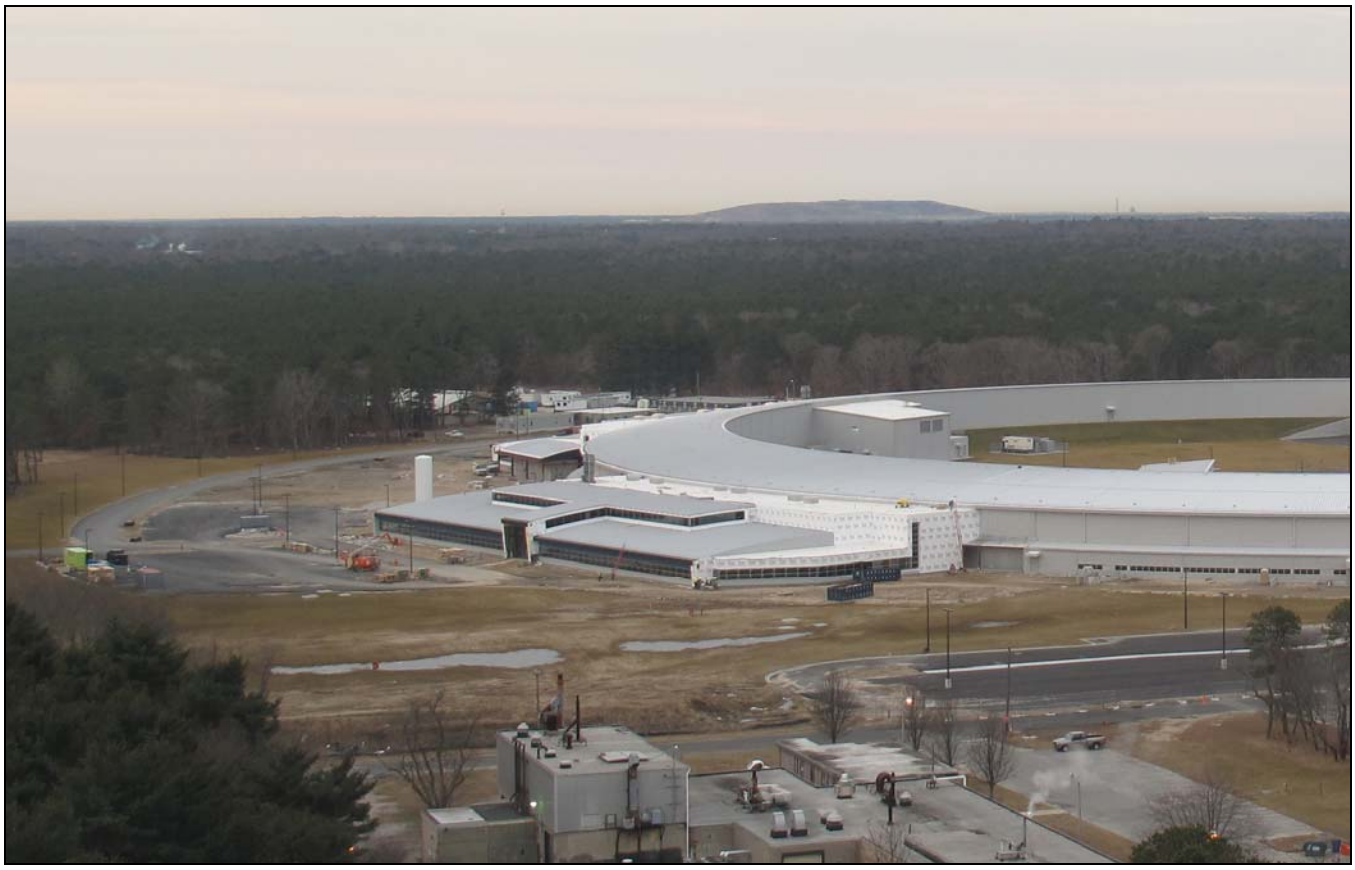
National Synchrotron Light Source II

Project Progress Report

February 2012



Workers assemble at LOB 2 early on February 28, with rain in the forecast.

report due date:
March 20, 2012

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BROOKHAVEN NATIONAL LABORATORY

OVERALL ASSESSMENT

The National Synchrotron Light Source II project made excellent progress, maintaining satisfactory cost and schedule performance. By the end of February, the project was 72% complete with over 36% of contingency and management reserve for the remaining Budget At Completion (BAC). The cumulative Schedule Performance Index (SPI) of 0.96 and the cumulative Cost Performance Index (CPI) of 1.01 are well within the acceptable range.

With the beneficial occupancy of pentant 5, construction of the ring building was completed at the end of February. Contract closeout will commence after resolution of all punchlist items, delivery of the remaining Operations and As-Built documents, and completion of the remaining site restoration work. All five lab-office buildings (LOBs) are making rapid progress, with all trades working to varying degrees in each building. Extra attention is being paid to safety and coordination. LOB 1 is on track for beneficial occupancy in early summer.

Excellent progress continued in production and installation of magnets, linac, booster, vacuum, RF, power supplies, and cryogenic systems, resulting in a positive schedule variance of $1.4M (SPI of 1.20) in February for Accelerator Systems.. With a successful accelerator readiness review (ARR), the linac will be ready for commissioning in March after a few minor action items have been addressed. Magnet production and magnet–girder integration continue to meet goals. In total, 15 magnet girders are now installed in the storage ring tunnel.

Progress continued with procurement for the six Project beamlines and preparation for the Personnel Protection System (PPS) and utilities needed for hutch installation.

Although a 14-month schedule float between the projected early completion date and the CD-4 milestone has been maintained, built-in schedule floats between various activities for accelerator installation and beamline procurements have been substantially reduced. Thorough schedule assessment will be conducted over the next few months.

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

UPCOMING EVENTS	2012
Installation Retreat	Mar 13
Science Advisory Committee (SAC)	Mar 15–16
Earned Value Management System (EVMS) training	Mar 20–21
Final Design Review (FDR) meetings, IXS and CSX Hutches	Mar 20–21
Project Advisory Committee (PAC)	Mar 29–30
HXN Beamline Advisory Team (BAT) Meeting - TBD	Apr or May
Review of High Level Application Programs for NSLS-II	Apr 4-6
Magnet Production Lessons Learned Workshop	Apr 11-13
DOE Review of NSLS-II Project	Apr 17–19
7th Bi-Annual CW and High Average RF Workshop	May 8-11
CHX BAT meeting	May 10
DOE Review of NSLS-II Pre-Operations Budget	May 14–16
Assoc. Lab Director (ALD)'s Prelim. Design Review, ABBIX	Jun 26-27
ALD's Preliminary Design Review of NEXT Project	July 17-19
DOE CD-2 Review of NEXT Project	Sep 11-13

ACCELERATOR SYSTEMS

Accelerator physics. The group prepared for the review of top-off safety for the NSLS-II storage ring, to be held March 7–8. The definition of high-level application programs needed for storage ring commissioning was worked out. Preparations for an external high-level application programs review (scheduled April 4–6) have begun. The accelerator physics team continued to identify heat transfer issues for vacuum components impacted by synchrotron radiation. Accelerator physicists are strongly involved in finalizing shielding layouts for the linac and booster. Impedance calculations keep track with designs being finalized. The 3D impedance contribution from IVU21 is being calculated for the canting magnet section of the SRX beamline. Design modifications of the transition section at the IVU20 undulators are being investigated, to reduce geometric impedance contribution from these devices.

Magnets and supports. Magnet production continues to go well. All 162 dipole correctors have been received, leaving only some of the 30 skew-quadrupole correctors to be completed. Tesla produced 11 quadrupole magnets in February and is on track with their delivery plan. Buckley produced and delivered two dipole magnets, not yet at the required production rate. The rest of the production goes well. Magnet-girder integration also progresses. The team made a concerted effort to complete two girders per week in two-shift operation. There are now 15 magnet girders in the tunnel.

Power supplies. All regulator modules and a large fraction (93%) of the main PSC boards for the multipole and corrector power supplies have been delivered and are being acceptance tested. PSC components for cell 25 have been individually tested and are installed in their chassis. All regulator chassis have been received, as well as all PSI modules. A necessary fix of an error on the PSI boards is 95% complete. Seven units of power amplifiers for the DC corrector supplies have been delivered and the supplier is ready for a production rate compatible with our schedule. The first pre-production fast corrector power amplifier has been built, and testing has begun. Preliminary results showed the amplifier meeting all requirements, but more thorough testing revealed a stability issue. Engineering worked out a solution and the amplifiers are now all working to specifications. All one-wire interface modules have been delivered. A simple test system has been created and a final traveler has been finished. The delivery of the AC input power modules is complete. All components such as shelves, hardware, and power modules are at hand. Testing and a small modification on the board are in progress. Units for the cell 25 test are available.

Vacuum systems. The welding of all 161 vacuum chambers for chambers at APS has been completed. Seven cell chambers were assembled and vacuum certified, bringing the total available chambers to 137 (>81%). The production of the chambers for the straight sections (we need 28 for start-up) has begun. Machining of the 13 long-straight chambers is completed, and welding is to start in March. Eight multipole girders and two dipole girders were completed and baked at the Bldg. 902 Annex. The assembly and bake-out rate has reached two girders per week. Vacuum assembly and

installation for cell 25 was successfully completed; the vacuum was closed and pumped down. After thermal conditioning (baking), a vacuum pressure of 10^{-11} (the lower limit of what can be detected) was achieved quickly.

The termination of vacuum cables continues in pentant 1 and has begun in pentant 2. The cabling list and rack layout for the booster and pentants 3 through 5 have been generated for review.

The LBT phase 1 vacuum is completed, pumped down, and has reached the 10^{-9} Torr range. LBT vacuum instruments, PLC, interlock, and control have been tested. Additional ion pumps were installed on the linac waveguide. The linac vacuum has been established, while the monitoring and interlock still need to be upgraded.

Second sets of bake-out heating jackets were received. All pump manifolds and gauge trees were also received. Four RF gate valves were received, bringing the total available to 22. More than 95% of all vacuum gauges/controllers and 80% of the RGA systems have been received. Second-phase cable orders are being received. The fabrication of four BST bending chambers has started at BNL Central Shops.

Electrical utilities. Most electrical utilities work now involves installation. Production of the low-precision temperature control chassis units is complete. The order for the high precision temperature controller chassis (used for the button position monitor racks) has been placed.

Injector. The NSLS-II linac is complete. All components have been tested and installed and the ARR was held successfully with no major action items generated. The production of components for the NSLS-II booster continues to go well at BINP. All girder stands and the first five fully equipped magnet girders have been delivered. The pulsed magnets for the booster (out-of-the-vacuum kickers) have been built and show satisfactory performance.

The order for the ceramic beam chambers for the NSLS-II storage ring injection kickers has been placed. The manufacturer's preliminary design review (PDR) for the storage ring injection septum was held and there were no surprises.

Insertion devices. The first article unit of the damping wigglers (DW) was assembled, and manufacturing of the DW support structures is almost complete. Integration of the last elliptically polarizing undulator (EPU) model for an update to the diagnostics was added, with no apparent incompatibilities. The final design review (FDR) for the EPU was held. A post-PDR meeting at the subcontractor's facility demonstrated good progress in addressing issues raised during the FDR. One reliable supplier has bid for the EPU vacuum chamber fabrication. The main contractor submitted the final version of the Control System Document, and final review for the controls will take place in March. The FDR for the in-vacuum magnetic measurement system (IVMMS) was held at BNL with the manufacturer. Based on discussions during the review, the manufacturer is finalizing the design now. The design for the integrated field measurement system (IFMS) has been completed and the conceptual design process for the IVU21 undulator is done. The canting magnet is being redesigned to accommodate the requirements of the available power supply. Proposals for the IVU22 (IXS undulator) have been received; review began in February.

Installation. Installation continues to proceed well. The linac installation is completed (Fig. 1), except for the erection of a cage around the electron gun and its supply. Cable pulling for the linac, including the LTB transfer line phase 1, is complete.

Figure 1. Completed linac.

Booster installation is making good progress. Piping for DI water systems is completed and most of the cable trays have been installed. The cable tray on the inner wall of the booster is complete (Fig. 2).

Figure 2. DI water piping and cable tray in the booster.

The cable tray for the Booster to Storage Ring (BtST) beam transfer line is also complete. About 50% of the tray connecting the booster wall penetrations into the injector service area is installed and the tray located in the other half of the injector service building is also complete. Conduit work for the Booster PPS also continues. The computer room AC power is complete and chilled water racks are operational. Work continues in the injector complex.

All equipment enclosures (racks) are installed in pentants 1, 2, and 3. Cable trays have been completed in pentant 4. Most signal cables have been pulled for pentant 2. AC power has been connected to the RF transmitters in the RF building. AC power installation in pentant 2 is complete, testing has finished, and the work in pentant 3 has started. Eight magnet girders have been installed in the storage ring. Girder floor plates in pentant 2 are complete (Fig. 3) and work in pentant 3 has started.

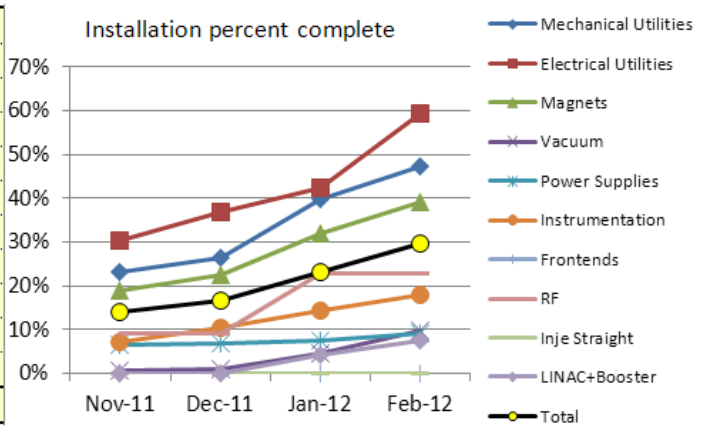
The SR RF power installation is completed. The installation of power supplies and instrumentation continues. Vacuum installation on the mezzanine of pentant 1 is completed, including termination of all vacuum cables on the mezzanine and in the tunnel.

Table 1 shows installation progress through the end of February, 2012.

Figure 3. Floor plate installation in pentant 2.

NSLS-II Accelerator Installation Progress

		Nov-11	Dec-11	Jan-12	Feb-12
Achieved	Mechanical Utilities	23%	26%	40%	47%
	Electrical Utilities	30%	37%	42%	59%
	Magnets	19%	23%	32%	39%
	Vacuum	0%	1%	5%	10%
	Power Supplies	6%	7%	7%	9%
	Instrumentation	7%	11%	14%	18%
	Frontends	0%	0%	0%	0%
	RF	9%	9%	23%	23%
	Inje Straight	0%	0%	0%	0%
	LINAC+Booster	0%	0%	4%	7%
	Total	**14%**	**17%**	**23%**	**30%**



Experimental Facilities

Experimental facilities procurement work continues, with many packages for the beamline optical components now being awarded, in evaluation, or released to bidders. Hutch work continues; manufacture of the first hutches, for CSX and HXN, is making good progress and installation is expected to start in the second half of March. The 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 specifications and statement of work (SOW) documents for the first optical enclosure package have been completed and are ready for procurement review. The FDR for the radiation enclosures has been scheduled for March 21–22. A call for expressions of interest has been posted for fabrication of the crystal optics for the high-resolution monochromator and the Analyzer system of the spectrometer; the contract will be placed in March.

In crystal optics R&D, the IXS team has begun preparing for the next beamtime in May at PETRA-III, where the multilayer collimating mirror will be tested, together with the crystal optics for the first time. The entire optics scheme will be tested with an actual sample system to validate the spectrometer performance for a total resolution of 1 meV. Preliminary testing of the multilayer mirror is currently being conducted at NSLS X16a as part of the preparations for the beamtime.

CHX. The CHX optics package evaluation has been completed and the contract will be released in March. Evaluation of the CHX diffractometer has also been completed and a best value proposal was selected.

CSX. Procurement packages for the toroidal mirrors and the monochromators went out for bid, with responses expected in March. The M3-A mirror procurement package is ready to go out and the M1A-M3B details are also being finalized for procurement. Design of smaller beamline components, such as white beam apertures, shutters, and the differential pump is proceeding, along with FEA analysis and vacuum calculations for those items. A new package has been initialized for obtaining a soft x-ray charge coupled device (CCD); preliminary procurement paperwork is underway. In February a list of other beamline components was completed and requests were initiated for quotes for the components that are commercially available.

HXN. The HXN team held the PDR with FMB-Oxford regarding beamline optics and components. The review included technical design of the instruments, the utilities arrangement, and safety details. Minor comments were made on the secondary source aperture and the mirrors. The

synchrotron and bremsstrahlung ray tracings submitted by the contractor were reviewed by the BNL radiation safety committee, who had only minor comments. FMB-Oxford is expecting to submit the written PDR Report in March.

XPD. The Double Laue Monochromator and the beamline components are being finalized. Five proposals for the design, manufacture, and installation of the XPD vertical focusing mirror were received on February 20, and their technical evaluation and scoring are underway. Preparation of technical documentation for the XPD diffractometer (including, but not limited to, the SOW and specifications) is in progress. A scope enhancement plan (supply, schedule, pricing) was submitted to management. It covers the development of a side-branch for offering unique pair distribution function capabilities at XPD.

SRX. Contract negotiations with the supplier for the SRX Optical Components Package have been successfully brought to an end; the contract is close to being finalized. Two proposals for the SRX KB mirror system have been received and evaluated. Clarification requests have been sent out to the suppliers. The SRX team has continued to work on testing stages feasible for the SRX endstations. There have been discussions with several manufacturers to clarify technical issues, and a visit to one facility.

Optical metrology. The ELCOMAT autocollimator is waiting for calibration from the Physikalisch-Technische-Bundestalt. The last coating for the pentaprism and other optics will be completed shortly. All parts are now delivered for the stitching platform; assembly of the system has begun.

Optics fabrication. Quotations for pitch-polishing equipment and consumables, as well as colloidal silica pad polishing, are being processed. Important progress on the Multi-Laue Lens (MLL) fabrication was made this month, when transmission x-ray microscopy (TXM) studies showed that stress-reduced (reactively sputtered) thick growths exhibited no defects. More detailed analysis of linearity through marker layers was completed by the HXN group; the high-resolution TXM agrees very well with scanning electron microscope (SEM) images. A new MLL with a slightly modified erosion compensation formula is being grown; SEM linearity analysis will occur in March.

CONVENTIONAL FACILITIES

Conventional construction continued to make excellent progress during February and a major construction milestone was completed as scheduled. Acceptance of the fifth and final section of the ring building for beneficial occupancy made the entire building available for accelerator installation. Figure 4 shows the lobby ready for use.

With turnover of pentant 5 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 available for installation activities. Given the accelerating pace of installation, these areas are quickly being used for staging and storing materials and equipment as they are readied for installation. The remaining ring building contractor work will include resolution of all punchlist items, completion of system commissioning and operator training, delivery of remaining Operations and As-Built documents, and final sitework that could not be completed during winter work conditions. Following completion of all physical work at the site, demobilization and contract closeout will commence.

The five LOBs continue to make excellent progress. LOB 1 activity is focused on completion of the exterior siding system, completion of mechanical and electrical systems, and completion of wall and room finishes in preparation for beneficial occupancy in June. Drywall taping is nearing completion and painting is underway, supplemented by the use of temporary heat. The roof is complete, glazing is installed, and exterior siding installation is underway. Permanent power will be brought in during March to enable start-up and testing of HVAC system components.

LOB 3 is the next one slated for full fit-out and is progressing right on the heels of LOB 1. The building sheathing, roofing, and glazing are in place and exterior siding is well underway. Interior partitions are in place, and drywall work and mechanical/electrical/plumbing (MEP) work is progressing rapidly (Fig. 5).

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

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

Figure 4. Lobby of the ring building, fitted and finished and ready for use.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) for the overall project is 1.01 and cumulative Schedule Performance Index (SPI) remains at 0.96, both well within the acceptable range. The project is 72% complete, with 33% of contingency and management reserve, based on EAC work remaining.

The project current-period schedule variance is green, with a current-month SPI of 1.01 ($230K), attributed to a positive schedule variance in Accelerator Systems of $1.4M, current month SPI of 1.20. The positive schedule performance is due to increased production magnet deliveries, progress on the fabrication of the storage ring RF cyro coldbox, and the procurement of niobium.

Conventional construction had a slight negative monthly schedule variance (relative to the size of the facilities budget) for February, with current month SPI of 0.88 (-$771K), due to LOBs 1, 2, and 3 completing mechanical and finishing work ahead of schedule in previous months and to delays in progress in the installation of metal siding and standing seam roof. Note that the LOBs continue to be ahead of schedule, cumulatively.

Experimental facilities schedule variance for the month was negative, with a current SPI of 0.69 (-$341K) due to late delivery of the stages for the MLL modules. The cumulative experimental facilities schedule variance is trending downward due to procurement delays. The procurement schedule is being monitored weekly.

The current month CPI for the project is green at 1.06 ($943K), and the project cumulative CPI is 1.01. 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 35% 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.

ENVIRONMENT, SAFETY, AND HEALTH

Beneficial occupancy readiness evaluations (BOREs) have been completed for the entire ring building. This includes pentants 1 through 5, the RF compressor, injection buildings, and cooling tower. The BORE process included assuring that all life safety and code compliance requirements were in place prior to installation staff beginning their work. The remaining post-occupancy items are being actively closed out.

The Accelerator Readiness Review for the linac commissioning was successfully completed. A team of accelerator operations and ESH personnel, assisted by BHSO, completed a full review of the project's readiness for commissioning, examining operational procedures, emergency procedures, training, qualifications criteria, conduit of operations, physical hardware, and the PPS system. The team did not identify any new pre-start items; a handful of self-identified pre-start items are expected to be completed by mid March, to allow linac commissioning to begin shortly after that.

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

PROCUREMENT ACTIVITIES

The Request for Proposals (RFP) for the EPU Vacuum Chambers was posted on FedBizOps in January. Proposals were received and are currently under review. Contracts for the CHX Beamline Optical Components, the SRX Beamline Optics, and XPD Beamline Components are ready for award pending final approvals. The CHX Beamline Diffractometer evaluation has been completed and an award is anticipated in late March. The Double Laue Monochromator was awarded on February 28, 2012. Proposals for the IVU for the IXS Beamline and the SRX Beamline KB Mirror System have been received and are currently under evaluation. The RFP for the CSX Beamline M3A Mirror and Optical Package has been issued, with proposals due by April 9, 2012.

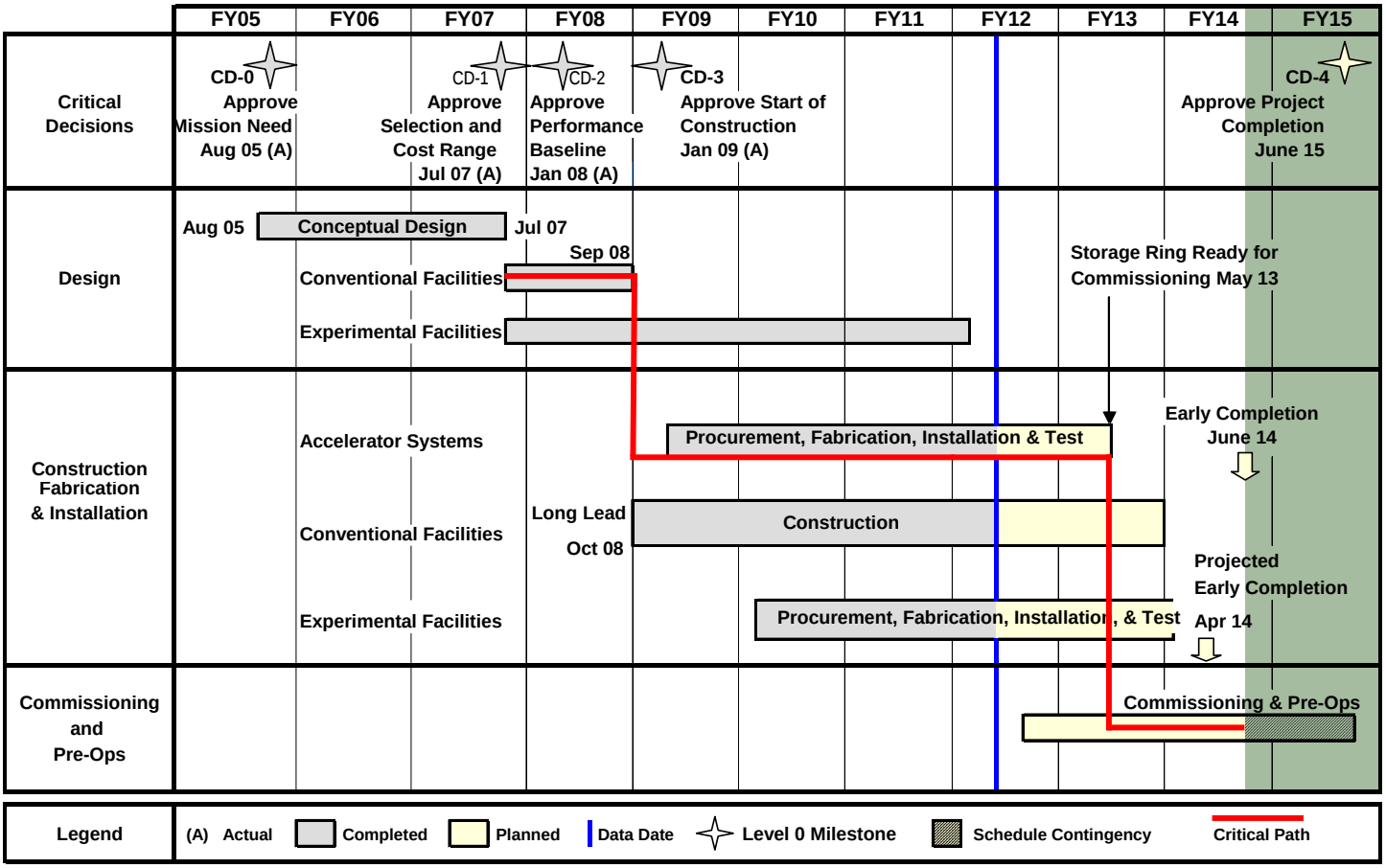
NEWLY HIRED

Ryan Craig – Survey Tech, Mechanical Engineering, Accelerator Div
Hengzi Wang – Mechanical Eng'r, Beamline Engineering, Photon Div

Figure 5. LOB 3 drywall installation underway.

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.