National Synchrotron Light Source II

Project Progress Report

November 2012

A quiet exterior belies the activity inside.

report due date:
December 20, 2012

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OVERALL ASSESSMENT

The National Synchrotron Light Source II Project continued to make good progress. At the end of November, the Project was 84% complete with 43% of contingency and management reserve for the remaining EAC (52% for the remaining BAC). The cumulative cost and schedule indices for the overall project remained at 0.99 and 0.95, respectively.

Conventional construction activities continue to wind down as the contractors work through the remaining punchlist items. The ring building contractor is partially demobilized and the Lab-Office Building (LOB) contractor is on track to substantially complete all LOBs by the end of December 2012.

Schedule performance for accelerator systems continued to improve, with a monthly schedule performance index of 1.10, +$365K, in November. The installation of the booster and transfer lines made excellent progress, on track to be completed by the end of January 2013. A total of 130 of 150 storage ring magnet girders have been installed, and delivery and installation of power supplies, vacuum, diagnostics, and RF systems continued. Installation of all components in pentant 1 (P1) was followed by low-current power testing for the entire system; high-current testing is in progress. Installation of all components in P2 was also completed and low-current power testing for that entire system is in progress. Installation in P3 will be completed in December, and excellent progress continues in P4 and P5. Various insertion device production activities made good progress with final design reviews and component acceptance tests.

Schedule variance seen in Experimental Facilities continues to be a concern. A number of design reviews for major beamline component contracts were conducted. Continuing delays in procurements for beamline components and hutch fabrication and installation led to a monthly schedule variance of 0.55 (-$1.4M) in November for Experimental Facilities. One issue contributing to some of the reported schedule variance was the major milestone-based statusing. This issue, which also created cash flow difficulties for the contractor, is being addressed.

The annual project-wide comprehensive EAC review was completed and incorporated in the November CPR (Cost Performance Report). A summary will be also presented at the December mini-review of the NSLS-II Project. The early completion date for the overall project continues to be June 2014, maintaining 12 months of schedule float (39% schedule contingency) with respect to the Project's CD-4 milestone date of June 2015.

UPCOMING EVENTS

XPD Monochromator Preliminary Design Review (PDR)	Dec 3
Optics Package FDR, Tech. Preliminary Design Review (PDR)	Dec 4–5
SRX Beamline FDR	Dec 6–7
XPD Diffractometer PDR	Dec 7
NSLS-II Mini-Review of NSLS-II Project	Dec 10
CSX-1 PDR	Dec 11–12
Project Controls EVMS Training	Jan 8–9
BNL Director's Review of the NSLS-II Beamline Projects	Jan 29–30
CD-2 review of NEXT Beamlines Project	Mar 5–6

ACCELERATOR SYSTEMS

Booster and transfer lines. All major components of the booster synchrotron have been installed, except for the two synchrotron light monitors. The RF cavity is installed and surveyed (Fig. 1). All long cables connecting BPM PTCs to the signal processing electronics located in the injector service area (ISA) have been pulled. Cable terminations will continue through December.

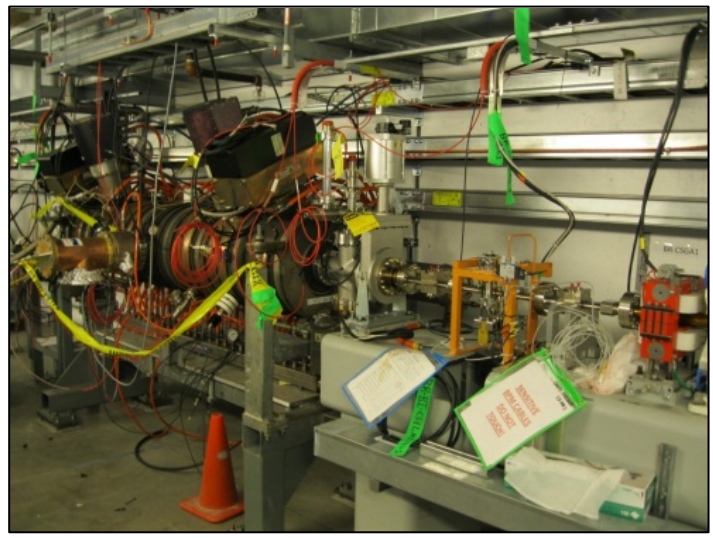


Figure 1. Installed booster cavity.

The booster flags have been connected to the compressed air main. All cables have been terminated and the flags have been connected to the control electronics in the ISA. The monitor tuning hardware was installed and cable connections are completed. Testing of the system was begun. Preparations for final testing of the large power supplies in January have been completed. The six booster kicker drivers (Fig. 2, left) which needed a small repair were disassembled, fixed, reassembled, and tested successfully. Ground wiring was established for all booster vacuum pumps. The installation of the LtB TL (Fig. 2, right) in the booster continued. Vacuum connections to the LtB TL part in the linac tunnels was established and lead shielding was reinstalled.

Figure 2. (left) Booster injection kickers. (right) LtB TL-II.

All stands for transfer lines in the booster tunnel have been installed and surveyed. All magnets have been installed and surveyed. Except for the five final BtS TL quadrupole magnets, all magnets have been received from the vendor. The

orders for the support structures for the storage ring (SR) injection straight and the TL section in the SR are about to be placed. All of the ferrite for the SR injection kicker magnets has been received and tested.

Injector shielding. The optimized linac supplementary radiation shielding design has been completed and the shielding has been formally reviewed by the Accelerator Division radiation shielding committee.

Vacuum. The girder integration at Bldgs. 902A and 905 continues smoothly, with four to five girders completed per week. All undulator exit pipes were fabricated. Cells 3 and 5 are assembled and aligned together with exit port components. All day-1 narrow straight section pipes, except those for RF and injection sections, are fabricated. The chamber and absorber cooling lines in P1 and part of P2 have been assembled, and cell 26 was pressure-tested. The assembly and pump-down of the booster diagnostic section (Fig. 3, left) is complete, and that of the RF section begun. All BtS chambers and drift pipes were cleaned and tested, ready for installation. The production of absorbers continues, with 70% completed and available for installation. Naming for injector vacuum components was updated, and color coding for the EPICS vacuum display was decided.

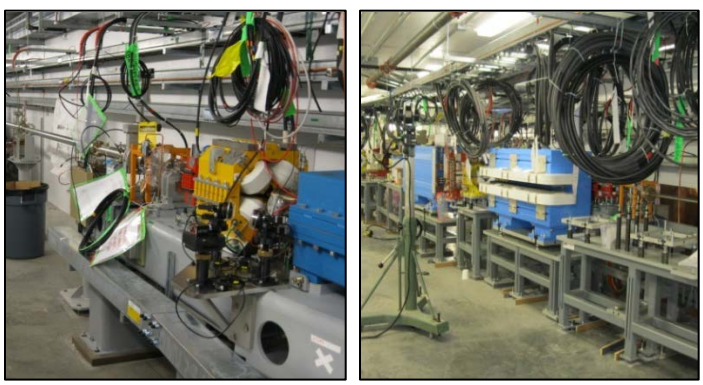


Figure 3. (left) Booster diagnostics straight section. (right) Booster extraction line (BtS TL-I).

Power supplies. The production of the power amplifiers for the dipole correction power supplies is complete and all units have been received. Most units have been tested. The polarity switch for the fast dipole corrector magnets needed to be redesigned and this work is now complete. Work on drawing packages and finalization of procurement documents is in progress.

Insertion devices. The first article damping wiggler has been delivered to Bldg. 832 without any major problem. The manufacturer of the EPU had difficulty in sorting the modules due to multipole components that were larger than anticipated. The expected final acceptance test (FAT) may be postponed to early March as a result. Supplier BINP produced the power supply system for strip conductor correction and corrector coils. A new linear motor Z-axis stage for the IVMMS has been delivered to Toyama, Co. The remainder of the FAT is being conducted. The LN2 test will be conducted in mid-December. The FDR for the SRX-IVU has been approved with conditions for modifications which make the use of air casters easier. A vendor has been selected for the SS-Canting Magnets and contract completion is imminent. The FDR report for the U20-IVU has been approved with conditions for modifications to facilitate the use of air casters. Fatigue analysis for the transition regions was conducted, as this device has longer transition design compared to previously manufactured IVUs, in order to reduce impedance. ADC, Inc. has obtained all the parts to assemble a 3PW.

SR installation and integrated testing. Installation of the storage ring is currently expected to be completed in June 2013 with the installation of the SR power supplies on the critical path. By the end of November, 130 magnet/girders (83 multipoles and 47 dipoles) had been installed in the SR tunnel. Pulling of fiber optic cables throughout the SR (Fig. 4) is in process. There is an emphasis to complete the HVAC commissioning to allow girder profiling and final alignment to begin.

Figure 4
Front end cable tray

Pentants. In P1**,** the mechanical utility group has completed high-pressure testing of the multipole magnet/girders. Low-current testing in P1 has been completed. Low-current testing of the power supplies in cells 27 and 28 is complete. High-current testing of the power supplies is in process (currently at 50% power). Installation of the FE and straight cable tray at cell 23 is in process. Testing of the PPS interlock A&B chains in P1 is complete.

In P2**,** power supply installation will be completed by December 7. Magnet cable termination in the tunnel is in process. Installation and cable termination of the diagnostic equipment is ongoing, and installation of the D&I SLM hutch (Fig. 5) is in process at 30-ID. Wiring of the SR PPS in the pentant is complete and ready for testing. Parts are being ordered to get the P2 copper DI system drops installed; the drop stand installation is in process. DI water is needed in P2 by mid-January for power supply testing. The P2 PCW has been opened up to the racks. Pressure testing of magnet DI piping on the P2 multipoles is complete in cells 29 through 2; testing of cell 3 is in process.

Figure 5
SLM hutch.

P3 (Fig. 6) is now fully populated with magnet/girders. Surveying of the completed cells is in process. Cable pulling is complete, excluding PPS cables. Bellows installation and vacuum bakeout is in process. Termination of the fiber optic cable in P3 is in process. The installation and cable termination of diagnostic equipment is ongoing. In P4, PCW tie-ins are being tested and flushed. Verification of AC cabling is complete. Installation of the interlock conduit in tunnel is complete. Pulling of vacuum cables is in process. Pulling of magnet cables will start the first week in December. In P5**,** the PPS cable conduit on the mezzanine is complete and is in progress on ratchet walls. AC cabling to racks in process. The testing and flushing of the P5 PCW system has begun.

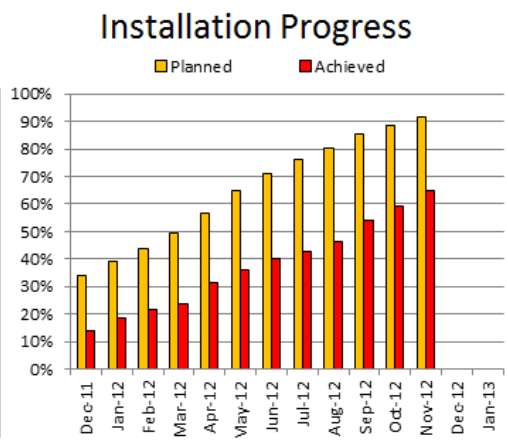
RF building. The AC power tie-in for the cryo system was completed.

Figure 6. SR tunnel in P3 (left), P4 (center), and P5 (right).

Table 1. Installation progress at the end of October 2012.

NSLS-II Accelerator Installation Progress

Achieved	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12
Mechanical Utilities	50%	50%	50%	51%	80%	80%	82%
Electrical Utilities	61%	65%	69%	72%	75%	80%	85%
Magnets	50%	62%	65%	68%	73%	78%	87%
Vacuum	10%	13%	14%	15%	21%	30%	38%
Power Supplies	15%	18%	22%	27%	30%	36%	43%
Instrumentation	27%	31%	38%	36%	37%	46%	53%
Frontends	0%	0%	0%	0%	0%	7%	12%
RF	27%	32%	33%	35%	38%	40%	45%
Inje Straight	0%	0%	0%	0%	0%	0%	0%
LINAC+Booster	27%	33%	42%	55%	74%	82%	92%
Total	**36%**	**40%**	**43%**	**46%**	**54%**	**59%**	**65%**



EXPERIMENTAL FACILITIES

Hutch installation activities continued and the acceptance testing for the first optics hutch in 23-ID has been initiated. A few items were found to be outside the technical specification, and a corrective plan has been submitted by the hutch contractor. Schedule delays associated with the complete assembly of the hutches has resulted in adjusted schedules for utility installations for the beamlines. The beamline groups are presently very engaged in design reviews of specialized beamline optics and instrumentation. These design reviews confirm that the design specifications and requirements will be achieved, and establish the vendor's fabrication, testing, and delivery schedules. Technical, contract administration, and QA representatives from NSLS-II Project visited many of the manufacturers who are fabricating optics and components for the NSLS-II beamlines. The vendors that were visited include FMB-Oxford, RPI, FMB-Berlin, Seso, WinlightX, Zeiss, Bruker, and Crystal Scientific Ltd. The results of these visits indicate a satisfactory overall fabrication schedule status. Overall, the schedules appear to be valid and the original contracted delivery schedules are anticipated.

CHX. The CHX group held the FDR with Bruker GmbH. for the beamline diffractometer. The diffractometer procurement is advancing on schedule for an expected delivery in April 2013. The team has also progressed with preparations for the optics package FDR with Bruker ASC, scheduled for early December. In preparation for an experiment scheduled at APS December 12–19, the CHX team has built and started testing an on-axis sample visualization (OAV) microscope. After the December APS experiment the OAV will be adapted to add the potential for in-vacuum operation and will eventually be a general-purpose instrument in the CHX endstation.

CSX. The full polarization control branch held discussions with the suppliers of the different optics and mechanics packages in order to be ready for the FDR. The toroidal mirror package is the most complicated for this branch and required much attention. The FDR for monochromators was held in the third week of November.

HXN. The HXN team continued to complete the design of mechanical and electrical utilities in the hutches. The team began prototyping controls for the HXN microscope using the power PMAC.

IXS. The preliminary design of the IXS KB Mirror System was well advanced following the October PDR with Toyama. The second part of the PDR on the mirrors and benders mechanism was held on November 15 with WinlightX; this completed all design requirements for the KB Mirror System. The PDR for the IXS FOE Components Package was held at Bruker on November 12–13. Contract negotiation for the IXS spectrometer is in the final stage and contract award is imminent.

SRX. On November 1–2, the preliminary design review of the SRC KB system took place at WinlightX in Pertuis, France, with the participation via video conference of BNL specialists for ESH, vacuum, radiation safety, and utilities engineering. In general, the preliminary design looks very good. For some intended movements of the mirrors, the preliminary design presented by WinlightX even surpasses the required specifications, but other specifications remain to be met. WinlightX continues to work on the design and presented their progress via several additional video conferences throughout the month. Figure 7 shows the design of the mechanical setup for the horizontally focusing mirror in the high-flux KB setup. The requirements here are especially strict, as this mirror has two surface shapes with three reflective coatings each in one body.

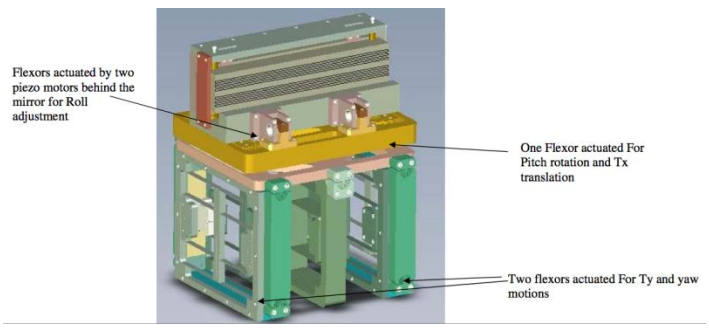


Figure 7: Mechanical setup of the horizontally focusing mirror of the high-flux KB setup.

Figure 8 shows the design of the mechanical setup for the horizontally focusing mirror in the high-resolution KB setup. Here, the difficulty lies in the extremely limited space, so that the mechanical mounts have to be arranged in a right angle around the mounting of the vertical focusing mirror, while fulfilling the stability requirements.

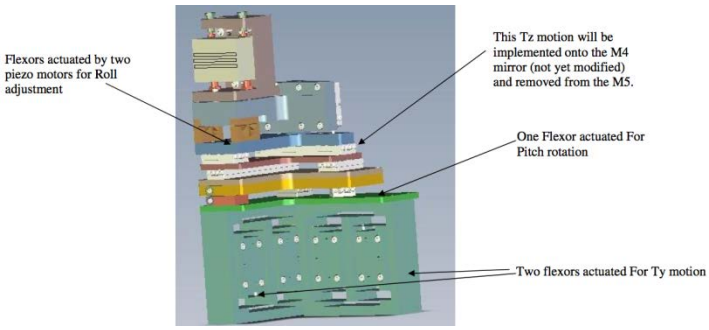


Figure 8: Mechanical setup of the horizontally focusing mirror of the high-resolution KB setup.

Weekly video conferences monitor Bruker-ASC's progress in design of the SRX Beamline Optics Package. With the final design review set for early December, many design details must be addressed. The construction of hutches 5-ID-A (FOE), 5-ID-C (XFN branch), and 5-ID-D (SRX branch) continued under supervision. More deviations from the design originally agreed on have been found and their correction has been discussed. Procurement of parts for the sample stages, interferometers, and the gantry for the detectors is continuing.

XPD. Purchase orders have been placed for a large number of components, including the filter array and the high-resolution monochromator, which will be the first assemblies built, alongside the diamond window assemblies. One of the diamond windows is due from Diamond Materials in January 2013. The build will start in January 2013.

Part 2 of the PDR packet for the Laue-Laue monochromator was submitted in mid November and the PDR is scheduled for the first week in December. Build of Part 1 will start in January 2013. The draft FDR report on Part 2 is due by the end of January, with a goal of achieving final design approval on Part 2 before testing of Part 1 starts in March at Diamond Light Source.

The final design approval for the vertical focusing mirror was sent by the tech rep to Procurement on November 5. The invoice for the FDR milestone was approved on November 14. Surface figuring of the mirror is complete. After measurements of the slope error (Fig. 9), it was determined that specifications have been met.

Figure 9. Tangential height profile of the mirror.

Many components (bender parts, motorization, granite base, pumping system) have been ordered and will be delivered in January. The vacuum vessel is also being fabricated.

The evaluation criteria were finalized for the x-ray photon counting pixel area detector on November 19 and the basis of award and the Request for Proposal package have been completed.

CONVENTIONAL FACILITIES

Conventional construction continued its excellent progress as all three of the five Lab–Office Buildings are complete and have beneficial occupancy, while the core and shell for LOBs 4 and 5 are on track for substantial completion in December. The ring building contractor has completed basic contract work and continues to work through the 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, final 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 February 2013, although they will continue to be available for any warranty work.

Construction of the five LOBs continues to make excellent progress. Base scope construction activities in LOBs 1 through 3, including the HXN area, are now completed. Beneficial occupancy was received for LOB 1 through 3 in October. Office furniture installation is underway in LOB 3 and will be completed in December, enabling move-in of new occupants in early January.

LOBs 4 and 5 are progressing on or ahead of schedule with steel, concrete, and exterior enclosure work completed and system start-up and commissioning in progress. Completion of the project scope for LOBs 4 and 5 is on track for December.

Sitework for the LOBs and the site overall is nearing completion. All major paving is now in place and the final site grading, topsoil distribution, and seeding are completed, although some areas may require touch-up in the spring.

ENVIRONMENT, SAFETY, AND HEALTH

A corrective action plan has been finalized in response to the report of the external, independent reviewers of a beam missteering excursion that occurred at the linac on May 29. Work is underway to implement the improvements identified. Linac commissioning activities have been suspended and will not resume until all necessary corrective actions have been satisfactorily implemented.

Beneficial occupancy readiness evaluations (BOREs) have been completed for LOBs 1, 2, and 3 (including the HXN beamline extension). LOBs 4 and 5 will be completed in the late-December time frame. The BORE process ensures 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. Operational Readiness Evaluations are now being planned for the laboratory space in LOB 3. This process, similar to the BORE, will ensure that all life safety, code compliance, and work planning/controls are in place prior to commencing with laboratory work.

Conventional construction activity continues to wind down, as the ring building and LOBs 1, 2, and 3 are completed except for punchlist work. A roof deck painting job in P 1 is ongoing to correct a paint delamination issue. This job will take an extensive coordination effort between the contractors and ongoing accelerator installation work in the area. The focus of remaining conventional construction is now on LOBs 4 and 5. 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. Overall, the contractor work force totals about 60 persons.

COST/SCHEDULE BASELINE STATUS

The cumulative cost performance index (CPI) for the Project overall is 0.99, and the cumulative schedule performance index (SPI) is 0.95, both well within the acceptable range. The Project is approximately 84% complete, with approximately 43% of contingency and management reserve, based on EAC work remaining.

The Project's current-period "red" schedule variance (SV) with a current-month SPI of 0.81 (-$2.0M) is due primarily to Experimental Facilities Beamlines, WBS 1.4, and Conventional Facilities, WBS 1.5.

The Experimental Facilities cumulative SPI, 0.86, is a decline from the previous month (-$5.6M), conferring "yellow" status. The decreased performance is due primarily to delays in hutch fabrication and installation work, SRX Optics FDR approval, and shutter procurements. These contributed to an overall WBS 1.4 negative SV for the current month (-$1.4M) and an SPI of 0.55.

Conventional Facilities' SPI for November is red, at 0.59 (-$751K); this is due to work deferred in LOB 5. The cumulative Conventional Construction SPI is 0.99 ($-2.0M), "green," due primarily to delays in delivery of standard equipment (office furniture) and deferment of work in the base contract for LOB 5.

In Accelerator Systems (WBS 1.3), there was positive schedule performance this month in several systems (Injection, Storage Ring, and Controls and Safety), resulting in a positive SPI overall of 1.10, +$365K. The cumulative WBS 1.3 SPI has continued to improve, now at 0.90, resulting in green status. The cumulative SV (-$25.4M) shows continued schedule improvement. Accelerator Pre-Ops (WBS 1.6.2, Integrated Test) is slightly behind schedule in the current month (-$241K).

The Project's current-month CPI is green at 0.90 (-$953K) and the cumulative CPI is 0.99, with a cost variance of (-$7.0M), green status. The critical path for the Project remains the same as reported in October and runs 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 with insertion devices. 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 39% schedule contingency.

NEWLY HIRED

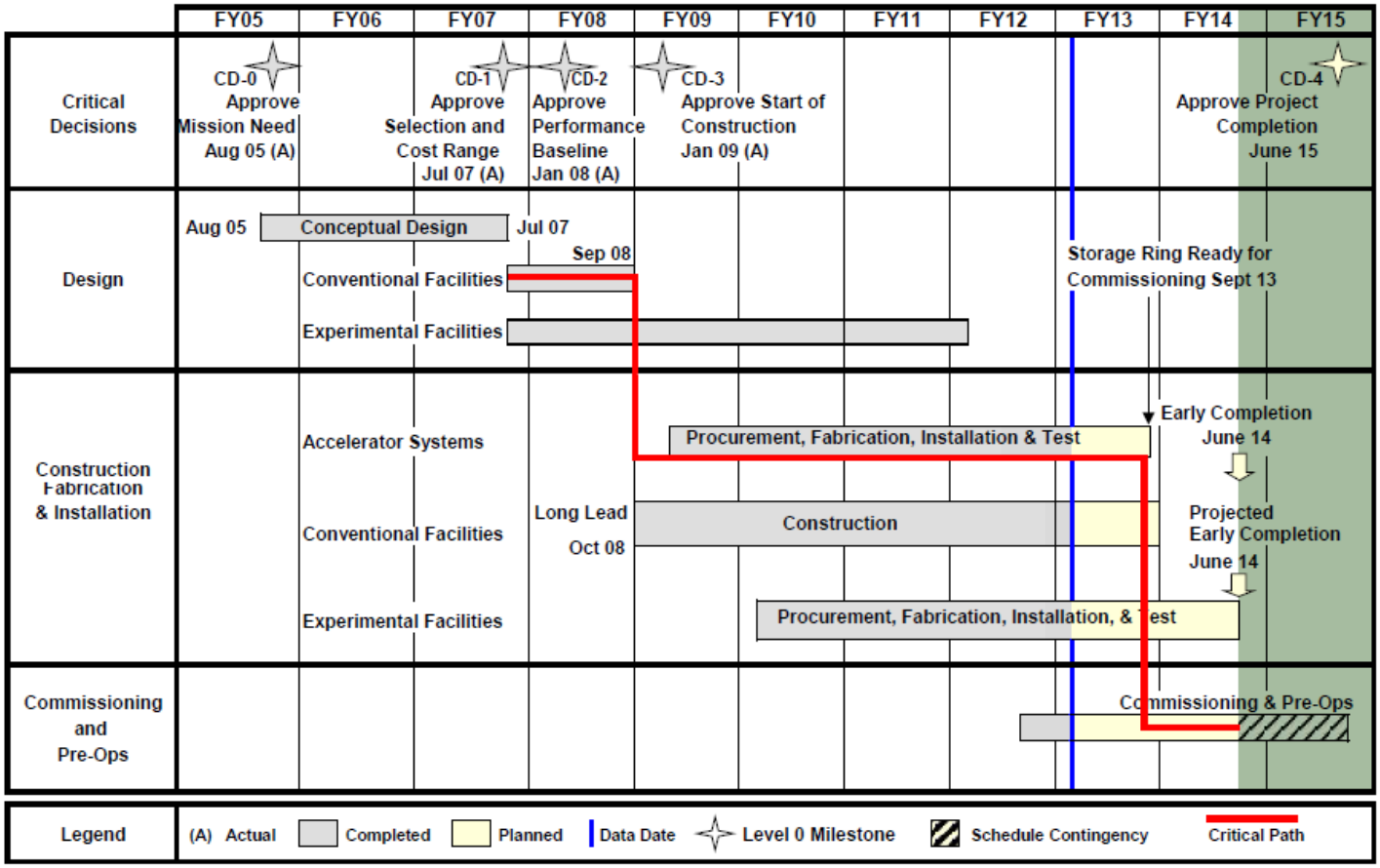
Matthew Vescovi – Electronics Technician – Photon Division

ACRONYMS

3PW	Three Pole Wiggler (magnet)
APS	Advanced Photon Source at Argonne Nat. Lab
ARRA	American Recovery and Reinvestment Act
BAC	Budget At Completion
BORE	Beneficial Occupancy Readiness Evaluation
BPM	Beam Position Monitor
BtS	Booster-to-Storage Ring
CHX	Coherent Hard X-ray beamline
CPI	Cost Performance Index
CSX	Coherent Soft X-ray beamline
DI	Deionized
D&I	Diagnostics and Instrumentation
EAC	Estimate at Completion
EPICS	Experimental Physics & Industrial Control Sys.
EPU	Elliptically Polarizing Wiggler (beamline)
FAT	Factory Acceptance Test
FDR	Final Design Review
FE	Front End
HVAC	Heating, Ventilation and Air Conditioning
HXN	Hard X-ray Nanoprobe beamline
ISA	Injector Service Area
ISR	In-Situ Resonant X-ray Studies beamline
IVMMS	In-Vacuum Magnetic Measurement System
IXS	Inelastic X-ray Scattering beamline
LOB	Lab–Office Building
LN2	Liquid Nitrogen
LtB	Linac-to-Booster
MLL	Multilayer Laue Lens
NEXT	NSLS-II Experimental Tools (beamlines)
OAV	On-Axis (sample) Visualization
P1, P2…	Pentant 1, Pentant 2, etc.
PCW	Process Chilled Water
PDR	Preliminary Design Review
PLC	Programmable Logic Controller
PPS	Personnel Protection System
PS	Power Supply
RF	Radio Frequency
SIX	Soft Inelastic X-ray Scattering beamline
SLM	Synchrotron Light Monitor
SPI	Schedule Performance Index
SR	Storage Ring
SRX	Submicron Resolution X-ray Spectroscopy
SV	Schedule Variance
TL	Transfer Line
XPD	X-ray Powder Diffraction beamline

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	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

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.