

National Synchrotron Light Source II

Project Progress Report

July 2011



Late in July, roofing is staged for LOB 1 and topsoil grading is underway inside the ring. Hidden from view are the dramatic interior transformations.

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OVERALL ASSESSMENT

The National Synchrotron Light Source II project made excellent progress and continued to maintain satisfactory cost and schedule performance. The cumulative Schedule Performance Index (SPI) improved to 0.97 from 0.96 in June and the cumulative Cost Performance Index (CPI) is 1.02. The current month SPI is 1.17, due to excellent progress in the ring building and LOB construction, and improvements in schedule performance by Accelerator Systems.

Construction of the ring building and lab-office buildings (LOBs) continues to be ahead of schedule. With drier than usual weather, the construction productivity in July was higher than expected. Beneficial occupancy for pentant 2 was taken in late July and the injection building is expected to be ready for occupancy in early August. The steel erection for three of the five LOBs is complete, and exterior envelope and interior build-out is progressing rapidly.

Excellent progress was made in most areas of Accelerator Systems during the month of July, resulting in a current period SPI for the Accelerator Systems of 0.97. With all subsystems in full production phase, the final safety-related analysis (such as studies for top-off safety and the storage ring loss control monitoring system) is going through a final review. The linac front-end and modulators were successfully tested at the supplier sites before the scheduled delivery in August. Booster production is also on track to complete various components by early 2012. Magnet production continues to improve, and all magnet types except for the 35 mm dipoles are in full production. Deliveries of components for the vacuum, electrical utilities, and power supply systems are well advanced in order to support the current installation schedule.

Progress continued on the major procurement packages for the six beamlines. The contracts for the lead and steel hutches and the optics package for CSX grating substrates were awarded. A number of optics procurement packages are in various phases, from evaluation of proposals to requests for proposals (RFPs) about to be released. We expect that about 75% of the major procurement packages for the six beamlines will be awarded by the end of calendar year 2011.

The projected early completion date remains at March 2014 and the critical path continues to pass through the 35 mm dipole magnet deliveries, girder assembly and installation, and integrated tests and commissioning of the storage ring. Activities funded by the American Recovery and Reinvestment Act (ARRA) continue to be on schedule and on budget.

UPCOMING EVENTS

2011

Design Validation Review – 2nd Source Quads 9808 & 9812	Aug 30
DOE NEXT Project CD-1 Review	Aug 30–Sep 1
Final Design Review - Booster Storage Ring Transport Line	Sept. 9

ACCELERATOR SYSTEMS

Two reviews with external participation, one on top-off safety analysis and another on the storage ring loss control monitoring system, were held in July. Both reviews supported our overall concept and procedures and provided useful input on details. There were intensive discussions about data storage and retrieval in the IRMIS-3 database. The design of the skew quadrupoles was found to have too large an octupole component and the design is being improved. Procurement is advancing well for the components of the bunch-by-bunch feedback system. Engineering design is advancing for the x-ray diagnostic beamlines.

Injector. Preparations for the linac front-end (LFE) tests have begun, with a goal to start testing in August. The LFE test stand is being completed on schedule. Linac commissioning procedures and sequence documents have been prepared. Linac manufacturing is proceeding as planned, with deliveries on site scheduled for September. The acceptance tests for the linac modulators were successfully performed at the manufacturer’s site.

Significant progress has been made on booster prototype dipole and multipole magnets. Manufacturing is completed and final tests will be completed early in August. The booster project is well on track for completion of manufacturing in January–March 2012.

Production at Stangenes Industries of magnets for transfer lines is delayed. The decision was made to perform magnet measurements at SLAC to expedite deliveries. The statement of work (SOW) for those magnet measurements has been prepared and sent out.

The injector software specification is being finalized, and testing has begun on the linac-to-booster (LtB) transfer line applications on the server. The design LtB is being completed and a bill of materials for in-house assembly of the transfer line has been generated. The date for the design review of the booster-to-storage ring (BtS) transfer line has been set tentatively for the end of August.

Proposals for the storage ring (SR) injection pulsed magnet systems have been evaluated. The decision was made to award a contract for the septum system only and to build the kicker system in-house. Design of the pulser for the SR kickers is being optimized. Semiconductor switches for prototyping have been ordered. Thickness and uniformity of the coating for the ceramic chambers have been worked out.

SR magnets. Storage ring magnet production made good progress in July. Series production for all quadrupole and sextupoles is now underway and good progress was made with all vendors.

The stacking fixture for the dipole magnets has been improved, resulting in a better distribution of pressure over the laminations in the stack. A first yoke has been built with the new fixture, and final assembly of the magnet is in progress. At the end of July some 36% of the magnet production has been achieved (Table 1).

Table 1: Magnet production status as of the end of July.

	Manufacturer	Units to be built	last updated	units Laminations	yokes stacked	machining	coil sets	assemblies	final measurements	shipped	received	accepted	complete
Quad-SC-S-W	Budker	30	7/26/11	30	30	25	30	25	14	12	2	2	78.8%
Quad-SC-S-N	Budker	30	7/26/11	30	30	18	30	9	7	6	2	2	65.0%
Quad-DC-L-N	Budker	30	7/26/11	13	13	6	17	5	5	3	2	2	32.0%
Quad-DC-L-N	Budker	30	7/26/11	13	13	5	17	5	5	5	2	1	32.2%
Quad-DC-S-N	TESLA	90	7/26/11	26	13	10	6	4	4	4	4	2	10.7%
Quad-DC-S-W	TESLA	30	7/26/11	9	8	7	6	2	2	2	2	1	17.3%
Sext-S-S-N	Danfysik	169	7/26/11	60	60	58	57	56	55	52	52	16	32.7%
Sext-S-S-W	IHEP	75	7/26/11	75	44	30	30	30	10	10	9	3	43.4%
Quad-LA	Buckley	60	7/27/11	66	66	20	14	12	10	9	3	3	44.0%
Sext-LA	Buckley	30	7/27/11	34	34	5	9	4	4	3	3	1	40.7%
Dipol-35	Buckley	54	7/27/11	3	3	3	3	3	1	1	1	0	4.6%
Dipole 90	Buckley	6	7/28/11	1	1	1	1	1	1	1	1	0	15.0%
Corr-100	Everson	102	7/27/11	61	61	53	47	43	42	34	34	4	47.4%
Corr-100-SQ	Everson	30	7/27/11	16	16	14	12	12	10	10	10	2	43.0%
Corr-156	Everson	60	7/27/11	42	38	30	27	27	24	22	19	2	50.5%
SUMMARY		826	7/27/11	479	430	285	306	238	194	174	146	41	36.1%

First articles of all components for the multipole power regulator supplies have been received and tested, and full production has been released.

About 25 percent of the power supply interfaces are in house. During incoming testing, we discovered that an unknown condition causes a chip to fail on one of the ADC circuits during power-up; engineers are investigating. The fix is likely to be a simple modification to the existing boards. The layout for the printed circuit

Vacuum. A general review of SR vacuum systems by outside experts was held. Seven chambers were assembled, baked, and vacuum certified this month, bringing the total available chambers to 89. The RFP for the damping wiggler chamber was published and sent to potential suppliers. Layouts for straight sections with and without insertion devices were generated for review. Detailed vacuum layout of the BtS transport line has started, and finite element analysis of four BtS transport line bending chambers was completed. The B2 dipole chamber for the LtB line passed the inspection and vacuum evaluation, making all four LtB bending chambers available for installation. A visit was made to Budker for inspection and assembly onto a magnet girder of the booster first-article arc chamber and other vacuum components.

Seven residual gas analyzers were received and are being tested. All 300 TSP cartridges were received, and 15% of the vacuum gauge controllers arrived. The first 24-zone bake-out controller was delivered and production of the remaining eight units will start in August. Installation of pump controllers and vacuum gauge controllers continues in pentant 1.

Electrical utilities and power supplies. Only one bid was received for the main power; contract award is in progress. The power supply controller (PSC) transition cards for the multipole power supplies have been delivered and are being tested. The production PSC main boards are in production, with production rate falling somewhat short of expectation. Testing of main boards started. Considerable effort has been spent setting up testing systems for all incoming PSC boards. The hardware and software are complete and boards are being tested using the system. The travelers are nearly complete for all the PSC board processing and testing. About 60% of the PSC chassis are in house. All PSC hardware for pentant 1 has been received.

board for the corrector power amplifiers is finished and the pre-production prototype board is fabricated; testing continues. Mechanical design work for this is completed and being reviewed. Procurement package drawings are done and a purchase order is being drafted. The engineering design for the fast corrector power amplifier has been completed and final layout is in progress. Long-lead items for both amplifiers are being ordered. Both of these designs are build-to-print procurements.

The second delivery of power converters has been received. The first units are being installed in racks in pentant 1 (Fig. 1). We now have the power converters for pentants 1 and 2 and the transport lines in-house. About 93% of all 575 equipment enclosures have been received. Rack deliveries should be complete by early August.



Figure 1. Pentant 1 mezzanine with equipment as far as the eye can see.

The production of low precision temperature control chassis is complete and all units have been delivered. A test procedure and traveler have been completed and testing will start next month.

The AC distribution of the computer room needed to be redesigned. The final design requires the installation of two additional 30 KVA UPS units. The cable tray design for the computer room is finished; some parts are in house and others are awaiting delivery. The installation of the pentant 2 cable tray (Fig. 2) will be complete by the end of August.



Figure 2. Equipment enclosures and cable trays in the computer room.

We have received additional UPS units and now have the hardware to equip four pentants in house. All the UPS units for pentant 1 have been installed.

Work continues on implementing the new designs for magnetic field measurement systems that will be needed for inspecting incoming production magnets. A PCR was approved and components have been ordered. The new measurement coil has been assembled for small aperture magnets and is now in calibration. However, work in this area is not progressing as fast as planned. We are using prototype regulators and hardware for the power supplies. Software work to integrate these power supply components into the existing measurement systems has proved very difficult. We are continuing to troubleshoot the new system and to work out hardware and software issues to speed up the measurements. Labor resources with the right expertise are still a factor.

Insertion devices (ID). Production of damping wigglers was delayed in July due to a shortage of permanent magnetic materials, with subsequent delays in procurement and material delivery.

Design work in industry of the EPU is underway and a number of technical issues have been resolved, involving input from the NSLS-II ID group. The RFP documentation for procuring the EPU vacuum chamber is almost complete. The supplier's preliminary design report for the in-vacuum magnetic measurement system has been received. Two types of Hall probe units have been developed for testing the Hall probe bench. The final acceptance tests for the manufacturer-supplied integrated field measurement system were not acceptable. Improvements will be implemented during

installation of the system on site. Three proposals for building the 1.5 m IVU21 in-vacuum undulator (IVU) have been received and proposal evaluation is in progress. The RFP for the IVU20 has been completed and sent out for bids.

Installation. The de-ionized-water piping is complete and insulated. All cells, excluding the girder location opposite the 6-ft. tunnel door, have had girder floor plates installed. Cells 27 and 28 still need to be grouted. The AC cable work is complete. The pulling of the quadrupole, sextupole, and dipole DC cables in pentant 1 is complete, as well (Fig. 3)

In the RF building and in the computer room, cable trays have been installed. Preparations for the transformer installation in the UPS room are completed.



Figure 3. Completed DC cabling for magnets in the accelerator tunnel.

EXPERIMENTAL FACILITIES

Experimental Facilities made good progress in July in the procurement of long-lead-time beamline components. Contracts for the lead and steel hutches were awarded in July to Global Partners in Shielding, Inc. (GPS) in Passaic, NJ. The total package includes nine lead hutches and nine steel hutches. The GPS Project Managers visited NSLS-II to better understand the needs for surveys and installation coordination. A preliminary design review is scheduled for the third week in September and a detailed work plan and delivery schedule are currently being worked out by GPS.

The beamline groups are working on several beamline optics packages. The optics package for the CSX beamline grating substrates was awarded to Zeiss. Bids for the high-heat-load, internally cooled, silicon mirrors for the CSX beamline are currently being evaluated. The RFP for the HXN beamline optics package was released in July with a due date

of Sept. 22, and the RFP for the XPD Laue monochromator was also released in July. Two other optics packages, for the CHX and SRX beamlines, are undergoing final reviews and should be released in August. Work has progressed well on a number of significant procurements, including the IXS optics, CHX diffractometer, and the CSX and XPD beamline components.

In the high energy-resolution optics R&D area, the IXS group made excellent progress in July, achieving <1 meV resolution with very sharp tails and an optical efficiency of 16 to 20%. This is a remarkable result and essentially validated the baseline 1 meV design for the IXS beamline.

The optical metrology group have awarded the contract for the gantry for the nanoradian measuring system (NMS) to Q-sys. This will be delivered to BNL at the start of calendar year 2012.

CONVENTIONAL FACILITIES

Construction of the ring building and LOBs made excellent progress during July and continues to remain ahead of schedule. Ring building pentant 2 (Fig. 4) was turned over to the project in July and beneficial occupancy of the injection building is scheduled for early August. LOB construction continues to gain momentum, as structural steel for three LOBs is now complete and exterior envelope and interior build-out is progressing rapidly. Favorable summer weather, drier than usual, has enabled high construction productivity for the period.



Figure 4. Bypass corridor ramp at pentant 2.

The beneficial occupancy of pentant 2 in early July enables accelerator installation activities to now take place in pentants 1 and 2 and the RF building. The availability of pentant 2 is also important because it provides temporary storage for the ever-increasing deliveries of various production components. Progress on the injection building was better than expected

during July, so the entire injection building will be turned over in early August instead of the two-phase approach previously planned. With August turnover of the injection building, nearly half the ring building space will have been completed sufficiently for ASD to accept occupancy and conduct installation activities. Limited contractor punchlist work remains in the occupied areas and is being coordinated under a work permit system.



Figure 5. HVAC supply duct installed in pentant 5, the last to be completed.

Work on the remaining sections of the ring building continues to progress well. The entire roof system will be completed in August and siding exterior panel installation is now underway in pentant 5. Completion of enclosure of the building is expected during September.



Figure 6. Fittings in the pentant 2 fire protection control room.

Interior mechanical and electrical work is ahead of schedule in pentants 3 and 4 and into pentant 5, including HVAC ductwork (Fig. 5); equipment placement and installation; fire protection (Fig. 6); heating/cooling system piping; and compressed air, nitrogen, and other utility services. Turnover is expected several months early. Completion of exterior sitework, which includes paving, finished grading, and

seeding of the entire site, has begun (Fig. 7), with the majority of this work planned for August and September.



Figure 7. Topsoil finish-graded and being readied for seeding at pentant 2.

PROCUREMENT ACTIVITIES

Proposal evaluations for the steel and lead hutches have been completed. Both contracts were awarded to Global Partners in Shielding, a small business located in Passaic, New Jersey. Seven solicitations were released to FedBizOps in the past four weeks. Most significant were RFPs for the damping wiggler vacuum chambers, the HXN beamline components, and the in-vacuum undulator. Awards should be made in September through early October.



Figure 8. Beamline hutch central exhaust system fans in place at service building 5.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) is 1.02 and the cumulative Schedule Performance Index (SPI) is now at 0.97, both well within the acceptable range. The project is 58% complete, with 27% of contingency and management reserve remaining, based on EAC work remaining. The project current-month CPI is 0.99, green status; the project current-month SPI is 1.17, yellow status.

The project current-period SPI of 1.17 is due to positive schedule performance in Conventional Facilities (1.54 SPI in July), due primarily to excellent performance in the injection building as well as work being performed ahead of schedule in LOB 1. Experimental Facilities continues to perform close to plan on a cumulative basis for both cost and schedule.

The critical path for the project has not changed since last month; the systems on the critical path include: 35 mm dipole magnet deliveries; pentant 5 girder assembly, installation, survey, and alignment; subsystem test diagnostics; EPU installation; integrated tests; and commissioning of the storage ring. The projected early completion date for the project remains at March 2014. There are 15 months of float between the project early completion milestone and CD-4, with approximately 32% schedule contingency.

RECENTLY HIRED

There were no new hires in July.

ENVIRONMENT, SAFETY, AND HEALTH (ESH)

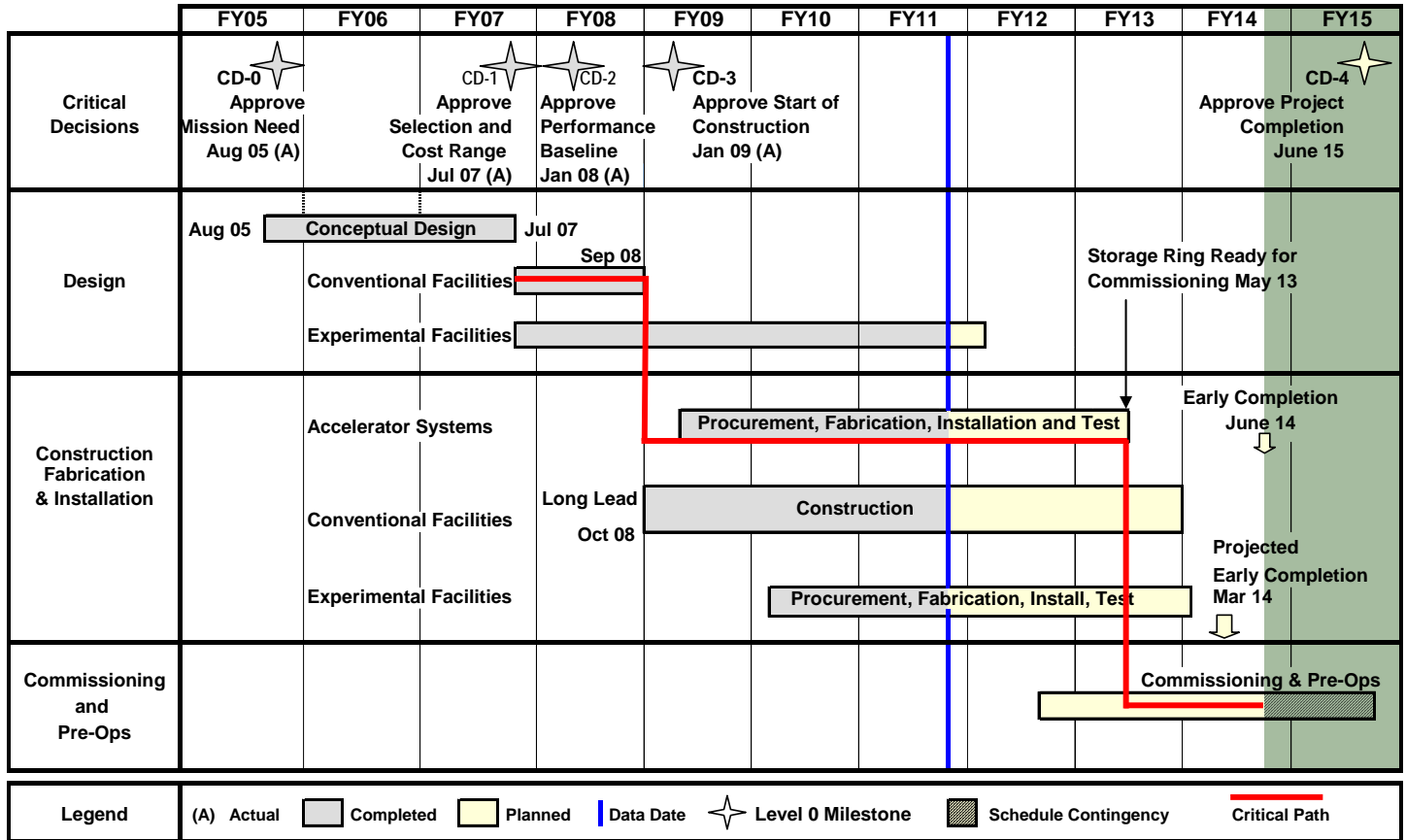
The beneficial occupancy readiness evaluation (BORE) for phase 4, which covers pentant 2, was successfully completed and occupancy was obtained. A BORE for the injection building will be conducted in early August, to support the installation of injection equipment.

The Accelerator Readiness Review (ARR) committee has been selected and all committee members are now on board. The Chair of the committee will visit NSLS-II in August in preparation for the ARR review of the linac, which will be held at the end of the calendar year. Several groups are working on documentation necessary for a successful commissioning ARR, including operational procedures, emergency procedures, and training and qualifications criteria; these tasks are on schedule.

The report on the radiological considerations of NSLS-II shielding calculations has been accepted for publication in *Nuclear Instruments and Methods*.

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

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.