# National Synchrotron Light Source II

# Project Progress Report

## February 2010

Structural steel work had begun in this shot taken February 23.

report due date:
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## OVERALL ASSESSMENT

The National Synchrotron Light Source II project maintained excellent technical progress and satisfactory cost and schedule performance. The DOE Independent Project Review (IPR) was conducted by the Office of Science on February 9–11. Due to a major snowfall, the second half of the review was moved offsite. The review was successfully completed despite this challenge; the committee concluded, *"Overall, the project is being properly managed for its successful execution and has made significant progress since the June 2009 DOE/SC review including staff hiring, conventional facility construction, and significant procurements in process for technical systems. In addition, the project has an excellent cost and schedule performance with robust contingency remaining."*

Despite abnormally cold weather and heavy snowfall in February, construction of the ring building and central chilled water plant expansion continued to progress well. Concrete work continued, completing the ring tunnel slab for pentant 4 and most of the right tunnel walls for pentant 3. Structural steel erection began for the RF and cooling tower buildings and service building 1, achieving a significant milestone. A Request for Proposals (RFP) for the Laboratory Office Buildings (LOB) was issued on February 9.

Progress was excellent in all areas of Accelerator Systems, maintaining its cost and schedule goals. The first sextupole was manufactured and being tested slightly ahead of schedule, and production approvals for five other magnet contracts were granted after rigorous design validation reviews. Production of the vacuum chambers also advances well, and substantial progress was made in remaining areas of vacuum system component production, power supply procurement, BPM electronics testing, and controls system design.

With details of technical scope clearly defined from the beamline conceptual design phase, preliminary design of the six project beamlines is progressing full speed. Excellent progress was made in the hard x-ray nanoprobe satellite building design and a number of R&D areas.

The activities funded by the American Recovery and Reinvestment Act (ARRA) continue on schedule and budget.

## SCHEDULED EVENTS 2010

| | |
|---|---|
| IXS Beamline Advisory Team (BAT) | Mar 23 |
| Data Acquisition and User Interfaces workshop | April 19-20 |
| NSLS-II Accelerator Systems Advisory Committee meeting | June |
| NSLS-II Conventional Facilities Advisory Committee meeting | June |
| Light Sources Scientific Advisory Committee meetings | Summer |
| Magnet Production Readiness Reviews (7) | May-July |
| Timing and Fast Orbit Feedback workshop | July |

## ACCELERATOR SYSTEMS DIVISION (ASD)

The end of February was marked by the first completed sextupole of the NSLS-II magnet production, a "wide" sextupole magnet (Fig. 1). For six of the seven production lines, magnet production has begun, following review and approval by NSLS-II engineers of the design validation reports from the vendors.

The first two dipole vacuum chambers, which were received in January, have been successfully tested, with one chamber treated by ozone to reduce contamination. Three vacuum chambers for the quadrupole-sextupole girder of type "S2-odd" have been completed at APS and are being tested. Meanwhile, the Al-extrusions are in full production. Twenty-one multipole extrusions were received at BNL and are being inspected. The design of the S4A Inconel-625 chamber was finalized and reviewed. The design of the beam transport line bending chambers has started.

The contract for 350 sputter ion pumps has been placed and the production plan agreed upon. The vendor's drawings for ion pumps and titanium sublimation pump manifolds have been checked for fitting with chambers and magnets on girders. The contract for ultrasonic cleaning facility is being placed with a vendor.

The main magnet power supply controls rack has been assembled and performance testing has started. There are 800 DCCT modules (out of a total of 1,850) in house. The system for automatic testing of these devices has been completed. After the final external design review of the equipment enclosures, all procurement documents have been completed and the procurement process can start. The design of power supplies for the beam transfer line is completed.

The system for continuous calibration of BPM electronics has been worked out and implementation has begun. The layout routing for the digital filter electronics (DFE) is completed and all DFE parts are on order. Testing the full chain of the analog filter electronics has been completed, and tests of the clock distribution and calibration section are in progress. A manufacturing problem with the RF BPM buttons has been resolved and production is back on track. Procurement documents for the injector BPMs are done.

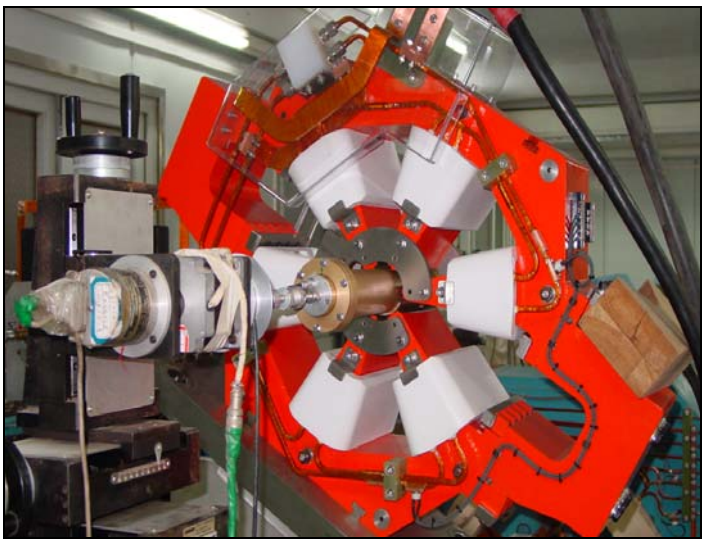


Figure 1: "Wide" sextupole magnet on the test stand, ready for measurement of magnetic field quality.

The instrumentation group also received the first article of the beryllium copper RF shields for rogue mode mitigation. These were tested and the design was subsequently improved. The final production order is in preparation. Two prototypes of a carbon fiber composite vacuum chamber support were developed and ordered. This is considered as an alternative approach to the invar multi-pole chamber supports. Optical components for the Visible Synchrotron Light Monitor have been specified. A re-layout of the optical beamline was carried out to adapt to details of the ring-building.

The Controls group completed various hardware testing, such as tests on digital imaging devices. A wireless network for access to the control system in the tunnel has been designed. Recently completed frontend software development included communication blocks for the BPM cell controller. The core of the interface design is complete and has been simulated and tested. The software can be booted from the flash, ROM, and parallel ports.

The display manager in Control System Studio has been used to build a set of test screens from which a list of required changes was generated. The group deployed an SNS build of Control System Studio with selected clients.

## EXPERIMENTAL FACILITIES DIVISION (XFD)

The Experimental Facilities Division (XFD) made progress on preliminary designs of the six project beamlines in February. One focus area is programmatic scope refinement of the hard x-ray nanoprobe satellite building design. Several design discussion meetings were held in February among XFD staff, CFD staff, and the design architect firm. The building design is aimed at providing an optimized operating environment for the nanoprobe endstation with maximum acoustic isolation and temperature stability. This key element of the nanoprobe beamline design will enable ~1nm spatial resolution for x-ray imaging experiments.

In the beamline controls area, detailed discussions were held to identify hardware and software options for beamline controls. A joint beamline controls working group consisting of staff from XFD, ASD, and NSLS organized several meetings since January, with excellent participations from local NSLS user groups.

In optics metrology, a preliminary plan for design and implementation of a next-generation long trace profiler is being developed, in communications and coordination with other synchrotron facilities in the U.S. A workshop on a slope measuring instrument is being planned at Lawrence Berkeley National Lab to discuss a preliminary design with modular options. NSLS-II will participate in the design and implementation effort, which will lead to a cutting-edge slope measurement device for developing and qualifying beamline optics for NSLS-II beamline and user groups.

In the optics R&D area, the high-precision rail (Fig. 2) has been aligned and inserted into the new Multilayer Laue lens (MLL) deposition system for production of ~1 nm optics.

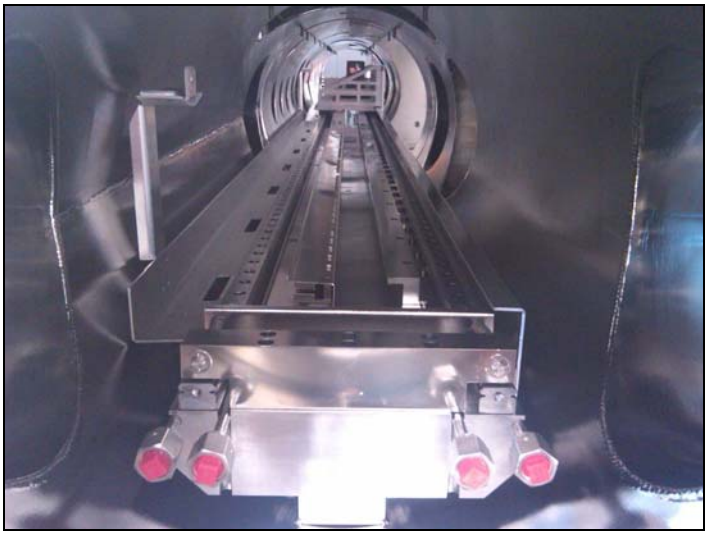


Figure 2: High-precision rail aligned and inserted into the new Multilayer Laue Lens deposition chamber for production of ~ 1 nm x-ray optics.

In MLL slicing technique development, significant progress has been made in using reactive ion etching (RIE) to fabricate MLL optics. In recent experiment runs, an etching depth of more than 6 microns has been achieved for Si/WSi2 multilayers (Fig. 3), showing the promise of this technique.

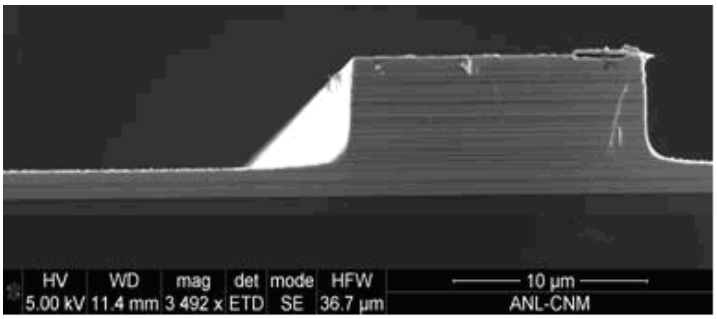



Figure 3: Scanning electron micrograph of a Si/WSi2 multilayer slice sectioned by reactive ion etching (RIE). The etch depth is 6.4 microns.

## CONVENTIONAL FACILITIES DIVISION (CFD)

Construction of conventional facilities continued to progress in February despite continued unseasonably cold weather and major snowfall events. Although some activities were deferred until warmer weather, overall progress continues to be on schedule as the contractor has been able to complete key activities on the critical path.

Concrete work continues to be the primary critical path activity, and progress in key areas was maintained in February. The ring tunnel slab was extended into pentant 4 by utilizing winter mixes and temporary heating techniques. The ring tunnel walls have been extended through most of pentant 3. The ring tunnel roof did not advance in February due to delay in placing the last section of high-density concrete wall. These high-density concrete walls have since been placed and the tunnel roof should progress rapidly in March.

A significant milestone was achieved in February when structural steel erection began. All structural steel has been fabricated and deliveries are arriving at the site (Fig. 4).

Figure 4: The first steel delivery took place on a sunny, dry day.

Erection of steel for the RF and Cooling Tower buildings and Service Building 1 began in late February (Fig. 5) and will be completed in early March. Mobilization of the large crawler crane is planned for early March and will enable the start of steel erection in pentant 1 shortly thereafter.


Figure 5: Steel erection began on the RF Building.

The continued cold weather has limited earthwork and backfill operations. February efforts focused on completing backfill in the RF, Cooling Tower, and Service Building 1 areas to enable positioning of the crane for steel erection. Backfill of the vehicle tunnel and footprints of the LOBs was deferred until warmer weather. This work is expected to resume in March and be completed during April.

Installation of utilities was slowed by February's weather, but much of this work was ahead of schedule so the impact is minimal. Electrical ductbanks are now completed to the locations of the RF and Injection buildings and Service buildings 1 through 3. The steam and water services piping in the utility tunnel is nearly complete. Installation of chilled water piping outside the ring and the various piping services in the inner ring courtyard will begin in March.

The electrical substation expansion continued, with interior work in Building 603 during February. The 15kV switchgear has been positioned in the equipment lineup, and fit-out of the gear is underway. Conduit from the gear to the transformer yard and from the gear to the 15kV ductbank has been installed. With the arrival of better weather in March, exterior work in the transformer yard will begin.

Figure 6: Injection Building foundation work progressed in February.

The expansion of the Chilled Water Plant continues to progress well. Steel erection is complete and the steel decking is in place. Placement of the composite concrete deck for the first and second floors is scheduled for the first week of March. Piping in the basement (the majority of project piping) is nearly complete. The cooling tower basins have been poured and the cooling tower steel structure has been erected. Foundations for the pumphouse are in place. The chillers have been fabricated, and witness testing and acceptance at the factory have been completed. Delivery and installation of the chillers will likely take place in April. Overall progress on the chilled water plant continues ahead of schedule.

## COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) changed slightly, from 1.03 to 1.04, and the cumulative Schedule Performance Index (SPI) continues to remain at 0.99 for the third consecutive month. Both cumulative indices have green status and are well within the DOE acceptable range.

CPI for the month is 1.20 (yellow status), due to a correction of an error in the accrual for the chilled water plant. The monthly SPI is 1.15 (green status), due primarily to the completion of six Design Validation Reports for the storage ring magnets which were scheduled for previous months, as well as the additional vendor receipt of raw materials which had been planned for January. The critical path remains the same, from conventional construction through storage ring installation, test, and commissioning, with early completion in February of 2014.

## ENVIRONMENT, SAFETY, AND HEALTH (ESH)

Radiological analysis for the supplementary shielding at high beam loss locations inside the accelerator enclosures is continuing. Supplementary shielding analysis for the linac beam dumps, booster beam dump, injection, and extraction septa has been completed and is in an advanced stage of engineering design. The ratchet wall shielding and the ratchet wall collimator shielding for six project beamlines has been designed and sent for pricing options. FLUKA Monte Carlo simulations for the injection scrapers to determine additional shielding required at the scraper locations is ongoing. Radiation dose that would be released during a hypothetical top-off injection accident (when injected beam comes down to the first optics enclosure of the beamlines) has been calculated using FLUKA simulations. Based on these, top-off injection interlock options were recommended to the top-off task force.

## RECENT HIRES

Paula Callejas-Lynn – Administrative Services Assistant, ASD

Frank DePaola –Manufacturing Engineer, Mech. Engineering, ASD

Charles Kitegi – Assistant Physicist, Insertion Devices, ASD

Ajesh Prabhu – FPGA Engineer, Diagnostics & Instrumentation, ASD

Vladislav Ruchinsky – Staff Engineer, Insertion Devices, ASD

Xianbo Shi – Research Associate, XPD Beamline, XFD

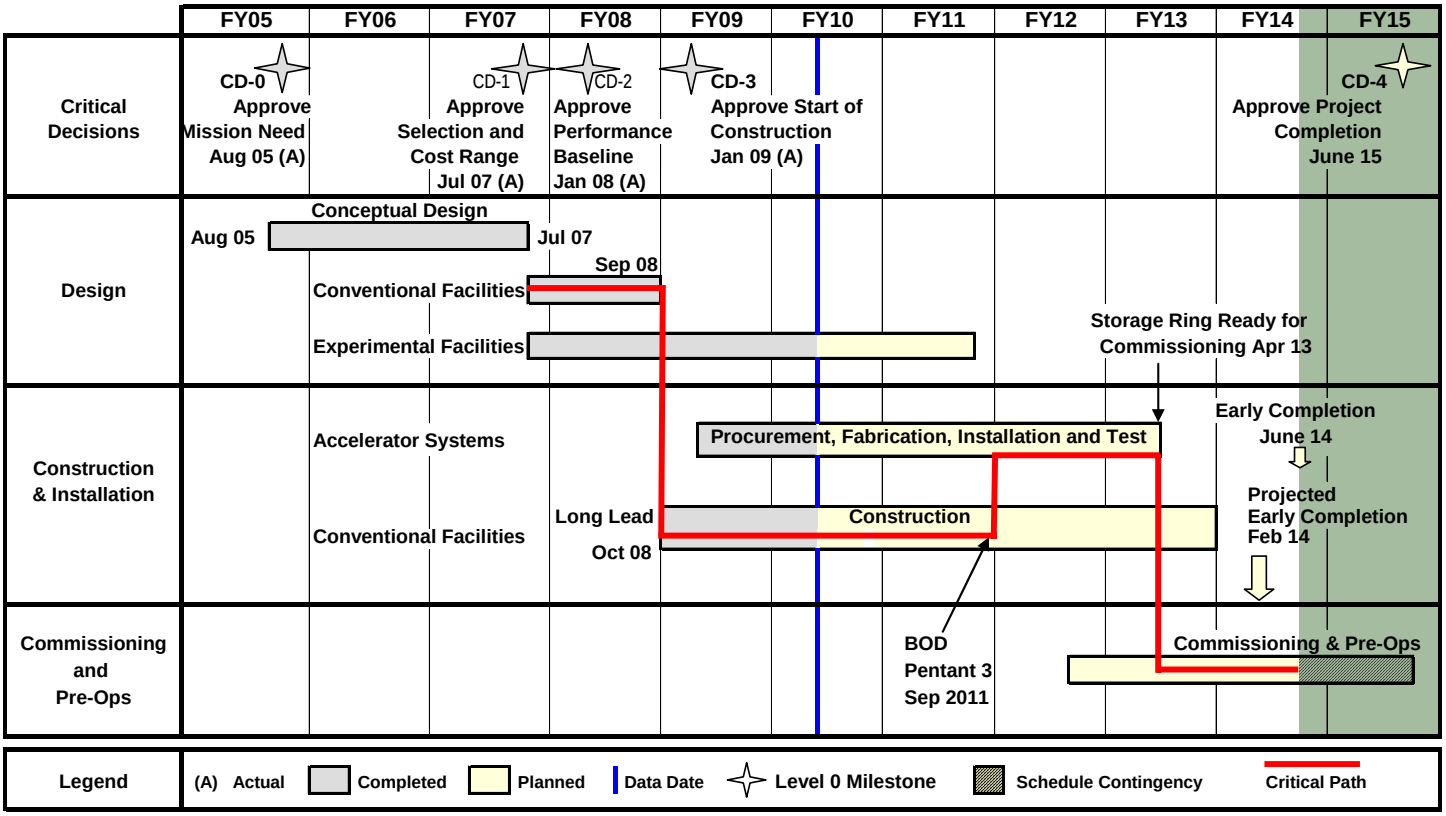
## RECENT PROJECT ACCOMPLISHMENTS

- The first NSLS-II sextupole was completed.
- The first two dipole vacuum chambers have been successfully tested.
- Three vacuum chambers for the quadrupole-sextupole girder have been completed at APS and are being tested.
- The main magnet power supply controls rack has been assembled and performance testing has started.
- Nearly half of the 1,850 DCCT modules have been delivered.
- In the optics R&D area, a high-precision rail has been aligned and inserted into the new Multilayer Laue Lens deposition system for production of ~1 nm optics.
- Structural steel erection began. All structural steel has been fabricated and deliveries are arriving at the site.
- Steel erection for the Chilled Water Plant is complete.
- The ring tunnel slab was extended into pentant 4 and the ring tunnel walls have been extended through most of pentant 3.
- Electrical ductbanks are now completed to the locations of the RF and Injection buildings, and Service buildings 1 – 3.

## PROJECT DESCRIPTION

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




### Key Personnel

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|---|---|---|---|
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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:
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