National Synchrotron Light Source II

Project Progress Report

March 2010

Erection of structural steel for pentant 1 progresses rapidly as the form and scale of the Ring Building take shape.

report due date:
April 20, 2010

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OVERALL ASSESSMENT

The National Synchrotron Light Source II project continues to be on schedule and on budget with excellent technical progress and satisfactory cost and schedule performances. The schedule performance has slightly improved from 0.99 in February to 1.00 in March.

The project has closed out all corrective actions from the injury that occurred at the ring building construction site on September 2009 and the revised safety incentive program has been approved and implemented, which will flow down a larger portion of the safety incentive to workers in the field.

To solicit ideas and proposals from the scientific user community for the next round of experimental facilities to be implemented at NSLS-II, a Call for Beamline Development Proposals was issued in March. New technical and beamline development and user access policy documents were finalized and published. An informational meeting is being planned for mid April 2010 to communicate these new developments and respond to questions and comments from the community.

With warmer weather, despite two major storm events in March, construction of the ring building and central chilled water plant expansion continued to be slightly ahead of schedule. Concrete work picked up the pace and structural steel erection is progressing rapidly. The installation of underground utilities is beginning to accelerate and the mobilization of the chilled water piping contractor has begun.

Excellent progress continued in all areas of Accelerator Systems, maintaining its cost and schedule goals. The linac contract is ready to be awarded under budget and three solid proposals were received for the Booster RFP. Production activities for magnets, girders and components for the vacuum system started to ramp up and substantial progress was made in remaining areas of the power supply, electronics, and controls systems.

Preliminary design of the six project beamlines progressed steadily and excellent progress was made in high spatial resolution optics R&D and optics metrology.

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

SCHEDULED EVENTS 2010

Data Acquisition and User Interfaces workshop	April 19–20
Scientific Computing at Modern Synch. Facilities workshop	April 21
Beamline Development workshops	April-June
Magnet Production Readiness Reviews	May–July
Radiation Safety workshop	June 22–23
Timing and Fast Orbit Feedback workshop	July
BNL Light Sources Scientific Advisory Committee meeting	Aug 12–13
DOE Mini-review of NSLS-II	August
NSLS-II Conventional Facilities Advisory Committee meeting	September
NSLS-II Accelerator Systems Advisory Committee meeting	September
DOE Review of NSLS-II	Nov 16-18

ACCELERATOR SYSTEMS DIVISION (ASD)

During March, the last of the seven magnet contracts was released for the production of the first article after completion of its design validation review. IHEP has produced the first sextupole magnet but its field quality was found to be unsatisfactory. Further analysis showed that this field quality issue was correlated to mechanical imperfections and can be fairly easily avoided. The productions of the first articles at other magnet contractors are also underway. Figure 1 shows a quadrupole coil ready for vacuum impregnation at Budker Institute of Nuclear Physics (BINP).

Figure 1: Quadrupole coil ready for vacuum impregnation at BINP.

The contract for the girder fabrication was awarded and the production has begun. First articles are scheduled to arrive at BNL by the end of April.

The parts for the test setup of the deionized cooling water systems have been received and the system is being assembled in Building 902.

The conceptual design of the transfer line magnets was completed and design work for the transfer line vacuum system has begun. The measurement technique for high-precision pulsed magnets has been developed in collaboration with BINP. The thyratron for the booster extraction kicker pulser has been procured and the conceptual design of vacuum elements in the injection straight section was also completed.

Six S2 type vacuum chambers were produced and three were delivered to BNL for inspection. The contract for vacuum ion pumps was awarded and production has begun. Prototype S4A Inconel chambers were procured and prototype titanium sublimation cartridges and power supplies were tested together with long cables. The contract for the ultrasonic cleaning facility was also placed.

A high percentage of bi-metallic flanges were found to be out of tolerance, which resulted in leaks at the bonding interface. The vendor was visited to resolve these issues.

Extensive testing on the main dipole power supply (PS) electronics has been carried out. The main controller board

layout for the multipole and corrector power supplies is complete and ready for fabrication; this concludes the most important PS design task. The backplane is being assembled in house, and the transition boards are out for fabrication. A prototype for the fast corrector power amplifier has been tested and meets all requirements. Two prototype regulators have been modified for operation of the fast corrector using shunt resistors instead of DCCTs. Preliminary tests have shown that the design will achieve the >10 kHz bandwidth that is required to minimize the phase shift of 4 degrees at 1 kHz (see Fig. 2 for the test setup). Work has finished on the construction of a system to inspect incoming 200-Amp DCCTs. To conform the accuracy of the calibration system, 20 devices have been checked multiple times. Reproducibility is below a ppm for most devices. The temperature stability of the test environment is $\pm$0.1°C. About 1,200 DCCT modules (60%) are already in house.

Figure 2: Test setup of Fast Corrector Power Supply.

The RFP for the equipment enclosures was published. Considerable effort was spent on electrical utilities to verify that the building contractor's drawings for the storage ring and injector are consistent with ASD plans for cables, penetrations, cable trays, and AC supplies. The one-line diagram for the injector complex AC power has been modified to reflect the increased power requirements needed for the booster-to-storage ring transport line power supplies.

The controls group implemented controls for a number of beamline elements of the test stands for X7A and X16A, and performed integrated hardware testing. Another hardware test was performed on an Agilent Acqiris fast digitizer, which was shown to work well at a maximum sampling speed of 8GS/s. It is ready for the Fast Current Transformer (FCT) test stand.

The controls and instrumentation groups are working closely on interfaces between hardware and the controls system. A particular focus is the digital front end (DFE) board for the in-house beam position monitor (BPM) electronics. The core of the synchronous device interface (SDI) design is complete, having been simulated and tested on the ML507 and the ATCA board at 5 GHz (the stretch goal). The SDI is the deterministic, redundant communication link that sends 10KHz data from the BPMs to cell controllers, and between all cell controllers. The DFE has a single-channel event receiver to provide event triggers and global data, such as time stamp, machine mode, and machine protection status. This has been tested with the event generator. Tests show full functionality and less than 10 psec jitter on the event decoding. This allows the direct connection of the event generator to each cell controller and BPM. The Modbus TCP/IP communication protocol is implemented. This allows data from the DFE board to be communicated into EPICS via the Gigabit Ethernet port over TCP/IP. The engineering tool set "Control System Studio," an application development tool, has been evaluated and improved. The first issue being addressed is to provide a robust build environment that allows independent source/ release control and building of updated packages.

EXPERIMENTAL FACILITIES DIVISION (XFD)

Preliminary design for the six project beamlines progressed steadily in March 2010. For the hard x-ray nanoprobe (HXN) satellite building, a preliminary design (Fig. 3) was finalized based on a series of design and value-engineering discussions among staff from XFD, CDF, and the A/E firm. The goal is to provide a vibration-isolated working environment for the ultrahigh-resolution x-ray microscopy that will enable ~1nm spatial resolution for a variety of x-ray imaging applications.

Figure 3: External view of a preliminary design of the hard x-ray nanoprobe satellite building to house the remote endstation for ~1nm imaging located at ~100 m from the undulator source.

The beamline advisory team (BAT) for the inelastic x-ray scattering (IXS) beamline met in March to review progress in R&D and in beamline designs. The BAT expressed their enthusiasm for the finalized conceptual design of the IXS beamline and for the recent R&D result in energy resolution measurement conducted at the X16A beamline at NSLS. A prototype ~1meV spectrometer design (Fig. 4) was presented to the BAT at the meeting. The prototype will be used to test a ~1meV CDDW/CDDW spectrometer at a third-generation synchrotron facility. The BAT also made several helpful recommendations to improve the design of the prototype and

to improve collaborations with other synchrotron facilities on the topic of ultrahigh-energy resolution optics R&D.

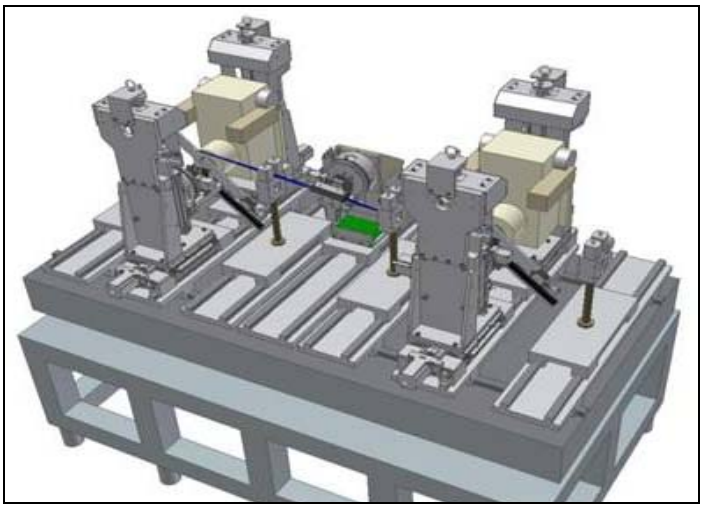


Figure 4: Schematic design of a prototype CDDW/CDDW spectrometer for inelastic x-ray scattering (IXS) with ~1meV energy resolution.

In high-spatial-resolution optics R&D, the commissioning of the new multilayer Laue lens (MLL) deposition chamber started in March. A series of periodic multilayer samples were grown in the new deposition chamber as part of the commissioning. Initial reflectivity measurement (Fig. 5) indicate excellent layer quality during the deposition process, although further tests for thicker films and for high-resolution layers are still to be performed.

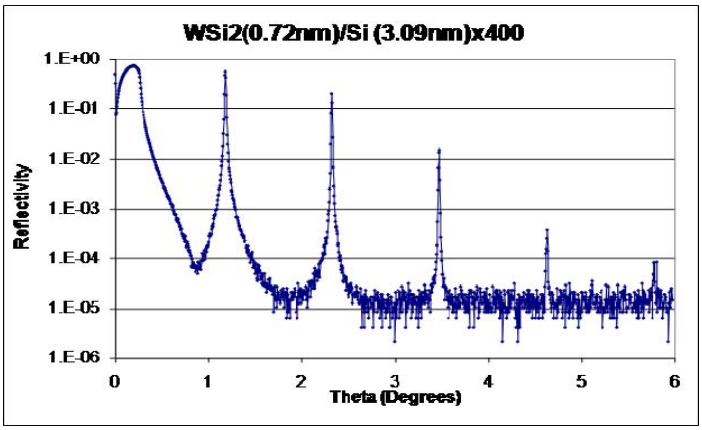


Figure 5: Initial measured reflectivity curve on first set of test periodic multilayer samples deposited using the new deposition system that is being commissioned for ~1nm optics R&D at NSLS-II.

In optics metrology, NSLS-II participated in a joint workshop held at Lawrence Berkeley National Laboratory to discuss a preliminary plan for design and implementation of a next-generation long-trace profiler with modular options. Meanwhile, the existing metrology tools (a Fizeau interferometer, atomic force microscope, and phase-shifting stitching interferometer) were used by the IXS group to test a prototype L-shaped double mirror system that was delivered in early March. Results indicated satisfactory performance.

CONVENTIONAL FACILITIES DIVISION (CFD)

The pace of construction accelerated in March, as the ground thawed and warmer weather arrived. However, this acceleration was tempered by two major storm events (nor'easters) that delayed some work activities due to flooded work areas and muddy conditions. Nevertheless, substantial progress was made and the conventional construction activities continue on or ahead of schedule.

The primary critical path activity is concrete, where substantial progress was made in March (Fig. 6). The storage ring (SR) tunnel slab was extended nearly to the end of pentant 4. The SR walls were completed through most of pentant 3, and the last of the high-density concrete sections were completed as well. Completion of that final high-density wall section enabled work on the SR tunnel roof to be completed through all of pentant 2. Additional concrete was completed for service building 2 foundations and the start of foundations for service building 3. Building footings for pentant 5 were prepped and will be poured in April.

Figure 6: Concrete work for the storage ring tunnel.

Structural steel erection began in late February with the RF building, cooling tower building, and service building 1. The steel supports for these buildings are now complete and the focus has shifted to pentant 1 (Fig. 7). The crawler crane has been set-up and erection of pentant 1 steel and roof joists is progressing rapidly, as seen on the report cover photo, taken March 31. The lobby structure has also been completed. Overall, steel erection is about 1 month ahead of schedule.

With better weather and the arrival of more trades on site, the installation of underground utilities is beginning to accelerate. The steam and condensate system installation has progressed well into the inner courtyard of the building, and preparations to form and pour the substantial concrete manholes for the steam system are underway. Chilled water piping has been installed in the outer loop and into the vehicle tunnel, and will be into the inner courtyard in April. Electrical ductbank installation continues, with services being run to the service buildings in the inner courtyard. Work on the electrical substation expansion continues: the interior of building 603 is being modified to accommodate the new

switchgear, cabling, and conduit. The transformer yard is being prepped to receive the new transformer, scheduled for delivery in June. The major outage needed to tie the new transformer into the utility grid is scheduled for September.

Figure 7: Steel erection for the RF building in early March, near pentant 1.

The chilled water plant expansion is making excellent progress and continues ahead of schedule. Steel erection is completed, the composite concrete decks are all in place, the roof is completed, and the building enclosure is proceeding rapidly. Piping in the basement pipe tunnel is nearly finished, condenser water pumps have been mounted in position, and building equipment is beginning to be installed on the upper floors. Cooling tower cells are ready for the delivery and installation of the cooling towers in early April. The chillers are ready for delivery and installation, and the building should be ready for chiller installation in late April or early May.

The chilled water piping contractor is continuing to mobilize to begin piping installation; however, several special fittings are still on order and have delayed the start of installation. Receipt of the fittings is expected in April and work will be completed well before it is required.

The LOB procurement is nearing completion. Proposals are due the first week of April. The level of interest among contractors continues to be high. Proposals are expected from six to eight firms and, given the current construction market conditions, competitive pricing is likely.

PROCUREMENT ACTIVITIES

Three supplier responses to the booster solicitation were received on March 30 and are currently in review and evaluation by the Source Selection Board. Award of the contract is anticipated in mid May. All magnet first articles are currently in production. The Laboratory–Office Buildings solicitation response date was extended to April 6, due to the volume of offeror-generated requests for information. Award of this contract also is anticipated for mid May. The linac proposal evaluations were completed, with final contract award pending Laboratory and DOE approval.

COST/SCHEDULE BASELINE STATUS

The cumulative Cost Performance Index (CPI) has remained the same at 1.04, and the cumulative Schedule Performance Index (SPI) has improved to 1.0. The overall project cumulative schedule variance is only $200K behind, with a positive cumulative cost variance of $8.6M for the project. Both cumulative indices have green status and are well within the DOE acceptable range.

The current-month CPI for the project is 1.09 (green status). The current-month SPI is 1.11 (green status), due primarily to significant progress made in construction of the ring building pentants and in underground mechanical utilities in March.

The negative current-month schedule variance for ASD is small, due to additional materials and design validation reports received in March for SR magnets planned previously.

Thirteen PCRs were processed and implemented in March.

ENVIRONMENT, SAFETY, AND HEALTH (ESH)

The project has closed out the final three corrective actions from the injury that occurred at the ring building construction site on September 2009. A third construction safety engineer was hired and scheduled to start in April. An assessment of the contractor's suspect/counterfeit parts program was completed. The safety incentive program that was approved by DOE was flowed down to the workers in the field.

Three radiation monitors have been purchased and installed on the NSLS experimental floor for evaluation during calendar year 2010. These instruments are being connected to the local area network to permit online record-keeping and observation of their performance**.**

Supplementary shielding analyses for the linac/booster injection shutters, linac beam dumps, booster beam dump, injection, and extraction septa have been completed and are in an advanced stage of engineering design. The ratchet wall shielding and collimator shielding for six project beamlines have been designed and are ready for procurement.

FLUKA Monte Carlo simulations for the injection scrapers have been summarized to determine the additional shielding required inside the storage ring. FLUKA simulations for the top-off injection have been completed and a document is being prepared. Based on the simulations, top-off injection interlock options have been determined.

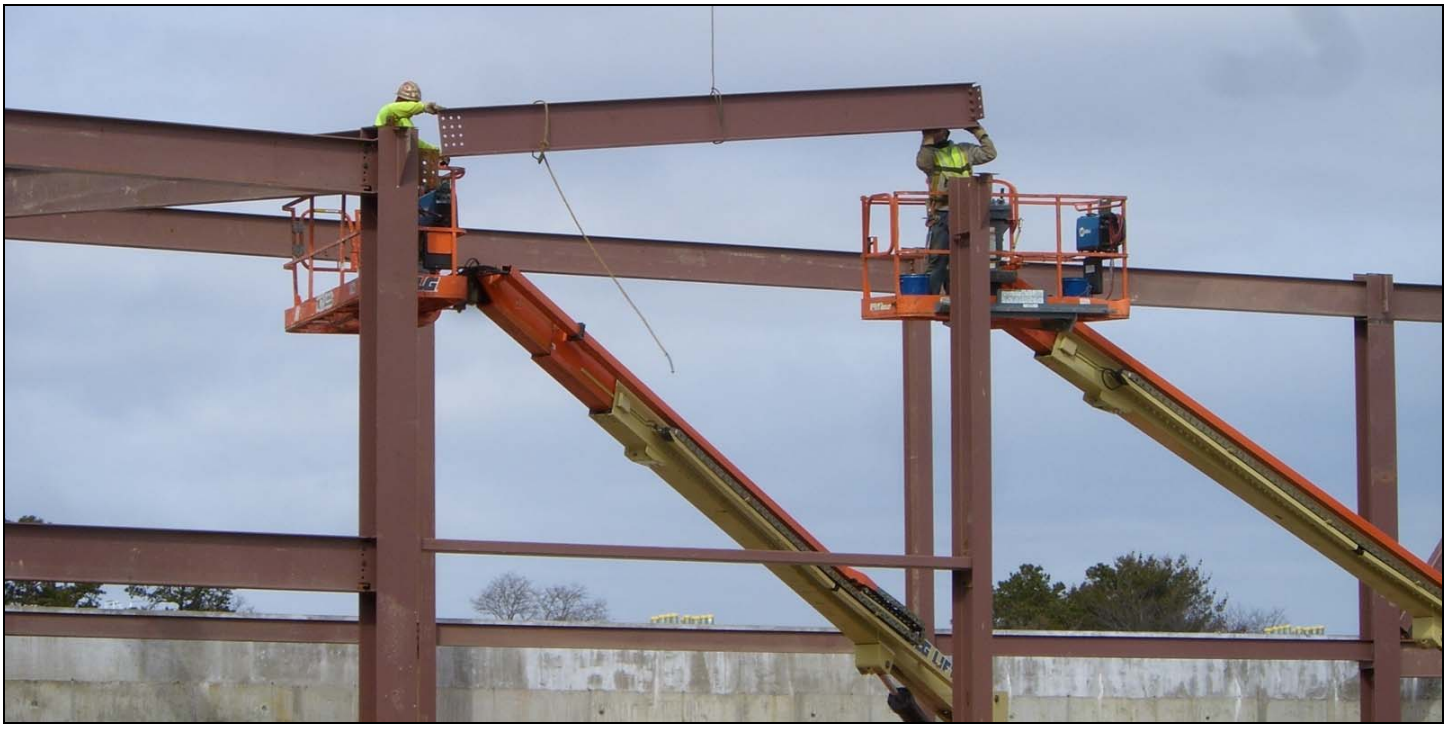
A radiation safety workshop is planned for the last week in June. Radiation safety professionals from SSRL, ALS, and ESRF have been invited to participate.

RECENT HIRES

James Grandy – Mechanical Technician, Vacuum Systems, ASD
Brian Henenveld – Construction Safety Engineer, ES&H
Brian Holub – RF Engineer, RF Systems, ASD
Wayne Lewis – Controls Engineer, Controls, ASD
Jonathan Louis – Student Asst, Enterprise & Sci Computing, PSD
Charles Weilbrenner – Quality Analyst, Quality Assurance

RECENT PROJECT ACCOMPLISHMENTS

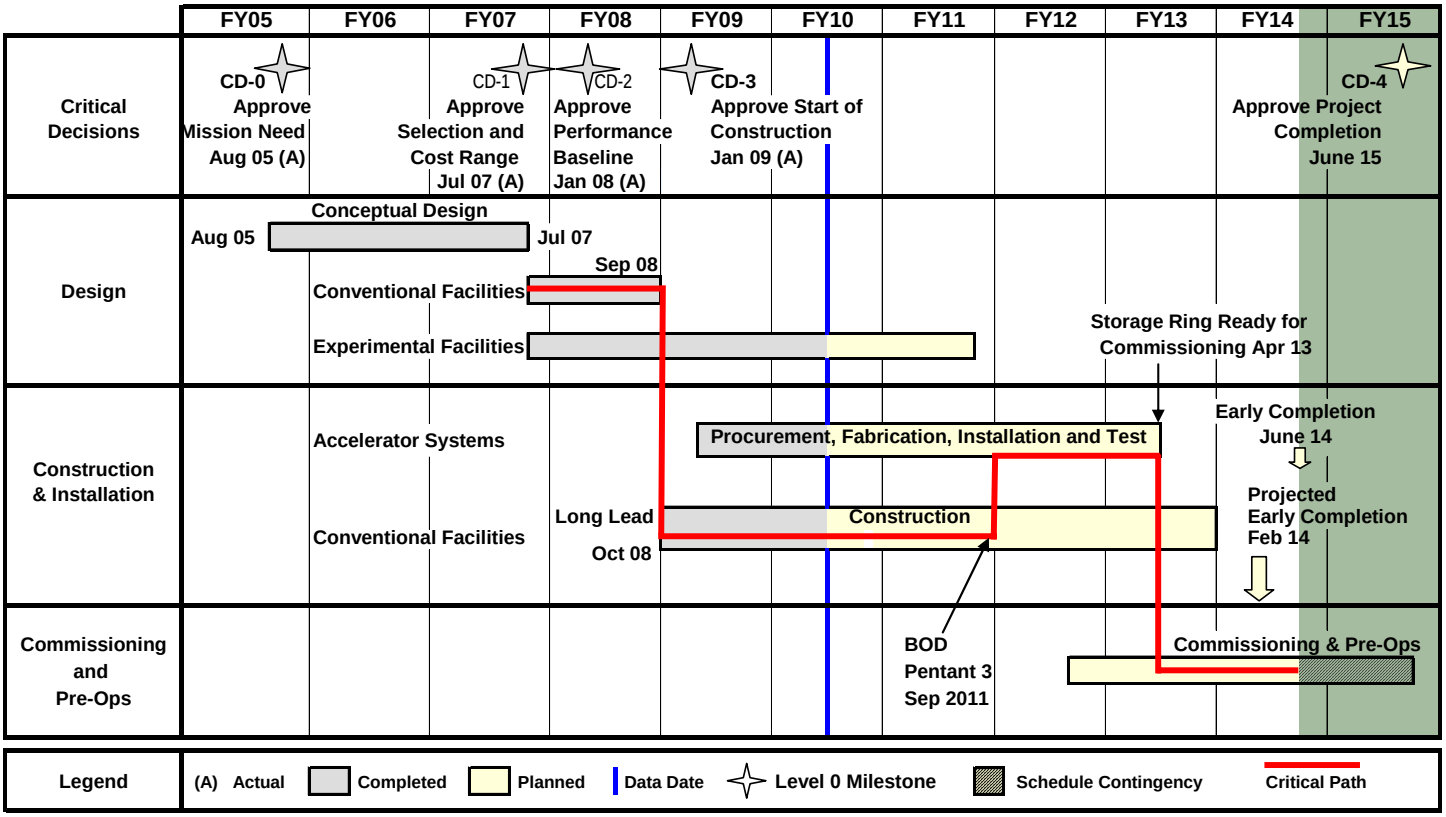
- In critical-path concrete work, the storage ring tunnel floor slab was extended nearly to the end of pentant 4. SR walls were completed through most of pentant 3, and the last high-density concrete sections were completed, enabling work on the SR tunnel roof to be completed through all of pentant 2.
- Sitewide, steel erection is about 1 month ahead of schedule. The chilled water plant expansion project continues ahead of schedule.
- Three booster RFP responses were received and are being evaluated by the Source Selection Board. The linac proposal evaluation was completed.
- All magnet first articles are in production.
- The contract for the girder fabrication was awarded.
- Conceptual design of the transfer line magnets was completed.
- The measurement technique for high-precision pulsed magnet measurement has been developed. The thyratron for the booster extraction kicker pulser has been procured.
- Six S2 type vacuum chambers were produced.
- The contract for vacuum ion pumps was awarded and production has begun.
- A series of periodic multilayer samples were grown in the new MLL deposition chamber as part of its commissioning.
- All corrective actions from the injury that occurred at the ring building construction site in September 2009 are closed.
- The revised safety incentive program has been approved and implemented, which will flow down a larger portion of the safety incentive to workers in the field.



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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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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