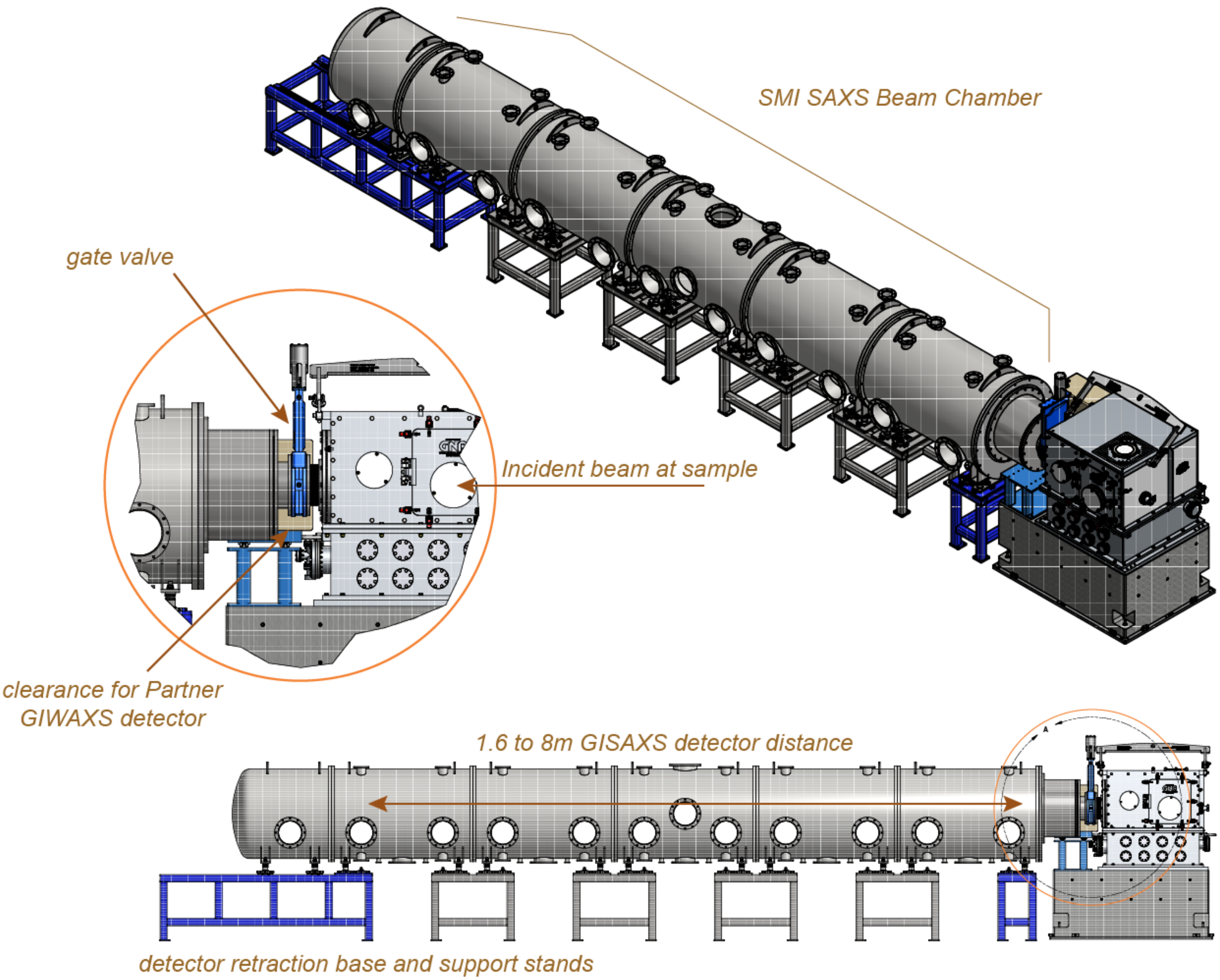
NSLS-II Experimental Tools (NEXT)

July 2015 Project Activity

Report due date: August 20, 2015



Rendering and drawings of the SMI endstation at 12-ID, including the Sample Vacuum Chamber, which houses the sample stages and WAXS hardware, and the SAXS Beam Chamber.

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NEXT Project Manager

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OVERALL ASSESSMENT

During July 2015, progress continued to be made on all phases of the project, including awarding and managing major procurements, finalizing endstation designs, and installations.

Two major procurement contracts were awarded during July, one for the SIX Sample Chamber Vessel on July 2 and the other for the ISS Sample Handling System on July 13. As of the end of July, two major procurements remained to be awarded. Monitoring and management of contractor progress on the 63 major procurement contracts awarded to date is an important ongoing activity, one that is crucial to maintaining project schedule.

Three Level 3 PCRs were approved in July, two related to contract awards or amendments and one adding labor and material, with a net cost increase to baseline of $968K: PCR NEXT_15_092 (WBS 2.08.02, ISS Beamline Systems, -$145K change to baseline) implemented award of the ISS XES Spectrometer contract; PCR NEXT_15_093 (WBS 2.07.02, ISR Beamline Systems, +$30K change to baseline) implemented an amendment to the ISR Gas Handling System contract; and PCR NEXT_15_094 (WBS 2.12.01, .02, .03, ID & FE Installation & Testing, +$1,083K change to baseline) added labor and material needed to complete ID and FE installation and testing.

BAC rose $0.97M in July, to $82.36M. EAC rose $1.17M, to $85.6M. The -$3.20M VAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), consists of $1.99M cumulative cost overage on work performed to date and $1.21M expected additions. The largest contributors to the expected additions are in Common Systems ($0.5M) and in ISS Beamline Systems ($0.6M).

As of July 31, 2015, the project is 54.1% complete (BAC). Cost contingency is reported at $7.64M, which represents 20.2% of $37.8M BAC work remaining. If all of estimated VAC were to materialize, contingency would be reduced to $4.4M, which represents 10.8% of $41.0M EAC work remaining. With outstanding commitments totaling $20.4M, the $4.4M contingency on EAC represents 23.8% of $18.6M unobligated EAC work to go.

A Risk Management Team meeting was held in July to update and track the value and impact of assessed risks remaining to the NEXT project. Two risks were retired: (1) raw material cost risk on ID magnetic materials, now that the EPU contractor has purchased all required magnetic material and (2) risk that ID & FE installation & testing is not funded, now that the estimated funding needed to complete these activities has been added to base scope. The total remaining assessed risk is now $4.56M, consisting of $2.83M likelihood-weighted value of remaining known risks and $1.73M for unknown risks, estimated at 10% of unobligated work remaining.

The cumulative EVMS schedule index rose 0.01 in July, to 0.97. The cumulative EVMS cost index fell 0.02, to 0.96, resulting from a large number of accruals and payments processed in July.

Acceptance testing of NEXT shielded enclosures (hutches) remained at 97% completion in July. Mitigation of outstanding discrepancies in four NEXT hutches is expected to be performed by the contractor in August and September.

COMMON SYSTEMS

NEXT mechanical and electrical utilities finishing work continued in July. SMI utilities are now completely installed, while ESM, ISS, and SIX utilities installations are approximately 95% complete. The installation of utilities in the SIX endstation building is the most significant utilities installation remaining on the project.

PPS design and development is well underway, with a focus on the interlock conduit installation. This month, PPS interlock conduit installation of the A and B chains was completed at SMI, and continues at ISR. Installation of the interlock conduit also started at ISS. Hardware installation at ESM continues this month, with a focus on the integration of hardware. In addition, the PPS team has been developing plans to adapt hutch interface points for compatibility with PPS hardware and the hutch suppliers have been engaged regarding remediation of mechanical interfaces. The majority (90%) of Personnel Protection System (PPS) components have been received. PPS installation work, while being part of one month behind schedule, is now being accelerated as resources previously deployed on ABBIX become available.

The Equipment Protection System (EPS) team is continuing to receive EPS requirements for each beamline, and participates actively in design reviews with vendors so that interface points between EPS and photon delivery components can be understood early. The procurement of EPS components is approximately 80% complete to date, with components continuing to be received as system definition matures. EPS chassis are being assembled and free issued to suppliers for connection and testing prior to delivery. Installation of EPS components is expected to start in late FY15, as beamline equipment is installed.

Control station furniture continues to be received for the NEXT project. Work benches for SMI were received this month. Design and development continues for the SIX end station furniture and equipment.

BEAMLINE CONTROLS

Controls installation continued to make strides in July, with cable pulling continuing at SMI (12-ID) and in the ISS FOE (8-ID-A). Cable termination work is underway in the SIX FOE (2-ID-A), ISR hutch C (4-ID-C), and the ESM FOE (21-ID-A).

With new standard PDUs (power distribution units) now in place to provide power for data storage servers, a network switch has been installed in the 8-ID (ISS) computing rack in preparation for installation and configuration of the ISS data storage server. The same type of PDU has been purchased for the ISR and SMI computing racks, and a purchase order for data storage servers for ISR and SMI was dispatched, with delivery expected in early September. The beamline data acquisition (DAQ) servers and data storage units for ESM and SIX were received in July.

Eight specialized motion controllers that support MACRO mode, used for coordinated motion between different controllers or for support of motions with absolute encoders, have been received. We expect to ship a few such units to vendors for motion testing.

In late July, control engineers attended the FAT for the ISS high heat load monochromator at Toyama.

Working with the ISR beamline scientists, control engineers performed the acceptance test for the ISR Dectris Eiger detector.

In July, NEXT controls hosted an on-site motion control training session led by a controls engineer from Delta Tau. A mix a scientists, engineers, and technicians totaling 10 students attended the 3-day hands-on training. Among other things, everyone was taught to tune the standard stepper motors in closed-loop mode. While the complexities of the controller can be overwhelming at times, the attendees now appreciate the enhanced motion control capabilities provided by Delta Tau controllers and how these can benefit their experiments.

ESM – ELECTRON SPECTRO-MICROSCOPY

ESM activity in July focused on completing some of the final details of beamline construction, all related to non-optics components. A complete layout of the entire beamline, including all optics, diagnostic units, and vacuum components (pumps and valves) was generated and used to detail the designs of all remaining support structures. The supports for beam pipes, vacuum components, and diagnostic units will be assembled from extruded Al pieces to be ordered next month and assembled in September. Progress has also been made in the final design of the endstation support structure: drawings have been completed and sent out to potential manufacturers for quotation. The fabricated parts should be ready for assembly in house by October.

An important final design issue regards that of the sample holders to be used in the μARPES endstation and compatibility with other ultra-high vacuum endstations at NSLS-II and laboratory facilities at BNL. Samples to be studied at ESM are mounted on sample "pucks" that can be firmly positioned on sample manipulators. Sample pucks can be introduced from air into the sample preparation chamber and from this to any of the of four sample manipulators of the ultra-high-vacuum μARPES endstation. These transfers are realized with the help of transfer arms equipped with mechanical claws or forks. The external shape of the pucks facilitates these operations. The pucks are hollow, with the cavity being used for heating elements and/or electrical contacts. The present puck design is the result of many hours of engineering work and represents a synthesis/compromise of different needs. It is a definite step toward standardization of sample holders across the NSLS-II complex – for now all endstations at ESM and SIX beamlines have adopted it – and across BNL – this sample puck design is fully compatible with the OASIS laboratory (ISB) and with the LEEM instrument at CFN. This sample puck design is referred to as the Universal Sample Holder (USH).

As a user facility, the ESM beamline needs to accommodate different types of experiments. This flexibility is obtained by usage of any of five configurations of the USH (see Figure 1):

USH-A: Used primarily for single crystal samples up to 10mm x 10mm and requiring e-beam heating > ~ 450 K. Efficient e-beam heating is obtained at the price of sub-optimal cooling performance, limited by the reduced sample contact area resulting from the central hole on the top face of the puck. Cu versions are for use < ~ 1200 K, while Mo versions are for use for temperatures > ~ 1200 K (Mo versions have even less cooling performance).

USH-B: Used for single crystal samples up to 10mm x 10 mm not requiring e-beam heating. The solid area behind the sample ensures better cooling contact than USH-A. Maximum temperature on these style pucks is ~ 450 K. Apart from the lack of hole behind the sample these holders are identical to the USH-A type holders**.**

USH-C: Used for samples that can be glued. Cooling at the sample is improved as it is a single piece unit however heating is similar to the type USH-B due to the lack of hole behind the sample.

USH-D: Used for "in-operando" measurements. Up to 4 electrical contacts can be made directly to the sample. One of the contacts is via the sample body, one via a contact to the e-beam shield and 2 by a pair of electrical contacts in the plate nut. Sample heating and cooling is compromised in order to electrically isolate the sample from the body. E-beam heating is possible but the small diameter of the hole behind the sample limits heating effectiveness.

USH-E: Used for mounting calibration instruments such as thermal diodes, optic diodes, thermocouples, hall probes etc. onto sample pucks for routine calibration measurements of the manipulators and beamline. These are identical to the type USH-D pucks without extra "trenches" in the puck surface for running cables under the sample.

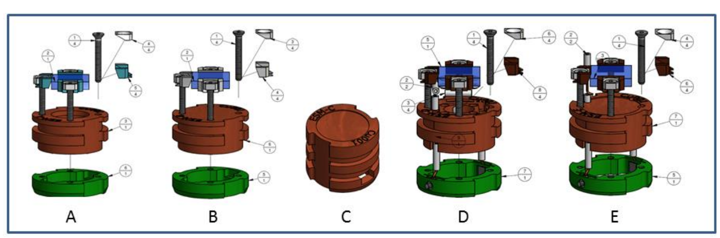


Figure 1: Five configurations of the Universal Sample Holder adopted for use at the ESM beamline, referred to as USH-[A,B,C,D,E].

FXI – FULL-FIELD X-RAY IMAGING

The FXI radiation enclosure (hutch) contract is proceeding on schedule, with final designs complete and fabrication continuing at Caratelli's site. Delivery and on-site construction is expected in September 2015.

ISR – IN-SITU AND RESONANT HARD X-RAY

Purchase orders were placed for high-vacuum slits, a differential pump, the five degree-of-freedom (DOF) table for the *in-situ* endstation, and DAQ, with delivery dates ranging from early September (DAQ) to mid-December (five DOF table) 2015.

The design of the mobile changeover stand, which will support the incident flight path for the 6-circle diffractometer or the downstream beam pipe in 4-ID-C when the *in-situ* endstation is in use, was completed, and the vendor item control drawing was released (see Figure 2). The mobile stand has deployable wheels such that it can be easily removed to provide space upstream of the 6-circle diffractometer for secondary focusing optics or for any other temporary beam conditioning component or diagnostic.

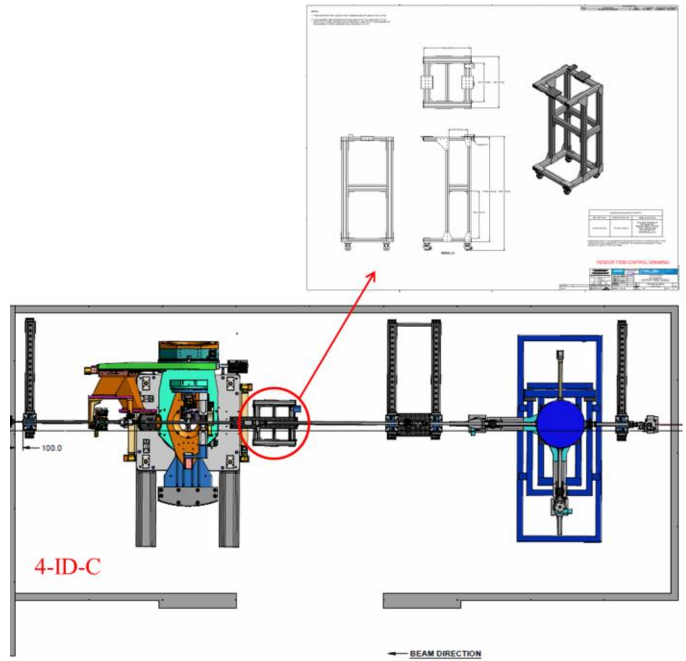


Figure 2: Vendor item control drawing (top) for the mobile stand, and its location upstream of the Instrumented Six-Circle Diffractometer (bottom) in ISR Hutch 4-ID-C.

The Final Design Review for the Instrumented Six-Circle Diffractometer was held on July 10. The contractor, Huber, presented a parking scheme for the diffractometer that will allow for the insertion of a beam pipe to deliver beam downstream to the *in-situ* endstation in hutch 4-ID-D. The design of the in-vacuum polarization analyzer and the 2θ flight path were discussed. These two components must be connected with a rotatable flange, which has not yet been designed. A safe and easy means of removing the polarization analyzer is also required, since it will occasionally be replaced by a standard analyzer 2-circle for high resolution measurements. The design includes provision of a motor kill switch, which will be mounted on the diffractometer and used to stop all motion in order to avoid personnel injury or equipment damage. Final documentation from Huber is expected in mid-August 2015.

The final acceptance tests for the steel hutches, 4-ID-B, -C, and –D were completed in July. In addition, the 4-ID-A hutch contractor corrected the height of the beam pipe penetration location in 4-ID-A by ~3 cm by cutting a hole in the downstream wall and inserting a new interface piece, as shown in Figure 3.

Figure 3: Corrected penetration on the downstream wall of ISR Hutch 4-ID-A.

Gate valves and ion pumps were received and the Dectris Eiger X 1M pixel array detector was successfully tested during July.

Three members of the ISR Team participated in a 3-day training course on the use of the Turbo Programmable Multi-Axis Controller from Delta Tau Data Systems. The course covered motor tuning and programming, including PLC programming. The three ISR Team members gained familiarity with diagnostic tools that should facilitate the testing of beamline components.

ISS – INNER SHELL SPECTROSCOPY

Part 2 of the FAT for the high heat load monochromator package, conducted successfully at the end of the month, was a crucial step in development of the ISS photon delivery system. It marked the transition from fabrication to installation activities. In collaboration with the supplier (Toyama), including two site visits by ISS staff during July, all technical problems, deficiencies in documentation, and all scheduling challenges which surfaced during part 1 of the FAT, were resolved. All dimensional, vacuum, motion, cryogenic, and controls specifications for the high heat load monochromator, all radiation safety components (pink beam stop, and bremsstrahlung stop), and the high resolution monochromator were met and documented using a FAT traveler developed by Toyama with the help of the NSLS-II Quality Assurance team. The system has been disassembled, packed, and prepared for shipment to BNL. Delivery to BNL is expected at the end of September, followed by installation in October.

A level 3 milestone for ISS and a level 2 milestone for the NEXT project were achieved in July with completion of installation of the Gas Handling System (GHS). All gas cabinets, the distribution cabinet including process pump, the mass-flow controller housing, all controls units, all interconnects, and all safety and warning features were installed and ready for testing. Connection to NSLS-II infrastructure and safety systems is underway, with support from the GHS contractor (Applied Energy Systems, Malverne, PA) and BNL ES&H. A view of the ISS beamline showing the installed gas cabinets, some of the inert gas distribution panels, and the gas distribution cabinet is shown in Figure 4.

Through weekly monitoring of the production progress of the directly cooled high heat load mirror, a 3-week slip in the production schedule occurred during the rough polishing step. The vendor (InSync) expects that this delay will postpone delivery of the system by only 2 weeks, with shipping now planned for August 25. The fabrication of this important mirror, as well as four others from this supplier for other NEXT beamlines, is being closely monitored by ISS staff, NEXT management, BNL PPM, and BHSO.

The PDR of the spectrometer package, which will provide two key detection systems for ISS (the spherical backscattering analyzer system (SBA) and the von Hamos spectrometer), was split into two phases. PDR1, held in July at PI-Micos, reviewed all aspects of the spectrometers themselves. PDR2 will focus on the interfaces between these spectrometers and the remainder of the endstation.

The most important outcomes of PDR1 are agreement on the design of the scattering chambers (the hearts of the spectrometers) and on the specifications for the various motion systems required. For the SBA, it was agreed to replace the goniometer/linear stage providing the alignment of the analyzer crystal on the Rowland circle with a double linear stage concept. The new design concept is cost and weight efficient and will allow easy extension to a 5-crystal multi-analyzer system. For the von Hamos spectrometer system, a piezo-driven tip-tilt stage will be used for angular adjustment of the analyzer crystal, allowing active feedback to be used. In addition, a double high-resolution absolute linear encoder system will be used on the top and bottom of the crystal cage to permit differential measurement of the angular variation of this cage as it is translated. This concept permits relaxation of the linear translation stage specifications while achieving an angular precision of 5μrad over a translation range of 0.4m, while also resulting in cost and, importantly, weight reduction. This solution uses feedback to minimize angular changes of the crystal cage induced by changes in the spectrometer. Finally, all motion control systems for both spectrometers were defined, permitting cable and rack layout in hutch 8-ID-B to proceed.

Spectrometer package PDR2 will concentrate on all interface aspects of the spectrometers, with the sample chamber, with other spectrometers, and with other detection systems. PDR2 will also review the design and proposed alignment procedures for the coupling lenses that will provide the virtual source point for the von Hamos spectrometers.

With the transition from production to installation phases of ISS, focus is turning to all integration and control aspects of the beamline. Cable pulling has been completed in the FOE, all controllers have been installed in the FOE racks, and the installation of the network and server infrastructure has started. Installation of PPS conduit began in July and was nearly completed by month end. The EPS control system will be installed by October 2015. Layout of the ISS control station has begun.

Figure 4: View of the ISS beamline between hutches 8-ID-A and 8-ID-B showing major components of the Gas Handling System, from left to right: a server rack, four gas cabinets providing seven fully-automated and two semi-automatic gas delivery points, a stainless steel enclosure housing the process pump and multiplexing gas distribution hardware, and gas distribution panels for two non-toxic gases (CO_2 and O_2).

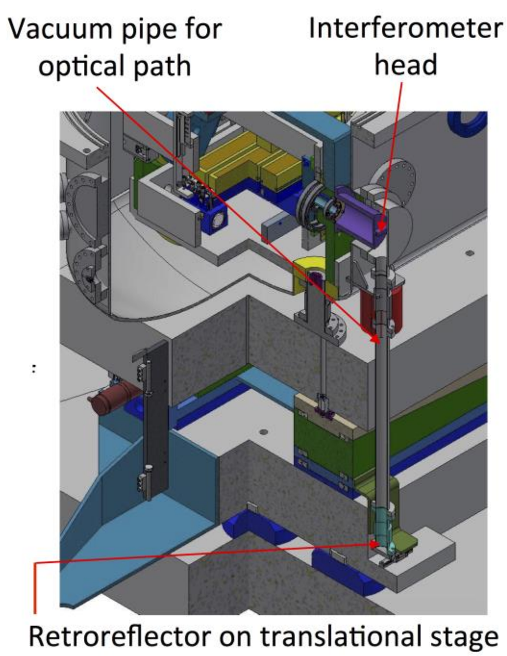
SIX – SOFT INELASTIC X-RAY

The FDR for the spectrometer arm system package was held with Bestec at BNL on July 8. Given the unusually large scale of the scope of work for this package, SIX and Bestec decided to hold a post-FDR three weeks later, by phone, in order to resolve a few design and EPS issues that were left pending at the FDR. An example of a solution proposed by Bestec at the post-FDR to resolve an issue raised at the FDR regarding the need to incorporate an interferometer to track the long-term vertical drift of the gratings is shown in Figure 5. Bestec designed an in-vacuum holder for the interferometer head concentric with the grating pitch rotation axis. The whole optical path from the interferometer to the retroreflector is in vacuum. The last remaining open issues are expected to be resolved by mid-August.

In order to expedite the long lead purchase of the M7 mirror, the specifications of the spectrometer arm system have been edited to add the optical specifications of M7. Approval of the corresponding contract amendment, which will allow for timely subcontract of the M7 mirror by Bestec, is slated for early August. In parallel, throughout the month, a more extensive update of the specifications has been ongoing in order to take into account the new optical scheme designed by the SIX optics scientist and approved by SIX and NEXT management in April. The updated specification document was sent to the procurement liaison engineer on July 29. Drawings are still in the process of being updated.

The contract for the sample chamber and triple rotating flange system was awarded to Bestec on July 2. The program plan was received on July 31.

The PDS mechanical systems in contract with Bestec, for M1, M3 and M4, are still in production. The FAT of M1 and M3 has been scheduled for August 13 and 14. The delivery and installation of M1 and M3 are scheduled to take place at the end of September and mid-October, respectively.



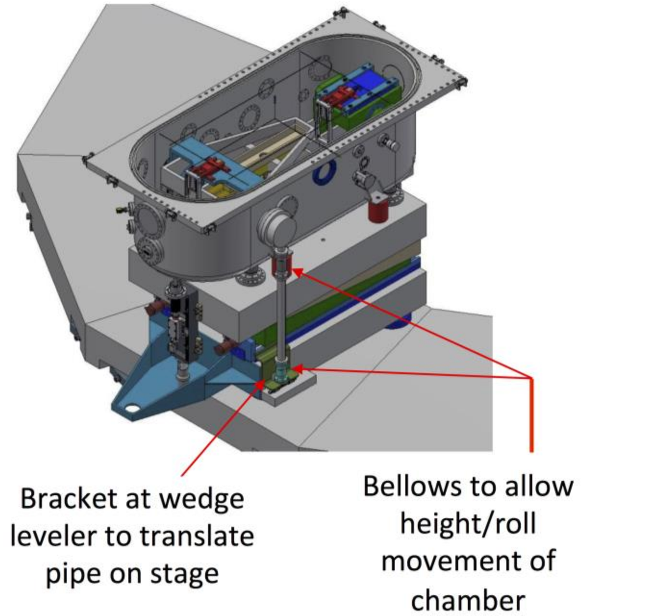


Figure 5: Rendering of the implementation scheme of an in-vacuum interferometer to track the long-term vertical drift of the gratings in the optics tank of the SIX spectrometer arm. The top layout shows a close-up view of the inside, and the bottom layout an overall view of the setup.

SMI – SOFT MATTER INTERFACES

Conceptual design and supporting documents for the SMI SAXS Beam Chamber procurement were finalized in July, enabling detailed design of all the components contained within to begin. The internal components include: a long Z rail enabling the Pilatus 1M detector to travel in a range from 1.6m to 8m from the sample; X and Y degrees of freedom for the detector to extend *q* range; an air enclosure vessel within the vacuum chamber, to accommodate the 1M air cooling; a beam stop mechanism; and substantial support for air, water, motion control, power, and data services, managed by a vacuum compatible cable chain leading from the moving detector platform to the chamber ports. The SAXS/WAXS endstation will need to sustain engineering/design/safety review, which will include review of the planned assembly procedure, the interfaces, and the safety features of the components and of the supporting vacuum system. Effort to prepare material for these reviews has been divided among the SMI group members and is proceeding in line with the NEXT schedule. The immediate next steps will be procurement of the chamber granite base and the detector vacuum vessel. The designs of these two components are nearly complete and the procurements are both requisitions of less than \$25K according to current cost estimates. The cover figure of this report shows the layout from Sample Chamber to SAXS Beam Chamber. For clarity, three components internal to the Sample Chamber are not illustrated: the Sample Stages (FDR in August 2015), the WAXS Goniometer (Figure 6), and the

Pilatus 300K-W detector (receipt scheduled for December 2015).

Included in the SAXS Beam Chamber procurement is the 10" gate valve isolating vacuum between the two sections. It will be important to separate the users' sample changes from the maintenance of detector vacuum. One of the most important procedural aspects is protection of the Pilatus sensors during bleed-up. The inlet gas must be clean and dry, and means of avoiding over-pressure must be ensured.

SMI's two scientists visited three European suppliers of SMI components during July. The FAT for the White Beam Components contract, exclusive of the DCM, was completed at IDT's plant in Widnes, UK. The components passed their tests with flying colors and were then packed for August shipment. The PDR of the SMI Sample Vacuum Stages contract was held at PI-miCos and both the minutes and the report from this review were accepted during July. Finally, a status visit was made to Huber in Rimsting, Germany to witness progress on fabrication of components of the WAXS Goniometer contract. Figure 6 shows the components waiting for assembly and test, expected to occur in August. The pedestals that will support the WAXS Goniometer on the Sample Chamber base plate will be provided by SMI. One of the challenges is to center the arc assembly exactly upon the sample rotation position, to which the beam will be aligned. Both the chamber and the goniometer have fiducials in the form of survey ball nests for this purpose, to be accomplished by the BNL Survey Group during installation.

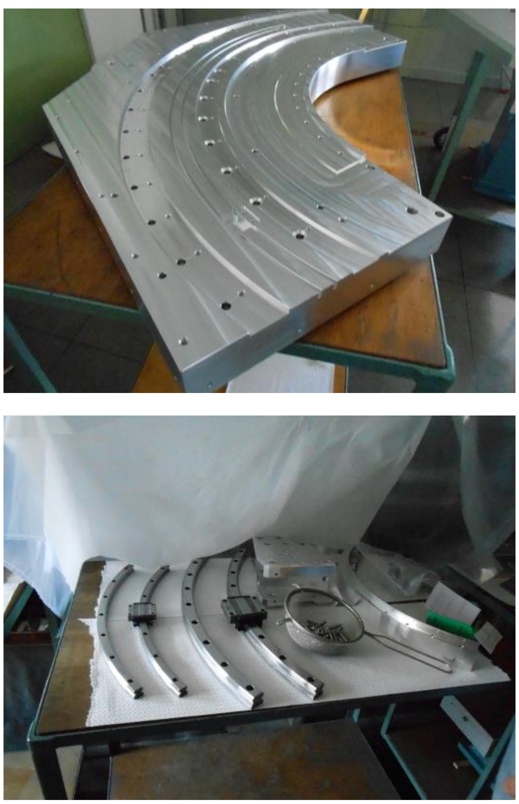


Figure 6: Components of the SMI WAXS Goniometer at the Huber plant. Top: goniometer base that will support the 90° arc rails. Some of the holes visible towards the near side are alignment fiducials. Bottom: rail and carriage pieces, along with some hardware for the moving platform.

Motor, encoder, and high voltage cables were pulled in the 12-ID-A hutch during July, with vacuum cables and cable terminations scheduled to be completed in August. Good progress was made on the special PPS interlocks that will allow B and C hutch experiments to share time in the canted beamline with a removable shielded beampipe. At the Synchrotron Radiation Instrumentation conference (July 6-10, NYC), SMI scientist Zhernenkov presented the simultaneous raytracing/wavefront analysis of the SMI photon delivery design, and the SMI team made connections with a vendor capable of using a reactive ion etch method to create the thin diamond sensors required for the tender x-ray operation of the X-ray Beam Position Monitors.

Two procurement contractor delays occurred during July, which will introduce schedule variances that are expected to be corrected in August. The first of these was delivery of the Sample Vacuum Chamber, which suffered a vacuum leak that was found and remedied during July but will delay delivery until August. The second is delivery of the Cryo-Cooler supplied by Bruker, which remains under test after re-work by a subcontractor and has missed its July ship date. The contractors are working hard to remedy the problems and delivery is expected in August.

INSERTION DEVICES

FMB Berlin completed the production of the first NEXT EPU vacuum chamber, as shown in Figure 7. The flanges at each end of the vacuum chamber have been welded on as well as the flanges to mount the BPM. The dimensions have been checked. Prior to the NEG coating to be performed by SAES Getters, the vacuum chamber will be sent to CERN for cleaning. The production of the second NEXT EPU vacuum chamber is nearly complete, with welding and dimensional checking to be performed in August. In addition, a number of the associated components are complete and in hand at FMB:

1. All components of the Support Stands are produced and at FMB.
2. Production of the end tapers is in progress by a subcontractor (wire eroding of the inside contour at the moment) and should be ready for baking in August.
3. The heating jackets have been manufactured and are at FMB.
4. Production of connection unit parts is complete and the units are being assembled and cabled at subcontractor ENZ.
5. The junction boxes are at FMB.
6. The flat wires (current strips) have been ordered, with delivery to FMB in August.

NSLS-II Insertion Device group staff will witness the Preliminary Mechanical Acceptance Test (PMAT) of the Short EPU for ESM, which will be conducted August 3-7 at the NEXT EPU contractor (Kyma) site, with participation by the subcontractor for design and manufacturing of the NEXT EPU mechanical frames, EUROMISURE S.a.S, a division of the WIKA Group (Pieve S. Giacomo, Italy). The purpose of the PMAT is for Kyma to formally accept these frames from EUROMISURE prior to adding the large attractive magnetic load between the upper and lower girders. A Final Mechanical Acceptance Test will be conducted after assembly and shimming of the magnets on girders. The PMAT will include initial testing and usage of the NEXT EPU control system, which must function in order to conduct the mechanical tests. This testing will provide an opportunity for BNL staff to review the control system for the NEXT EPUs months ahead of delivery.

Figure 7. Photos of the first NEXT EPU vacuum chamber, support, connection box, and main subsystems.

ID/FE INSTALLATION

During this month, termination of the vacuum cables on the SR tunnel end for the NEXT front ends was completed. The slits and collimator 1 were installed in the SR tunnel for ISS. Plumbing and connection work is ongoing for the ISR & SMI front end stands in the SR tunnel. Wiring of the safety shutters is continuing on the ESM, ISS, and SIX front end assemblies. Installation planning for the August shutdown is process.

The ISR straight section floor was surveyed in preparation for the IVU installation during August. The bakeout of the first IVU23 has been completed and the measurement of second IVU23 is finishing. Testing of the insertion device control system is also ongoing in the magnetic measurement lab.

PROJECT MILESTONES

Milestone	Planned	Actual
CD-0 (Mission Need):	May 27, 2010	May 27, 2010
CD-1 (Alternative Selection):	Dec. 19, 2011	Dec. 19, 2011
CD-2 (Performance Baseline):	Oct. 9, 2013	Oct. 9, 2013
CD-3A (Long Lead Procurement):	Oct. 9, 2013	Oct. 9, 2013
CD-3 (Start Construction):	Mar. 31, 2014	Jul. 7, 2014
Internal Early Project Completion – Beamlines	Sept. 30, 2016	
Early Project Completion:	Jan. 31, 2017	
CD-4 (Project Completion):	Sept. 29, 2017	

UPCOMING EVENTS

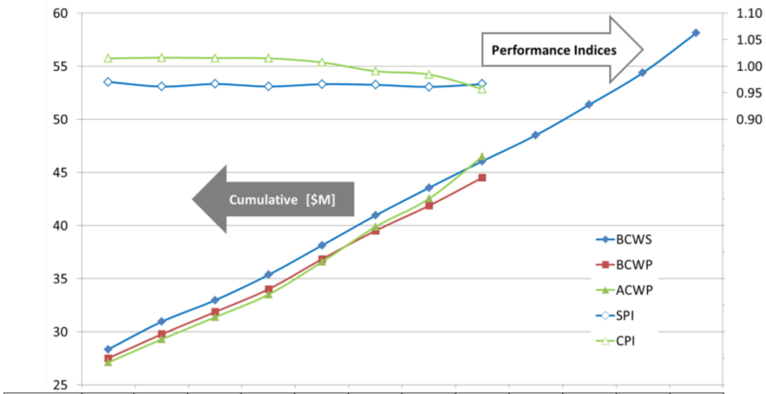
DOE/SC Status Review	November 3-4, 2015

Acronyms and Abbreviations

ABBIX	Advanced Beamlines for Biological Investigations with X-rays
ACWP	Actual Cost of Work Performed
APP	Advanced Procurement Plan
BAC	Budget at Completion
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BHSO	Brookhaven Site Office
BNL	Brookhaven National Laboratory
BPM	Beam Position Monitor
CD	Critical Decision
CERN	European Council for Nuclear Research
CPI	Cost Performance Index
CV	Cost Variance
DAQ	Data Acquisition
DCM	Double Crystal Monochromator
DOE	Department of Energy
DOF	Degree of Freedom
EAC	Estimate at Completion
EPS	Equipment Protection System
EPU	Elliptically Polarizing Undulator
ES&H	Environment, Safety & Health
ESM	Electron Spectro-Microscopy beamline
ETC	Estimated Cost to Complete
EVMS	Earned Value Management System
FAT	Factory Acceptance Test
FDR	Final Design Review
FE	Front Ends
FOE	First Optics Enclosure
FPGA	Field-programmable Gate Array
FTE	Full Time Equivalent
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
GHS	Gas Handling System
GISAXS	Grazing Incidence SAXS
GIWAXS	Grazing Incidence WAXS
ID	Insertion Device
IDT	Insertion Device Team
ISB	Integrated Sciences Building (BNL)
ISR	Integrated In-Situ and Resonant X-ray Studies
ISS	Inner Shell Spectroscopy beamline
IVU	In-Vacuum Undulator
LEEM	Low Energy Electron Microscopy
M&S	Material & Supplies
MACRO	Motion And Control Ring Optical
NEG	Non-Evaporable Getter
NEXT	NSLS-II Experimental Tools project
NSLS-II	National Synchrotron Light Source ll
OASIS	Ultra-low vibration laboratory at ISB, BNL
OPC	Other Project Costs
PCR	Project Change Request
PDR	Preliminary Design Review
PDS	Photon Delivery System
PDU	Power Distribution List
PLC	Programmable Logic Controller
PMAT	Preliminary Mechanical Acceptance Test
PMB	Performance Management Baseline
PPM	Procurement & Property Management
PPS	Personnel Protection System
SAXS	Small Angle X-ray Scattering
SBA	Spherical Backscattering Analyzer
SC	Office of Science
SIX	Soft Inelastic X-ray Scattering beamline
SMI	Soft Matter Interfaces beamline
SPI	Schedule Performance Index
SR	Storage Ring
SV	Schedule Variance
TEC	Total Estimated Cost
TPC	Total Project Cost
UB	Undistributed Budget
USH	Universal Sample Holder
VAC	Variance At Completion
WAXS	Wide Angle X-ray Scattering
WBS	Work Breakdown Structure
WS	Working Schedule
XES	X-ray Emission Spectrometer
µARPES	Micro Angle-Resolved Photoelectron Spectroscopy

COST AND SCHEDULE STATUS

Cost and schedule progress is being tracked using an Earned Value Management System (EVMS) against the cost and schedule baseline established on October 1, 2013. All baseline changes are being controlled through the NEXT Change Control Board. Cost and schedule revisions are being managed using Project Change Control procedures. From June 2015 forward, EAC is reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), at the individual activity and resource level. ETC values are shown in the final row of the EVMS table below, and all EAC changes are captured in the monthly EAC log.



Cum $M	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15
BCWS	28.4	31.0	33.0	35.4	38.1	41.0	43.6	46.1	48.5	51.4	54.4	58.1
BCWP	27.5	29.8	31.9	34.0	36.9	39.5	41.9	44.5				
ACWP	27.1	29.3	31.4	33.5	36.6	39.9	42.5	46.5				
SPI	0.97	0.96	0.97	0.96	0.97	0.97	0.96	0.97				
CPI	1.01	1.02	1.02	1.01	1.01	0.99	0.98	0.96				
ETC								39.0	36.6	33.6	30.7	26.9

The NEXT project Schedule Variance (SV) for July 2015 is +$144K, with an associated monthly Schedule Performance Index (SPI) of 1.06 (green status). The cumulative SPI is 0.97 (green status), 0.01 higher than it was in June 2015. The positive current month schedule variance is the net result of an equal number of number positive contributors (5) and negative contributors (5), with the positives outweighing the negatives. The largest positive contributor is +$144K in WBS 2.09 (SIX Beamline) resulting from earned value for the spectrometer and detector contracts which was scheduled in previous and subsequent months, while the largest negative contributor is -$209K in WBS 2.10 (SMI Beamline) resulting from delayed delivery (expected to be by one month) of the cryocooler and the sample chamber.

The NEXT project Cost Variance (CV) for July 2015 is -$1336K, with an associated monthly Cost Performance Index (CPI) of 0.67 (red status). The primary contributors to the monthly CV in July are: -$240K in WBS 2.05 (ESM Beamline), -$237K in WBS 2.07 (ISR Beamline), -$371K in WBS 2.09 (SIX Beamline), and -$509K in WBS 2.11 (Insertion Devices), all resulting from payments and accruals for work earned in earlier months. The cumulative CPI is 0.96 (green status).

As of July 31, 2015, the project is 54.1% complete with 20.2% contingency ($7.6M) for $37.8M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through July 2015.

The project EAC for July is reported at $85,563K against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $82,360K. The Variance At Completion (VAC) is given by VAC = BAC – EAC, with EAC = ACWP + ETC. Through July 2015, VAC is -$3,203K, of which 62% ($1.99M) comes from actual cost overages to date and 38% ($1.21M) represents contributors to EAC which have not been added to the project baseline. The major contributors to the $1.21M portion of VAC at the end of July include: -$0.50M in WBS 2.03 (Common Systems) for ES&H-driven additions to hutches of smoke detection (all hutches) and sprinklers (the ISS and ISR hutches that support gas handling systems), addition of Area Radiation Monitors for each beamline, additional PPS coding effort, and additional material for EPS systems; -$0.63M in WBS 2.08 (ISS Beamline) for procurement contract amendments to the Sample Handling System and Spectrometer Mechanics packages and addition of FPGA controls units; +$0.38M in WBS 2.09 (SIX Beamline) for a contract awarded below the estimated cost; and -$0.18M in WBS 2.01 (Project Management & Support) for expected overage in effort for procurements and for portable vacuum equipment.

The contingency ($7.6M) is 18.6% of $41.0M EAC work remaining.

3 PCRs were approved and implemented in July.

PCR	PCR Level	Baseline Change [$]	Description
PCR-15-092	L3	-144,890	ISS XES Spectrometer Contract Award (APP033NX)
PCR-15-093	L3	29,701	ISR Gas Handling System Contract Amendment
PCR-15-094	L3	1,083,366	Additional Labor and Material for ID and FE Installation & Testing *

* For FY16 ID/FE activities; the associated project risk has now been retired

Forthcoming PCRs include five Level 3 PCRs: (i) PCR NEXT_15_097 to implement award of the 5-DOF table contract and refine DAQ requirements in WBS 2.07.02 (ISR Beamline Systems), (ii) PCR NEXT_15_096 to implement contract awards and amendments in WBS 2.08.02 (ISS Beamline Systems), (iii) PCR NEXT_15_090 to add material and labor for utilities installation in WBS 2.03.01 (Common Systems Utilities), (iv) PCR NEXT_15_095 to add material and labor for PPS and EPS in WBS 2.03.02 and 2.03.03, respectively), and (v) PCR NEXT_15_098 to implement a contract award in WBS 2.09.02 (SIX Beamline Systems).

NEXT as of 7/31/2015	Current Period	Cum-to-Date
Plan (BCWS) $K	2,512	46,068
Earned (BCWP) $K	2,656	44,525
Actual (ACWP) $K	3,991	46,520
SV $K	144	-1,543
CV $K	-1,336	-1,994
SPI	1.06	0.97
CPI	0.67	0.96
Budget at Completion $K (PMB [UB])		82,360
Planned % Complete (BCWS/BAC)		55.9%
Earned % Complete (BCWP/BAC)		54.1%
Contingency $K		7,640
Contingency / (BAC – BCWP)		20.2%
EAC $K		85,563
Contingency / (EAC – BCWP)		18.6%
(Contingency + VAC) / (EAC – BCWP)		10.8%
TPC = PMB + Contingency		90,000

SPI Project to Date*:

0.97

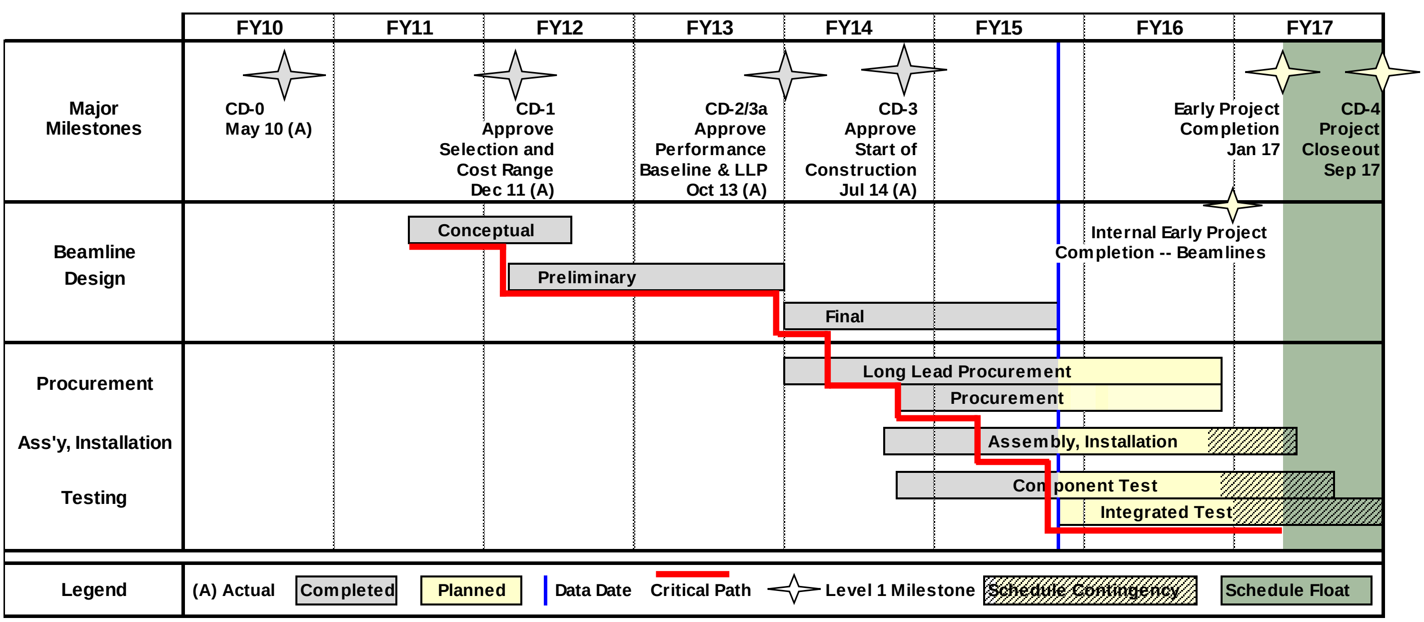
CPI Project to Date*:

0.96

**Cause & Impact:* No reportable variance
Corrective Action: None required

Milestones – Near Term		Planned	Actual	Notes
L2	Receive 1st Soft X-ray Grating	10-Mar-15	1-Jul-15	
L2,L3	Receive ISS Gas Handling System	17-Mar-15	22-Jul-15	Extensive ESH review
L3	SIX – Award Spectrometer Grating Chamber	17-Mar-15	4-Feb-15	
L3	ISS – Award XES Spectrometer	21-May-15	5-Jun-15	
L3	ESM – Testing Monochromator and Slits complete	12-Nov-15		
L3	ISR – Bench Test of Dual Phase Plate Assembly Complete	17-Nov-15		~Mar-16 (forthcoming PCR)
L3	SMI - Bench Test of DCM Monochromator Complete	30-Nov-15		WS: 9-Nov-15
L3	ISS – Testing High Heatload Monochromator Complete	5-Jan-16		WS: 9-Feb-16
L2, L3	Common Beamline Systems: Mechanical Utilities Installed	14-Jan-16		WS: 2-Feb-16
L3	Common Beamline Systems: Electrical Utilities Installed	20-Jan-16		WS: 27-Nov-15
L3	SMI – Installation of CRL Focusing Optics Complete	26-Jan-16		
L2	Receive 1st Double Crystal X-ray Monochromator	16-Feb-16		WS: 8-Sep-15

PROJECT SCHEDULE



The project critical path runs through activities in WBS 2.10 (SMI beamline). As of July 2015, the active critical path activity is specification, procurement, design, fabrication, delivery, installation, and testing of the SMI Double Crystal Deflector, which delivers the SMI x-ray beam of varying energy to a fixed point on the surface of liquid samples in the liquids endstation (SMI ES1).

Staffing Report

Staffing as of 7/31/2015	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	1.07	0.61	29.26	27.63
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	1.03	0.45 *	13.45	5.47 *
WBS 2.04 Control System	0.88	1.14	11.04	10.71
WBS 2.05 ESM Beamline	0.63	0.51	10.10	10.43
WBS 2.06 FXI Beamline	0.00	0.04	4.62	4.51
WBS 2.07 ISR Beamline	0.28	0.33	10.17	9.42
WBS 2.08 ISS Beamline	0.22	0.31	9.30	9.57
WBS 2.09 SIX Beamline	0.42	0.53	13.22	14.18
WBS 2.10 SMI Beamline	0.27	0.26	8.99	9.21
WBS 2.11 Insertion Devices	0.15	0.17	3.32	2.35
WBS 2.12 ID & FE Installation	0.03	0.87	2.12	3.11
Total	4.97	5.22	124.32	115.33

** Based on the NEXT working schedule

* More than half of utilities installation was performed by contractors (M&S) rather than staff as originally planned

Number of individuals who worked on NEXT during July 2015: 131

Funding Profile

Funding Type	NEXT Funding Profile ($M)						
	FY11	FY12	FY13	FY14	FY15	FY16	Total
OPC	3.0						3.0
TEC – Design		3.0	2.0				5.0
TEC – Fabrication		9.0	10.0	25.0	22.5	15.5	82.0
Total Project Cost	**3.0**	**12.0**	**12.0**	**25.0**	**22.5**	**15.5**	**90.0**

Key NEXT Personnel

Title	Name	Email	Phone
Federal Project Director	Robert Caradonna	rcaradonna@bnl.gov	631-344-2945
NEXT Project Manager	Steve Hulbert	hulbert@bnl.gov	631-344-7570

COST PERFORMANCE REPORT

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE

$ | FORM APPROVED OMB No. 0704-0188

1. CONTRACTOR	2. CONTRACT	3. PROGRAM	4. REPORT PERIOD
a. NAME Brookhaven National Laboratory	a. NAME	a. NAME NSLS-II Experimental Tools (NEXT) Project	a. FROM *(YYYYMMDD)* 2015 / 07 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER	b. PHASE	b. TO *(YYYYMMDD)* 2015 / 07 / 31
	c. TYPE / d. SHARE RATIO	c. EVMS ACCEPTANCE X YES	

WBS (2) / WBS (3) / Work Package / ITEM (1)	CURRENT PERIOD BUDGETED COST WORK SCHEDULED (2)	CURRENT PERIOD BUDGETED COST WORK PERFORMED (3)	CURRENT PERIOD ACTUAL COST WORK PERFORMED (4)	CURRENT PERIOD VARIANCE SCHEDULE (5)	CURRENT PERIOD VARIANCE COST (6)	CUMULATIVE TO DATE BUDGETED COST WORK SCHEDULED (7)	CUMULATIVE TO DATE BUDGETED COST WORK PERFORMED (8)	CUMULATIVE TO DATE ACTUAL COST WORK PERFORMED (9)	CUMULATIVE TO DATE VARIANCE SCHEDULE (10)	CUMULATIVE TO DATE VARIANCE COST (11)	AT COMPLETION BUDGETED (14)	AT COMPLETION ESTIMATED (15)	AT COMPLETION VARIANCE (16)
2.01 Project Management and Support	198,712	198,712	166,399	0	32,313	6,775,414	6,775,414	7,210,936	0	-435,522	9,792,909	10,407,620	-614,711
2.01.01 Project Management	81,896	81,896	62,719	0	19,177	3,257,299	3,257,299	3,115,542	0	141,757	4,657,379	4,515,616	141,763
2.01.02 Project Support	116,816	116,816	103,679	0	13,137	3,518,115	3,518,115	4,095,393	0	-577,279	5,135,530	5,892,005	-756,474
2.02 Conceptual Design and Advanced Conceptual Design	0	0	0	0	0	1,807,316	1,807,316	1,807,316	0	0	1,807,316	1,807,316	0
2.03 Common Beamline Systems	169,340	300,189	203,666	130,849	96,524	4,680,238	4,338,088	5,416,662	-342,150	-1,078,573	6,382,454	7,964,422	-1,581,968
2.03.01 Utilities	110,315	179,251	82,021	68,936	97,230	3,447,341	3,106,435	3,536,140	-340,906	-429,705	3,692,703	4,385,874	-693,171
2.03.02 Personnel Protection System (PPS)	29,047	48,866	80,609	19,819	-31,743	537,786	552,509	914,493	14,723	-361,984	1,323,218	1,856,198	-532,979
2.03.03 Equipment Protection System (EPS)	4,411	31,572	24,837	27,160	6,735	271,895	242,903	446,818	-28,992	-203,916	594,451	855,109	-260,658
2.03.04 Control Station	16,316	31,249	3,627	14,933	27,623	44,900	57,925	58,489	13,025	-564	295,394	308,081	-12,687
2.03.05 Common Beamline Systems Management	9,251	9,251	12,572	0	-3,321	378,316	378,316	460,722	0	-82,405	476,689	559,161	-82,472
2.04 Control System	86,208	218,257	351,230	132,049	-132,973	3,461,155	2,946,754	3,055,705	-514,402	-108,952	4,558,236	4,549,068	9,169
2.04.01 Control System Management	6,803	6,803	5,055	0	1,748	210,197	210,197	152,865	0	57,331	294,427	237,096	57,331
2.04.02 Control System Design & Implementation	65,933	137,074	156,714	71,141	-19,640	2,067,314	1,646,022	1,800,512	-421,292	-154,490	2,913,586	3,023,885	-110,299
2.04.03 Control System Equipment	13,472	74,380	189,461	60,908	-115,082	1,183,644	1,090,535	1,102,328	-93,110	-11,793	1,350,223	1,288,087	62,137
2.05 ESM Beamline	227,659	359,123	599,039	131,463	-239,917	5,777,569	5,924,251	6,128,607	146,682	-204,356	9,197,637	9,530,328	-332,691
2.05.01 ESM Management	11,509	11,509	6,139	0	5,369	411,978	411,978	389,525	0	22,452	692,100	665,698	26,402
2.05.02 ESM Beamline Systems	216,151	347,614	592,900	131,463	-245,286	5,365,591	5,512,273	5,739,082	146,682	-226,809	8,505,536	8,864,629	-359,093
2.06 FXI Beamline	37,250	0	8,218	-37,250	-8,218	1,468,746	1,497,524	1,292,214	28,777	205,309	1,818,324	1,613,016	205,308
2.06.01 FXI Management	0	0	4,912	0	-4,912	409,359	409,359	470,270	0	-60,911	409,359	470,270	-60,911
2.06.02 FXI Beamline Systems	37,250	0	3,307	-37,250	-3,307	1,059,387	1,088,164	821,944	28,777	266,220	1,408,965	1,142,746	266,219
2.07 ISR Beamline	331,128	312,514	549,029	-18,614	-236,515	3,902,084	3,399,121	3,587,687	-502,963	-188,565	10,226,160	10,499,531	-273,370
2.07.01 ISR Management	27,545	27,545	25,201	0	2,345	710,263	710,263	696,022	0	14,241	1,076,573	1,061,579	14,994
2.07.02 ISR Beamline Systems	303,583	284,968	523,828	-18,614	-238,860	3,191,822	2,688,859	2,891,665	-502,963	-202,806	9,149,587	9,437,951	-288,364
2.08 ISS Beamline	412,946	365,454	250,466	-47,491	114,988	5,839,407	5,735,469	5,337,252	-103,938	398,217	9,742,485	9,974,382	-231,897
2.08.01 ISS Management	19,913	19,913	19,808	0	105	505,569	505,569	502,860	0	2,709	838,199	834,058	4,141
2.08.02 ISS Beamline Systems	393,033	345,542	230,658	-47,491	114,883	5,333,838	5,229,900	4,834,393	-103,938	395,508	8,904,287	9,140,325	-236,038
2.09 SIX Beamline	313,874	458,188	828,975	144,314	-370,787	5,472,720	5,618,750	6,174,756	146,030	-556,006	12,189,914	12,364,000	-174,086
2.09.01 SIX Management	18,847	18,847	15,313	0	3,534	449,894	449,894	454,342	0	-4,448	845,551	848,190	-2,639
2.09.02 SIX Beamline Systems	295,026	439,340	813,662	144,314	-374,322	5,022,825	5,168,855	5,720,414	146,030	-551,558	11,344,363	11,515,810	-171,447
2.10 SMI Beamline	363,670	154,661	131,277	-209,009	23,384	4,515,112	4,351,023	4,291,621	-164,089	59,402	9,763,449	9,790,128	-26,678
2.10.01 SMI Management	24,636	24,636	7,515	0	17,121	544,698	544,698	460,655	0	84,043	918,583	834,542	84,042
2.10.02 SMI Beamline Systems	339,034	130,025	123,761	-209,009	6,263	3,970,414	3,806,325	3,830,965	-164,089	-24,641	8,844,866	8,955,586	-110,720
2.11 Insertion Devices	353,900	235,560	744,309	-118,340	-508,750	1,849,780	1,713,405	1,529,631	-136,375	183,774	4,779,614	4,623,445	156,168
2.11.01 ESM EPU Insertion Device	351,200	232,860	739,470	-118,340	-506,611	1,677,384	1,541,009	1,424,727	-136,375	116,282	4,562,016	4,473,339	88,677
2.11.02 SIX EPU Insertion Device	0	0	0	0	0	117,137	117,137	70,375	0	46,762	117,137	70,375	46,762
2.11.03 Insertion Devices Management	2,700	2,700	4,839	0	-2,139	55,259	55,259	34,530	0	20,729	100,460	79,732	20,729
2.12 ID & FE Installation & Testing	16,821	52,908	158,516	36,087	-105,608	518,675	418,383	687,357	-100,292	-268,974	2,101,147	2,439,592	-338,444
2.12.01 ID & FE Installation & Testing Management	2,704	2,704	1,766	0	938	15,733	15,733	7,565	0	8,168	52,716	44,054	8,662
2.12.02 ID Installation & Testing	0	9,454	81,855	9,454	-72,401	87,733	89,915	302,408	2,182	-212,493	1,240,295	1,485,596	-245,301
2.12.03 FE Installation & Testing	14,117	40,750	74,895	26,633	-34,145	415,209	312,736	377,385	-102,473	-64,649	808,136	909,942	-101,805
Total Project Baseline	2,511,509	2,655,566	3,991,125	144,057	-1,335,559	46,068,216	44,525,498	46,519,744	-1,542,719	-1,994,247	82,359,646	85,562,848	-3,203,202
Undistributed Budget													
Management Reserve													
Performance Management Baseline - PMB	**2,511,509**	**2,655,566**	**3,991,125**	**144,057**	**-1,335,559**	**46,068,216**	**44,525,498**	**46,519,744**	**-1,542,719**	**-1,994,247**	**82,359,646**	**85,562,848**	**-3,203,202**