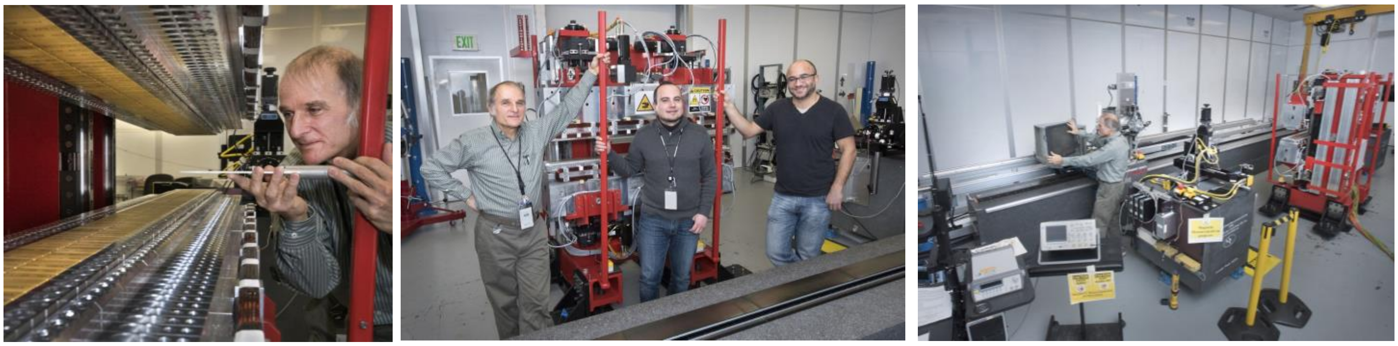
NSLS-II Experimental Tools (NEXT)

January 2016 Project Activity

Report due date: February 20, 2016



EPU57 Insertion Device for ESM preparing to be measured in the Magnetic Measurement Laboratory

SIX: Beamline installation at 2-ID

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OVERALL ASSESSMENT

During January 2016, technical progress continued to be made on PDS installations on the NSLS-II experimental floor and on all remaining major procurement contracts. The majority of ISS photon delivery system components was installed in January, with the remainder to be installed in February. The photon delivery system components for ISR were in transit during January, for delivery early in February.

Preparations are underway for IRRs upcoming in the next two months: the IRR for the SMI ID and FE, planned for February 22, and the ISS photon delivery system IRR, planned for March 24.

As of January 31, 2016, the project is 74.4% complete based on base scope performance earned to date. The cumulative EVMS schedule and cost indices remained the same as in December, at 0.95 and 0.94, respectively.

No PCRs were proposed in January.

Monitoring and management of contractor progress on the 35 remaining major procurement contracts are important ongoing activities that are crucial to maintaining project schedule.

BAC remained flat in January at $82.3M. Cost contingency is reported at $7.7M, which represents 36.6% of $21.1M BAC work remaining. The EAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), is $85.75M, which is $0.56M greater than the December EAC value. The largest contributor to this growth is in WBS 2.03.02 (PPS), based on recent actual costs to complete beamline PPS systems. As of the end of January, contingency on EAC is $4.25M, which represents 20.3% of $20.9M EAC work remaining. Outstanding commitments total $11.6M, so the $4.25M contingency on EAC represents 45.9% of $9.3M unobligated EAC work to go. ETC will continue to be assessed monthly through project completion to contain costs while maintaining the good schedule performance that the project has demonstrated to date.

COMMON SYSTEMS

NEXT mechanical and electrical utilities finishing work continued in January. Cable trays in the SIX satellite building were run from the utilities room to the beamline and endstation equipment. Installation will continue in February.

PPS design, development, and installation continued to make significant progress this month. Final testing of the ISS PPS was completed and certification, which was nearly completed in January, will be completed during the two-day maintenance period on February 8-9. In addition, PPS installation effort resumed at ESM and ISR, both of which are scheduled to be PPS-certified during the May 2016 maintenance period.

The Equipment Protection System (EPS) team is continuing to receive EPS requirements for each beamline, and their efforts are being directed to where major beamline component installations are or soon will be taking place. At ISS, the focusing mirror thermocouples have been integrated into EPS. Integration with other recently installed beamline equipment will take place in February. At SMI, the vacuum gate valves have been terminated and integrated into EPS. At ESM, the installation of EPS hardware will begin in February.

Control station configurations for all NEXT beamlines have been approved by the Light Source Safety and Operations Council (LSSOC), and remaining control station furniture is being procured. Integration of AC power and network cables for all NEXT control stations is planned to occur over the next several months, after the control station partitions are received and installed.

BEAMLINE CONTROLS

Control engineers are fully occupied with component testing following the optics installations that are in full swing at all NEXT beamlines. The controls tasks for these components include testing motions with the actual controllers to be deployed, tuning the motors for smooth motion in closed-loop configuration, and configuring the EPICS IOC and CSS operator screens. During January, all motions for mirrors M1, M2, and M3 for both the ESM and SIX beamlines, as well as the KB refocusing mirrors for the µARPES branch of ESM, were tuned using the Geobrick controller, and EPICS control was established. The SMI controls engineer tuned and tested Delta-Tau controllers for the white beam slits and tested EPICS control of the Newport XPS controller for the DCM motions, all with actual controllers mounted in the rack. Also at SMI, vacuum controls for the installed components were deployed and tested, as well as the controls for the Pilatus3 1M and 300K-W detector controls.

Control cable termination work continued at all beamlines to support controls deployment. At SMI and ESM, motion cable termination followed optics installation, while for ISS and ISR, the motion cables were terminated prior to installations. During January, ISR motion cable terminations were completed in Hutches 4-ID-A (FOE) and 4-ID-B (SOE), ahead of optics installation by Toyama to begin in February.

ISR controls network installation made good progress in January, with all servers installed and the controls network turned on. In addition, the ISR controls engineer participated in two FATs during January: one for the Gas Handling System (Applied Energy Systems, Malvern, PA) and the other for the 5-DOF KB mirror table and the 6-circle diffractometer (Square One, Jackson, WY). In both cases, any remaining controls issues were resolved during the FATs.

In addition to ISS controls installation and testing effort, the ISS controls engineer is working with the beamline scientists to prepare for the PDS IRR, scheduled for March.

ESM – ELECTRON SPECTRO-MICROSCOPY

ESM construction activities continued at 21-ID during January. The main accomplishment this month was installation of the KB mirror system.

The uniqueness of the µARPES branch of ESM is its very small spot size (1 µm), which is accomplished without compromising any of the experimental capabilities associated with more conventional ARPES endstations around the world. To achieve this degree of focusing while ensuring that the spot on the sample is spatially stable, highly curved mirrors and a specialized mounting mechanism are required. The optical configuration is the classical Kirkpatrick-Baez (KB) type. The mirrors, supplied by JTEC, are mounted on a mechanical system supplied by CINEL. Both mirrors are mounted on the same granite base, as is the sample stage. All three components are decoupled from their vacuum vessels by bellows. This design provides the required stability (~ 100nm) between the KB mirrors and the sample.

The KB mirror system was installed at ESM in January (Figure 1). The compact design of the highly stable support ensures that the entire system can be placed on top of a single granite block. The sample stage will be mounted to a granite column attached to the same granite block (see Figure 1). The KB mirror system also contains a unique, high frequency feedback system for controlling the pitch of both mirrors in the KB pair. This system has the added benefit that by plotting out the measured pitch value (from the encoders) as a function of time, one can get an indirect measure of the impact of environmental sources of vibration on the stability of the system. While not a direct measure of the expected stability of the sample-mirror system, the encoder time series gives a good indication of what vibration sources may be causing problems, and a Fourier transform of this signal provides information on the frequency of these sources. The measurements of this type taken to date indicate that traffic on the experimental floor within 1-2 m of the KB mirror system is observable, whereas traffic outside of this area is not likely to cause problems. The exception to this is traffic on the pedestrian bridge spanning the 21-ID experimental area, which is clearly visible despite the effort of the feedback system and will severely limit the spatial resolution that can be obtained. Restricting traffic on this bridge or finding alternative means to mitigate vibration caused by traffic on the bridge will be necessary.

Installation of this KB mirror system and the initial in-situ indications of its performance provide evidence supporting the technical viability of the ESM mechanical design.

Installation of the KB mirrors was completed in January, including survey and verification of the leak tightness. The system is undergoing a long, gentle bake to provide ultra-high vacuum without damaging the mirrors.

Progress toward completing installation of the M1 and M3 mirror systems is planned for February.

Figure 1: ESM: The KB mirror system installed at 21-ID. The granite support column for mounting the sample stage is seen in the foreground on top of the main granite block. The highly stable mirror supports are located within the blue chamber support frame.

ISR – IN-SITU AND RESONANT HARD X-RAY

Synchrotron radiation raytracing and associated PPS components were finalized in January. Drawings of the mis-steer protection flange and monochromatic beam masks were released, and the FEA report for the flange was finalized. The report indicates the onset of melting from exposure to the 1.3 kW beam in 23 ms, and 2.5 mm penetration of the melting temperature contour at 2 s. Since the trigger from the PPS aperture will lead to the photon shutter in the front end closing within 1 s, the 18.6 mm thick flange is sufficient to protect the bremsstrahlung collimators in the FOE from any melting of the lead bricks. A purchase order for the flange and two masks was placed, with an expected delivery date in late February. Purchase orders for the PPS aperture and laser curtain, which is a part of the laser interlock, were also placed, with expected delivery dates in late March and late February, respectively.

The magnet chamber ICD was released, and vendor quotes were sought for the fabrication, installation, and pressure testing of beryllium windows that can withstand the high brightness of the ISR beam. Drawings required for impending installations of the Shielded Beam Transport System and the HFM water re-circulating system were also released.

Inspection reports of the HFM (see Figure 2) and VFM were received from Winlight X. Both mirrors meet all specifications, and were being prepared for shipment at the end of January, for expected delivery in early February.

The ISR team met with Huber at BNL on January 21 to discuss FAT scheduling and protocols for the Dual Phase Plate Assembly (DPPA). Huber and PINK, the subcontractor for the vacuum chamber, will receive BNL-owned vacuum equipment (e.g., ion pump power supply, vacuum gauge controller, and associated cables), which are expected to arrive in mid-February. After receipt of the vacuum equipment, vacuum testing of the empty chamber is expected to take two weeks, and testing (vacuum as well as verification of motion under vacuum) with the DPPA installed in the chamber will last another week. The ISR team will then travel to Huber for the FAT, which will include detailed motion testing with the NSLS-II Geo Brick motion controller. This testing will include a measurement of the sphere of confusion for each circle.

Two FATs for ISR components were held during the last week of January: the Gas Handling System on January 26 (see Figure 3), and the KB Mirrors table on January 28 (see Figure 4). For the Gas Handling system, all tests of the hardware went well, but work on the user interface remains to be completed. Installation of the Gas Handling System is anticipated to begin in early February and continue into March. Testing of the entire system, including the user interface, will then commence. For the KB mirrors table, all requirements were satisfied during the FAT. Receipt of the KB Mirrors table is expected by the end of February.

Installation work ramped up in preparation for the February start of the vendor installation of the FOE Optical Components Package, the Double Harmonic Rejection Mirror, and the Secondary Source Aperture. The survey group marked the locations of anchors for floor plates and stands in hutches 4-ID-A and -B, carpenters drilled the holes in the floor, masons scarified the areas that will be grouted, and carpenters installed the anchors. Vacuum terminations for the ten ion pumps in the FOE were begun, with the goal of having them completed before the start of the FOE Optical Components Package installation. The water re-circulating system, which will be used to cool the white beam HFM, was installed on the roof of hutch 4-ID-A.

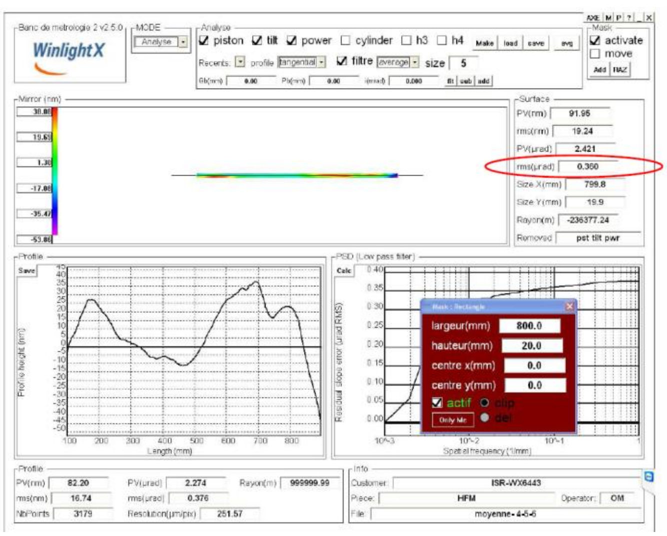


Figure 2: ISR: HFM inspection report from Winlight X showing the results of tangential slope error measurements.

Figure 3: One component of the gas handling system, a vented enclosure with shut-off valves, undergoing Factory Acceptance Testing at Applied Energy Systems.

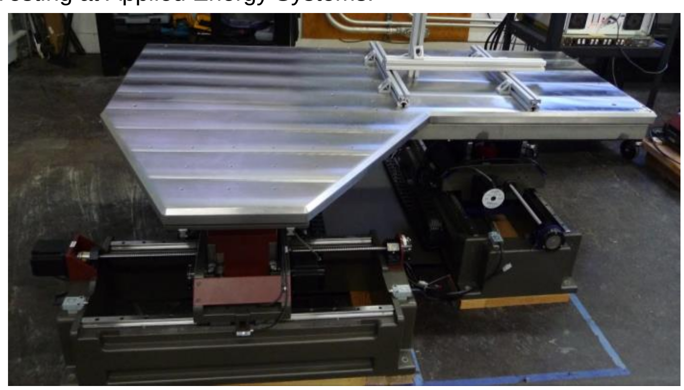


Figure 4: ISR: KB mirrors table undergoing Factory Acceptance Testing at Square One.

ISS – INNER SHELL SPECTROSCOPY

The ISS team is currently focused on activities required by the Instrument Readiness Review (IRR) planned for March 24th and the subsequent technical commissioning with beam. This includes completion of the Photon Delivery System (PDS), preparation of all necessary documentation including training for personnel, and integration of all equipment into the data acquisition system including installation of the control station.

The filter box, which houses mask 0, was surveyed and aligned into its final position (Figure 5). Its vacuum hardware (3 ion pumps, 3 vacuum gauges, and quadrupole mass spectrometer) is connected and functional. The system reached the target pressure of $5x10^{-9}$ mbar after one week of pumping and achieved all vacuum requirements without additional baking. All EPICS I/O's for this chamber (except the gate valve control) are active and displayed in control screens.

The largest PDS component, the collimation mirror tank (Figure 5), is 4.5m long and houses the high heat load flat mirror, the collimation mirror, 3 masks, 1 bremsstrahlung collimator, and a series of secondary bremsstrahlung shields. All radiation safety devices are mounted, aligned, and surveyed on a single granite block, thereby minimizing long term relative motion caused by eventual floor movements. Fabrication and alignment tolerances for the radiation shielding components in this chamber are 120 μm instead of the standard 400 μm value suggested by the beamline ray trace procedure. These tolerances, combined with those of the pink beam stop in the monochromator, provide protection to all radiation shields even if the collimation and/or high heat load mirror are mis-steered.

After the collimation mirror system was installed, it was revealed that the remaining space inside the FOE is too limited to safely place the lid of this large tank next to it. To permit installation and maintenance of the two mirror systems, a stand was designed, fabricated, and installed around the monochromator system which permits the tank lid to be “parked” safely above the monochromator. Installation of both mirrors is planned for February.

The complete beam transport section, connecting the photon beam shutter located in the FOE with the endstation hutch, was installed. The system was evacuated and reached the specified end pressure within one week. All vacuum cables and controllers for this section will be installed in February. All of its EPICS IOC’s are configured and ready to be used.

Currently, the only PDS components remaining to be installed are four beam position monitors (in-house design, currently being assembled and tested) and some of the secondary bremsstrahlung shields. The inboard-side gaps in the vacuum system exist to provide easy access for mirror installations. Completion of the full PDS is expected by the end of February.

A central component of the IRR documentation is the report from the Radiation Safety Committee (RSC), which is scheduled to review all aspects of ISS radiation safety in February. The inputs to the RSC include the ray trace document, the primary and secondary bremsstrahlung reports, and the radiation survey plan. In addition, the training profiles of all ISS personnel were updated to reflect the new responsibilities at an operating beamline.

With the Instrument Readiness Plan document written and other required documents being collected, ISS is on track for successful completion of the IRR on March 24. This is a major step toward bringing the beamline online and making it available to the general user program.

A call for ISS scientific commissioning proposals was announced in January, a precondition to beginning scientific commissioning in July/August 2016. The first phase of this commissioning will focus on the fast energy scanning capabilities of the beamline in combination with a subset of the eventual fast gas switching capabilities of the gas handling system (GHS). The ISS team is working with ES&H and NSLS-II management to develop a three-phase plan to bring the GHS into full operation. In the first phase, a simplified version of the system will provide inert gases and dilute H_2 and CO, enabling experiments demonstrating unique capabilities of ISS such as the water-gas shift reaction, an industrially important reaction that forms CO_2 and H_2 out of CO and H_2O.

Endstation instrumentation development activities are in full progress. These include successful completion of the FAT of the high harmonic rejection mirror system (Axilon AG), a preparation meeting for the FDR of the Sample Handling System (Square One), and completion of cable pulling in the endstation.

A delay in the fabrication of one of the hexapods in the Sample Chamber contract (PI) will delay installation of this system by two months. ISS is scheduled to visit PI at the end of February to inspect progress and discuss schedule details to avoid additional delays. The revised delivery date at the end of May matches an NSLS-II maintenance period and will not impact ISS commissioning or the NEXT project early completion milestone.

Figure 5: ISS: Filter box (far right) and collimation mirror system (center) shown during installation, following survey and alignment into their final positions. Part of the high heat load monochromator, previously installed, is visible downstream of the mirror chamber (left).

SIX – SOFT INELASTIC X-RAY

Steady progress was made in January on the SIX endstation package designs (Bestec). For the sample chamber, the interface volume of the triple rotating flange, including the vacuum system, was approved, which allowed Bestec to place the order for this assembly with their subcontractor. Drawings are expected by mid-February. The kick-off meeting for the components related to the spectrometer contract amendment was held on January 22. A preliminary design for the polarimeter chamber was presented, together with a concept for the detector cooling head support aimed at limiting the transmission of vibrations to the detector sensors. SIX is working with Bestec to finalize the location of the patch panel which serves as the interface between motion control, EPS, and diagnostic signal cables running along the spectrometer arm (to be provided by Bestec) with NSLS-II cables. Progress was also made on the final design of the sample manipulator system, for which SmarAct suggested a simple and workable solution to route the SIX cables going to the sample holder, which passes through the lock mechanism in the center of the SmarPod base. As illustrated in Figure 6, the procedure to insert the SIX cables when the lock is removed is to encapsulate the cables with the cover (1), connect the lock mechanism to the rotating base of the SmarPod (2) and then add the lower cable protection to the base plate (3). This final design is headed for an approval in early February, after which SmarAct will start production.

On the 2-ID experimental floor, installation of the non-optics components continued in January, including gate valves, diagnostic systems, Pirani and cold cathode gauges, and tightening of flange bolts. The two photon shutters, received at the end of December, were bench surveyed and leak tested on January 6, and installed around January 20. The small-aperture shutter was installed in the FOE downstream of M1 (Figure 7(a)) and the large-aperture shutter was installed downstream of the PGM (Figure 7(b)). In the SIX satellite building, the upstream half of the cable tray was installed along the inboard wall of the experimental hall, and connected through the upstream wall and around the M3 mirror system to the outboard cable basket running along the beam pipe stands. A photo of the tray and basket is shown in Figure SIX-7(c).

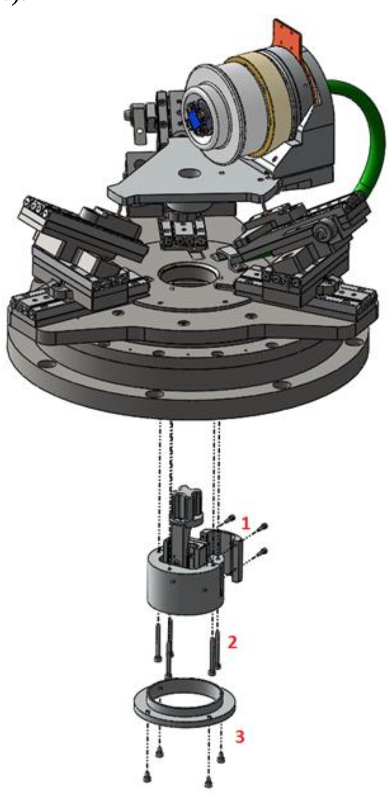


Figure 6: SIX: Final design of the SmarAct sample manipulator system with cable routing passing through the lock mechanism.

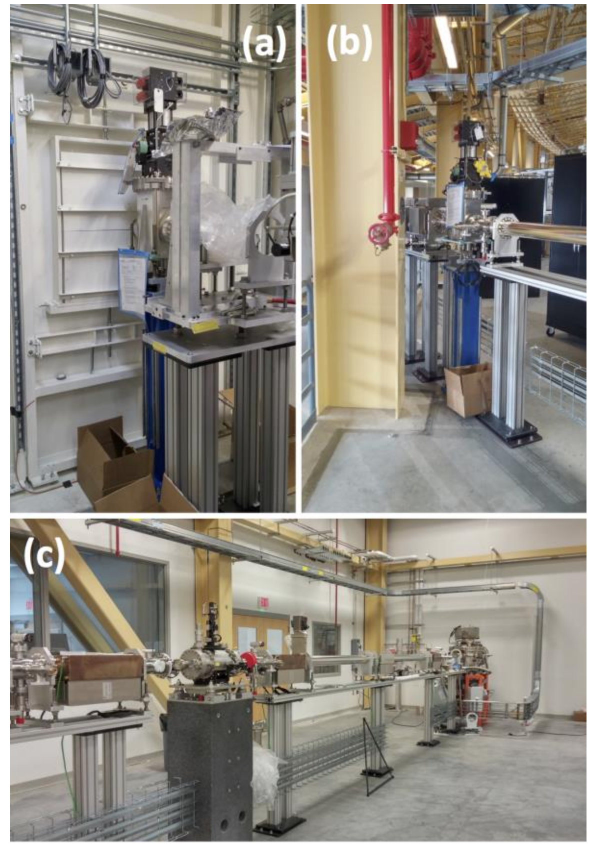


Figure 7: SIX: Photon shutters installed in the FOE (a) and on the experimental floor (b). Portion of the cable tray installed in the SIX satellite building (c).

SMI – SOFT MATTER INTERFACES

As planned, SMI kicked off the New Year with commissioning and testing of the two Pilatus3 detectors that had recently been delivered. The detectors require chilled water for operation and dry nitrogen flow for operation out of vacuum. Utility setups (valves, filters, flow meters) were assembled both in the 12-ID-C hutch and in laboratory 3LL05, where the detectors will be kept during the rest of SMI construction. Figure 8 shows the 1M detector placed on a cart for tests (a) and with all connections live (b), including connection to all three Dectris servers. Figure 8(c) displays the first detected particles: cosmic rays acquired by the 1M during test frame acquisition. The high-throughput 500 Hz data acquisition mode was also tested. This mode is supported by a RAM disk and a Dectris server process that moves files. When tests were concluded on both the 1M and 300K-W detectors, both detectors were moved to the dry lab where they will be bagged with desiccant and maintained with dry nitrogen flow across the silicon sensors until they can be installed in their respective vacuum chambers.

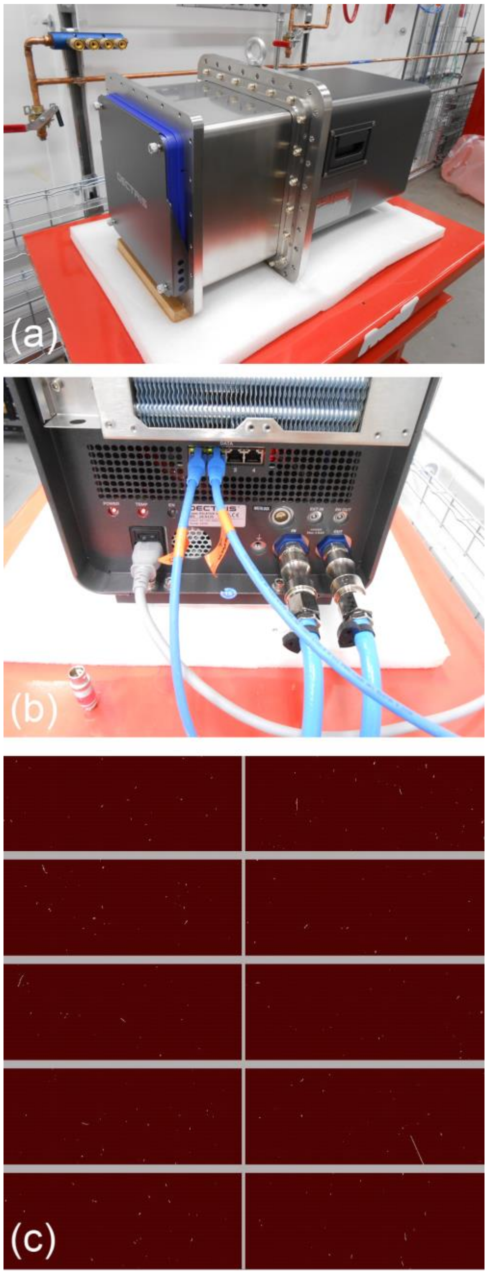


Figure 8: (a) The Pilatus3 1M area detector for SMI SAXS. (b) The back of the detector, showing power, water, data, and vacuum interlock connections. For the working installation, all of these utilities will connect to feedthroughs in the Detector Vacuum Chamber back plate and then into vacuum hoses managed by a 6m-long cable track within the SAXS Beam Chamber, to another feedthrough in that chamber. (c) 1M data frame with a cosmic ray trace acquired during a 30 second test scan without beam in the 12-ID-C hutch.

Work continued on the SMI X-ray Beam Position Monitors (XBPMs). Effort in January focused on activities by Sydor, who are contracted to supply packages and wiring for four XBPM units. SMI's requested design is a departure from Sydor's standard package, since the SMI devices have a thin window region for tender X-rays, and a standard region for hard X-rays, requiring seven coaxial leads – six pads, one bias – instead of the usual five. There is also an asymmetric placement of the so-called "streets" between active regions that needs to be finalized among all participants in the design. SMI and Sydor conducted teleconferences in January and discussed all aspects of the package including vacuum compatibility of the materials, risk factors associated with the mechanical properties of the thin windows, electronic properties such as current limits and capacitive coupling, and confirmation of the intended test procedures. The agreed package is shown in Figure 9, which is excerpted from Sydor's released title block drawing. SMI approved the drawing early in the month.

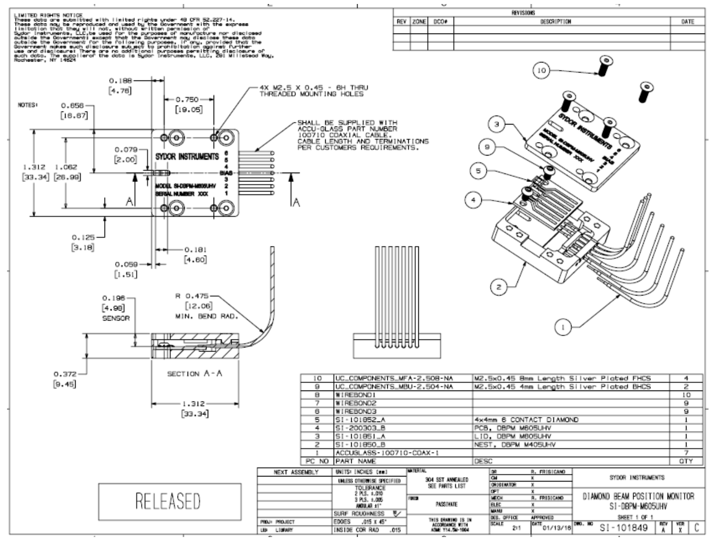


Figure 9: SMI: Excerpt from Sydor's final design drawing for the SMI XBPM package, approved by SMI in early January.

Two remaining endstation design activities were completed in January. FDR of the SAXS Beam Chamber, sourced to GNB, was completed. Secondly, SMI requested an in-house review of the Bounce-Down Mirror to support Liquid Surface science in the GISAXS geometry. SMI's Associate Scientist, Misha Zhernenkov, presented all foreseen design details, installation plan, and budget to the panel, who returned a draft review report by the end of January.

The FAT for the CRL Transfocator contract was held at the JJ X-ray plant in Denmark. Installation and test activities in January included EPS debugging, small cable sheet revisions, White Beam Slit motor tests, traveler executions, and an array of preparations for the H-V Mirror contract FAT trips to the Cinel and Thales-SESO plants in Europe, scheduled for February, and the H-V Mirror and CRL Transfocator installations, scheduled to begin in March and continue through April.

INSERTION DEVICES

The second and last insertion device vacuum chamber fabricated by FMB Oxford for the NEXT project was delivered during the second week of January and was successfully leak checked by the NSLS-II vacuum group. The ID vacuum chamber scope of WBS 2.11 is now complete. This vacuum chamber is scheduled to be installed, using non-

NEXT funds, in the 2-ID straight section (SIX beamline) during the May maintenance period.

The ESM EPU57 insertion device provided by Kyma s.r.l. was shipped by boat from Italy on December 18 and delivered to BNL on Monday, January 11. As the device is relatively short and light, the crate was forklifted out of the container (Figure 10). Upon the unwrapping of the device, the Shockwatch logger fixed on the device was retrieved to analyze the temperature, humidity, and acceleration history during shipment. Analysis of the recorded data indicates smooth transport (Figure 11).

Figure 10: Delivery of the ESM EPU57 insertion device to BNL. The length and the weight of the device allowed the crate to be forklifted out of the container (top). Once the crate was delivered to Bldg 832, the device was unwrapped to retrieve the Shockwatch logger (bottom).

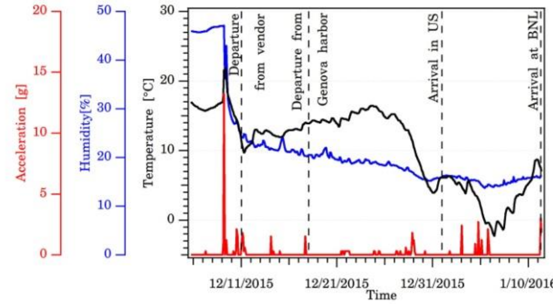


Figure 11: Acceleration (red), humidity (blue), and temperature (black) recorded by the Shockwatch logger during shipment of the ESM EPU57 insertion device. The large acceleration recorded on December 9 was a test performed on the Shockwatch logger by the vendor prior to attaching it to the EPU for shipment.

After the shipment of the ESM EPU57 insertion device, Kyma focused on the completion of the contract for two long EPU devices (3.5m-long EPU57 for SIX, 2.8m-long EPU105 for ESM). In collaboration with 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), Kyma completed the Preliminary Mechanical Acceptance Test (PMAT) of the ESM EPU105 insertion device. As for the other EPUs, the PMAT consisted of two main parts: first, the deformation of the mechanical frame under a force with a magnitude similar or larger than the eventual magnetic force is measured; and second, the plates on which the magnet arrays are to be mounted are installed and motion repeatability tests are conducted.

During the same time frame, Kyma completed assembly and measurement of the magnet modules for the SIX EPU57 device. These modules were then assembled on the mechanical frame in preparation for the SIX EPU57 Final Mechanical Acceptance Test (FMAT), which was held January 26-29 at the Kyma site in Slovenia. Staff from the NSLS-II Insertion Devices group was in attendance for two purposes:

1. To witness the SIX EPU57 FMAT. The FMAT confirms that mechanical deformation and motion repeatability meets specifications in the presence of the magnetic forces generated by the installed magnet arrays, as opposed to forces simulated by load cells during the PMAT.
2. To review the assembled magnet arrays and to observe the procedure for magnet module insertion and extraction from these arrays (Figure 12). Unlike the case of ESM EPU57, the contract for SIX EPU57 and ESM EPU105 does not include sorting or shimming of the magnet modules in the arrays. Therefore, it was important to have BNL personnel witness the magnet handling procedures before performing them at BNL.

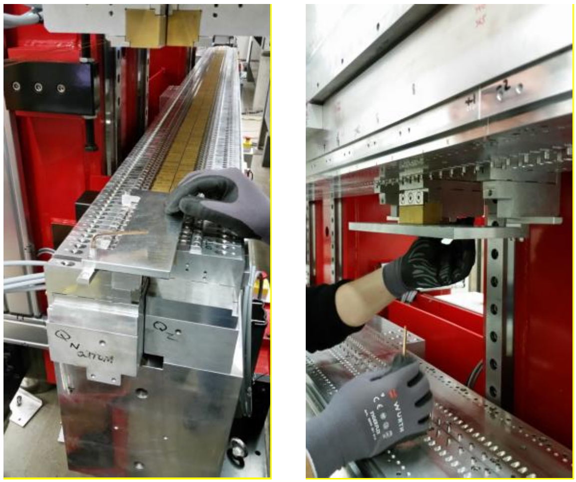


Figure 12: Demonstration of EPU magnet module insertion and removal procedure witnessed by BNL personnel during the SIX EPU57 FMAT held at the Kyma site in Slovenia.

PROJECT MILESTONES

Milestone	Planned	Actual
CD-0 (Mission Need):	May 27, 2010	May 27, 2010
CD-1 (Alternative Selection):	Sept. 30, 2011	Dec. 19, 2011
CD-2 (Performance Baseline):	Dec. 31, 2013	Oct. 9, 2013
CD-3A (Long Lead Procurement):	Dec. 31, 2013	Oct. 9, 2013
CD-3 (Start Construction):	Mar. 31, 2014	Jul. 7, 2014
Internal Early Project Completion – Beamlines	Oct. 14, 2016	
Early Project Completion:	Jan. 31, 2017	
CD-4 (Project Completion):	Sept. 29, 2017	

RECENT AND UPCOMING EVENTS

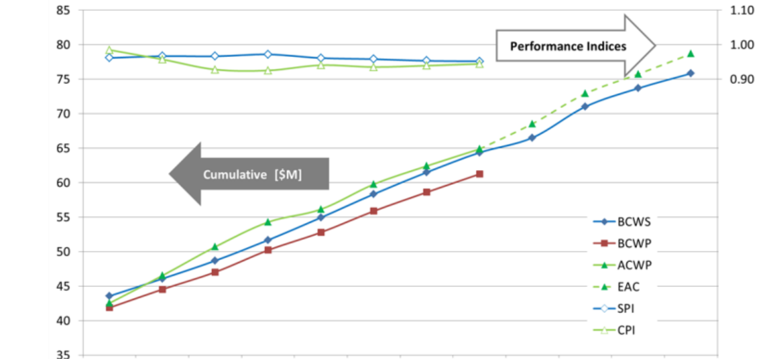
EVMS Desktop Review (BNL)	April 2016

Acronyms and Abbreviations

AC	Alternating Current
ACWP	Actual Cost of Work Performed
ARPES	Angle-Resolved PhotoElectron Spectroscopy
BAC	Budget at Completion
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BNL	Brookhaven National Laboratory
BPM	Beam Position Monitor
CD	Critical Decision
CPI	Cost Performance Index
CRL	Compound Refractive Lens
CSS	Control System Studio
CV	Cost Variance
DCM	Double Crystal Monochromator
DOE	Department of Energy
DOF	Degree of Freedom
DPPA	Dual Phase Plate Assembly
EAC	Estimate at Completion
EPICS	Experimental Physics and Industrial Control System
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 End
FMAT	Final Mechanical Acceptance Test
FOE	First Optics Enclosure
FTE	Full Time Equivalent
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
GHS	Gas Handling System
GISAXS	Grazing Incidence SAXS
HFM	Horizontal Focusing Mirror
ICD	Interface Control Drawing
ID	Insertion Device
IOC	Input/Output Controller
IRR	Instrument Readiness Review
ISR	Integrated In-Situ and Resonant X-ray Studies
ISS	Inner Shell Spectroscopy beamline
IVU	In-Vacuum Undulator
KB	Kirkpatrick Baez
LSSOC	Light Source Safety and Operations Council
MSM	Monthly Status Meeting
M&S	Material & Supplies
NEXT	NSLS-II Experimental Tools project
NSLS	National Synchrotron Light Source
NSLS-II	National Synchrotron Light Source II
OPA	Office of Project Assessment
OPC	Other Project Costs
PCR	Project Change Request
PDS	Photon Delivery System
PGM	Plane Grating Monochromator
PLC	Programmable Logic Controller
PMAT	Preliminary Mechanical Acceptance Test
PMB	Performance Management Baseline
PPS	Personnel Protection System
RAM	Random-Access Memory
RSC	Radiation Safety Committee
SAXS	Small Angle X-ray Scattering
SC	Office of Science
SIX	Soft Inelastic X-ray Scattering beamline
SMI	Soft Matter Interfaces beamline
SOE	Second Optics Enclosure
SPI	Schedule Performance Index
SV	Schedule Variance
TEC	Total Estimated Cost
TPC	Total Project Cost
UB	Undistributed Budget
VAC	Variance At Completion
VFM	Vertical Focusing Mirror
WBS	Work Breakdown Structure
WS	Working Schedule
XBPM	X-ray Beam Position Monitor

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, with account-level cost corrections applied as needed to account for the difference between the Earned Value and accrual schedules. 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	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16
BCWS	43.6	46.1	48.7	51.7	54.9	58.3	61.5	64.3	66.5	71.0	73.7	75.8
BCWP	41.9	44.5	47.0	50.2	52.8	55.9	58.6	61.2				
ACWP	42.5	46.5	50.7	54.3	56.1	59.8	62.4	64.9				
SPI	0.96	0.97	0.97	0.97	0.96	0.96	0.95	0.95				
CPI	0.98	0.96	0.93	0.93	0.94	0.93	0.94	0.94				
ETC								20.9	17.2	12.9	10.0	7.1

The NEXT project Schedule Variance (SV) for January 2016 is -$220k, with an associated monthly Schedule Performance Index (SPI) of 0.92 (green status). The largest contributors to the current month schedule variance are provided in the table below. The cumulative SPI is 0.95 (green status), the same as it was in December.

The NEXT project Cost Variance (CV) for January 2016 is +$179k, with an associated monthly Cost Performance Index (CPI) of 1.07 (green status). The primary contributors to the current month CV are provided in the table below. The cumulative CPI is 0.94 (green status), the same as it was in December.

Leading Current Month Variances [$K], January 2016

WBS	Title	Schedule		Cost	
		SV	Issues	CV	Issues
2.01	Project Support	-12	--	-109	HR performance incentive program costed in a single month, planned linearly
2.03	Common Systems	34	Earned value in Control Station (WBS 2.03.04) greater than planned	-16	--
2.04	Controls	-70	High sensitivity cameras earned this month, scheduled earlier and later	-25	--
2.05	ESM systems	-60	Late M4 and KB mirror activities	53	KB installation earned but not accrued/paid in January
2.06	FXI	43	Shielded enclosure test activities earned this month, scheduled for Nov. & Dec. 2015	42	Shielded enclosure test activities performed below estimated cost
2.07	ISR	-24	--	-24	--
2.08	ISS	-10	--	-40	Underestimated M&S and labor experienced during PDS installation
2.09	SIX	-289	Sum of a number of late PDS activities (M4, PGM, grating ruling, non-optics)	-38	--
2.10	SMI	-60	Removable Pipe FDR scheduled this month, completed in Dec. 2015	38	--
2.11	Insertion Devices	228	Earned EPU and EPU power supply activities, scheduled earlier or later	208	EPU105 PMAT earned but not accrued in January, EV for power supplies paid earlier
2.12	ID & FE Install	0	--	90	Corrections to earlier labor charges
	Total	**-220**	**Total**	**179**	

As of January 31, 2016, the project is 74.4% complete with 36.6% contingency ($7.7M) for $21.1M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through January 2016. The project EAC for January is reported at $85,752k against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $82,300k. The Variance At Completion (VAC) is given by VAC = BAC – EAC, with EAC = ACWP + ETC. Through January 2016, the VAC (-$3,452k) is nearly equal to the cumulative cost variance (-$3,628k), which is in turn dominated by labor cost overage on work performed to date.

The January 2016 EAC ($85.75M) is $0.56M greater than the December 2015 value. The major contributors to EAC growth in January are: PPS cost maturation (+$210k), ISS installation cost overruns (+$125k), SIX endstation design evolution (+$160k), insertion devices cost underruns (-$70k), and cost overruns in project support (+$140k). As of the end of January, contingency on EAC is $4.25M, which represents 20.3% of $20.9M EAC work remaining. Outstanding commitments total $11.6M, so the $4.25M contingency on EAC represents 45.9% of $9.3M unobligated EAC work to go. ETC will continue to be assessed monthly through project completion to contain costs while maintaining the good schedule performance that the project has demonstrated to date.

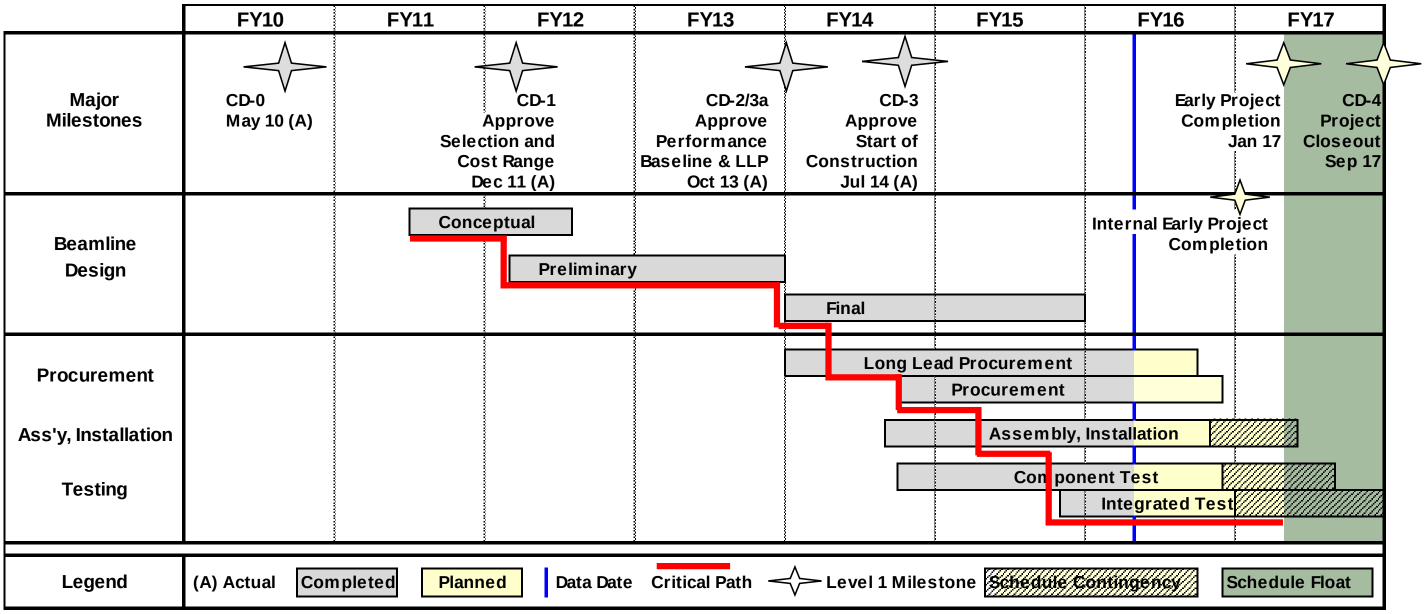
No PCRs were proposed in January.

3 PCRs are planned for February 2016: PCR 16_110, a Level 3 PCR in WBS 2.11.01 (Insertion Devices) to implement schedule changes to the contract with Kyma for a 3.5m-long EPU57 for SIX and a 2.8m-long EPU105 for ESM; PCR 16_111, a Level 3 PCR in WBS 2.08 (ISS Beamline Systems) to implement amendments to the Gas Handling System and Sample Chamber Assembly contracts; and PCR 16_112, a Level 2 PCR to implement milestone date changes associated with PCR 16_107 (a December PCR that added future ETC items into the NEXT baseline).

NEXT as of 1/31/2016	Current Period	Cum-to-Date
Plan (BCWS) $k	2,863	64,349
Earned (BCWP) $k	2,644	61,240
Actual (ACWP) $k	2,465	64,868
SV $k	-220	-3,108
CV $k	179	-3,628
SPI	0.92	0.95
CPI	1.07	0.94
Budget at Completion $k (PMB [UB])		82,300
Planned % Complete (BCWS/BAC)		78.2%
Earned % Complete (BCWP/BAC)		74.4%
Contingency $k		7,700
Contingency / (BAC – BCWP)		36.6%
EAC $k		85,752
Contingency / (EAC – BCWP)		31.4%
(Contingency + VAC) / (EAC – ACWP)		20.3%
TPC = PMB + Contingency		90,000

Milestones – Near Term		Planned	Actual
L3	ISS – Testing High Heatload Monochromator Complete	5-Jan-16	23-Nov-15
L2	Receive 1st Double Crystal X-ray Monochromator	16-Feb-16	30-Sep-15
L3	ISR - Bench test of Dual Phase Plate Assembly complete	24-Feb-16	
L3	SIX - Testing Monochromator and Slits complete	1-Mar-16	
L3	ESM - Photon Delivery System Ready for Integration	7-Mar-16	
L3	ISR - Installation of DCM Monochromator complete	15-Mar-16	
L3	Common Beamline Systems: Electrical Utilities Installed	29-Apr-16	
L3	ESM - Testing Monochromator and Slits complete	12-May-16	
L2	Complete Installation of 1st Beamline Components	25-May-16	
L2, L3	Common Beamline Systems: Mechanical Utilities Installed	31-May-16	
L3	Insertion Devices - SIX EPU Received	6-Jun-16	
L3	SMI - Installation of CRL Focusing Optics Complete	17-Jun-16	
L3	ISR – Installation of Beamline Components Complete	29-Jun-16	
L3	ISS - Testing Collimating Mirror complete	7-Jul-16	
L2	Receive EPUs for ESM and SIX	12-Aug-16	
L3	Insertion Devices - ESM EPU Received	12-Aug-16	11-Jan-16 (1st of 2)
L3	SIX - Testing of Spectrometer Detector Complete	23-Aug-16	
L3	Common Beamline Systems: EPS Installed	25-Aug-16	
L3	WBS 2.04 – Beamline Control Systems Complete	14-Sep-16	
L3	ISS – Installation of Beamline Components Complete	14-Sep-16	
L3	SMI – Installation of Beamline Components Complete	16-Sep-16	
L3	ESM – Installation of Beamline Components Complete	29-Sep-16	
L3	SIX – Installation of Beamline Components Complete	30-Sep-16	
L2, L3	Complete Installation of Common Beamline Systems PPS	30-Sep-16	
L2	1st Beamline Available	30-Sep-16	
L2	Early Project Completion – incl. IRR	31-Jan-17	

PROJECT SCHEDULE



The project critical path runs through activities in WBS 2.09 (SIX beamline). As of January 2016, the active critical path runs through fabrication, assembly, testing, delivery, installation, and phase 1 commissioning (including controls) of the SIX Beamline Spectrometer Arm System.

Staffing Report

Staffing as of 1/31/2016	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	0.62	0.44	33.68	31.13
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	1.11	0.78	22.60	10.24 *
WBS 2.04 Control System	0.68	0.68	15.78	15.01
WBS 2.05 ESM Beamline	0.62	0.47	13.15	13.75
WBS 2.06 FXI Beamline	0.01	0.00	4.76	4.58
WBS 2.07 ISR Beamline	0.44	0.28	12.57	11.55
WBS 2.08 ISS Beamline	0.53	0.47	12.09	11.89
WBS 2.09 SIX Beamline	0.32	0.43	15.15	17.74
WBS 2.10 SMI Beamline	0.41	0.27	12.14	11.63
WBS 2.11 Insertion Devices	0.12	0.13	4.29	3.71
WBS 2.12 ID & FE Installation	0.00	-0.62	3.88	7.97
Total	**4.86**	**3.33**	**158.83**	**147.94**

** 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 January 2016: 136

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 NEXT	a. NAME NSLS-II Experimental Tools (NEXT) Project	a. FROM *(YYYYMMDD)* 2016 / 01 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER	b. PHASE	b. TO *(YYYYMMDD)* 2016 / 01 / 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)	BUDGETED COST WORK PERFORMED (3)	ACTUAL COST WORK PERFORMED (4)	VARIANCE SCHEDULE (5)	VARIANCE COST (6)	CUMULATIVE TO DATE: BUDGETED COST WORK SCHEDULED (7)	BUDGETED COST WORK PERFORMED (8)	ACTUAL COST WORK PERFORMED (9)	VARIANCE SCHEDULE (10)	VARIANCE COST (11)	AT COMPLETION: BUDGETED (14)	ESTIMATED (15)	VARIANCE (16)
2.01 Project Management and Support	168,704	157,096	266,167	(11,608)	(109,072)	7,857,123	7,857,123	8,611,935	0	(754,812)	9,918,232	10,567,289	(649,057)
2.01.01 Project Management	72,023	72,023	46,331	0	25,692	3,708,879	3,708,879	3,462,670	0	246,210	4,598,029	4,359,261	238,767
2.01.02 Project Support	96,680	85,072	219,836	(11,608)	(134,763)	4,148,244	4,148,244	5,149,266	0	(1,001,022)	5,320,204	6,208,028	(887,824)
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	130,813	165,178	181,346	34,365	(16,169)	5,651,014	5,531,950	6,701,026	(119,063)	(1,169,076)	7,212,607	8,506,993	(1,294,386)
2.03.01 Utilities	93,560	88,844	50,523	(4,716)	38,320	4,164,048	3,779,025	3,936,324	(385,023)	(157,299)	4,209,423	4,397,829	(188,407)
2.03.02 Personnel Protection System (PPS)	27,343	19,706	80,955	(7,637)	(61,249)	638,421	791,821	1,514,448	153,401	(722,626)	1,523,306	2,287,916	(764,610)
2.03.03 Equipment Protection System (EPS)	1,689	14,241	34,334	12,553	(20,093)	331,581	405,423	653,691	73,843	(248,268)	680,294	981,698	(301,404)
2.03.04 Control Station	220	35,275	9,126	35,055	26,149	93,100	133,596	88,616	40,496	44,980	306,744	260,228	46,516
2.03.05 Common Beamline Systems Management	8,002	7,112	6,408	(890)	704	423,864	422,084	507,947	(1,780)	(85,863)	492,840	579,322	(86,481)
2.04 Control System	154,985	84,564	109,488	(70,421)	(24,924)	3,794,909	3,722,157	3,809,539	(72,752)	(87,382)	4,558,236	4,595,717	(37,481)
2.04.01 Control System Management	4,964	4,964	4,707	0	257	242,804	242,804	200,407	0	42,397	294,427	252,048	42,379
2.04.02 Control System Design & Implementation	79,133	79,600	96,602	467	(17,002)	2,201,881	2,280,448	2,396,683	78,566	(116,235)	2,913,586	3,025,670	(112,084)
2.04.03 Control System Equipment	70,888	0	8,179	(70,888)	(8,179)	1,350,223	1,198,905	1,212,449	(151,319)	(13,545)	1,350,223	1,317,999	32,224
2.05 ESM Beamline	318,153	258,200	205,452	(59,953)	52,748	8,714,564	8,072,281	8,467,218	(642,282)	(394,936)	9,289,079	9,527,958	(238,879)
2.05.01 ESM Management	13,815	13,815	4,789	0	9,027	481,025	481,025	435,669	0	45,356	626,650	571,966	54,684
2.05.02 ESM Beamline Systems	304,338	244,385	200,664	(59,953)	43,721	8,233,539	7,591,257	8,031,549	(642,282)	(440,293)	8,662,429	8,955,992	(293,563)
2.06 FXI Beamline	0	43,089	638	43,089	42,451	1,818,324	1,806,749	1,636,049	(11,575)	170,699	1,818,324	1,811,340	6,984
2.06.01 FXI Management	0	0	638	0	(638)	409,359	409,359	470,908	0	(61,549)	409,359	470,908	(61,549)
2.06.02 FXI Beamline Systems	0	43,089	0	43,089	43,089	1,408,965	1,397,389	1,165,141	(11,575)	232,248	1,408,965	1,340,431	68,534
2.07 ISR Beamline	1,005,661	981,588	1,005,451	(24,073)	(23,863)	6,474,382	5,791,627	6,071,233	(682,755)	(279,606)	10,361,410	10,552,049	(190,639)
2.07.01 ISR Management	26,964	26,964	18,123	0	8,841	837,208	837,208	836,234	0	974	1,105,394	1,039,329	66,065
2.07.02 ISR Beamline Systems	978,697	954,625	987,328	(24,073)	(32,703)	5,637,174	4,954,419	5,234,999	(682,755)	(280,580)	9,256,015	9,512,720	(256,704)
2.08 ISS Beamline	322,131	312,087	352,551	(10,044)	(40,464)	8,172,197	8,390,388	9,009,012	218,190	(618,625)	10,414,964	11,002,805	(587,841)
2.08.01 ISS Management	12,928	23,510	9,190	10,583	14,320	594,679	637,009	576,728	42,331	60,281	838,199	741,089	97,110
2.08.02 ISS Beamline Systems	309,203	288,576	343,361	(20,627)	(54,784)	7,577,519	7,753,379	8,432,284	175,860	(678,906)	9,576,765	10,261,716	(684,950)
2.09 SIX Beamline	388,783	99,431	137,053	(289,352)	(37,622)	8,691,836	7,106,917	7,759,730	(1,584,919)	(652,813)	11,572,208	12,304,781	(732,574)
2.09.01 SIX Management	18,223	18,223	7,455	0	10,768	557,901	557,901	569,974	0	(12,073)	729,841	741,620	(11,779)
2.09.02 SIX Beamline Systems	370,560	81,208	129,598	(289,352)	(48,390)	8,133,935	6,549,017	7,189,756	(1,584,919)	(640,740)	10,842,367	11,563,161	(720,795)
2.10 SMI Beamline	250,153	190,564	152,777	(59,589)	37,787	6,803,367	6,565,996	6,655,532	(237,371)	(89,536)	9,108,910	9,087,655	21,255
2.10.01 SMI Management	11,253	11,253	14,646	0	(3,393)	636,208	636,208	544,246	0	91,963	802,179	710,030	92,149
2.10.02 SMI Beamline Systems	238,899	179,310	138,131	(59,589)	41,180	6,167,158	5,929,788	6,111,287	(237,371)	(181,499)	8,306,731	8,377,624	(70,894)
2.11 Insertion Devices	123,979	351,906	143,619	227,927	208,287	3,110,680	3,135,093	2,841,172	24,413	293,921	4,785,909	4,535,339	250,570
2.11.01 ESM EPU Insertion Device	121,402	349,329	133,850	227,927	215,479	2,922,943	2,947,356	2,706,510	24,413	240,846	4,568,312	4,370,807	197,505
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	2,577	2,577	9,770	0	(7,192)	70,600	70,600	64,287	0	6,313	100,460	94,157	6,303
2.12 ID & FE Installation & Testing	0	0	(89,966)	0	89,966	1,452,816	1,452,816	1,498,527	0	(45,711)	1,452,816	1,452,816	0
2.12.01 ID & FE Installation & Testing Management	0	0	0	0	0	20,739	20,739	20,739	0	0	20,739	20,739	0
2.12.02 ID Installation & Testing	0	0	(45,630)	0	45,630	584,560	584,560	619,626	0	(35,065)	584,560	584,560	0
2.12.03 FE Installation & Testing	0	0	(44,336)	0	44,336	847,517	847,517	858,163	0	(10,646)	847,517	847,517	0
Total Project Baseline	2,863,362	2,643,703	2,464,578	(219,659)	179,126	64,348,528	61,240,413	64,868,291	(3,108,114)	(3,627,878)	82,300,012	85,752,058	(3,452,046)
Undistributed Budget													
Management Reserve													
Performance Management Baseline - PMB	**2,863,362**	**2,643,703**	**2,464,578**	**(219,659)**	**179,126**	**64,348,528**	**61,240,413**	**64,868,291**	**(3,108,114)**	**(3,627,878)**	**82,300,012**	**85,752,058**	**(3,452,046)**