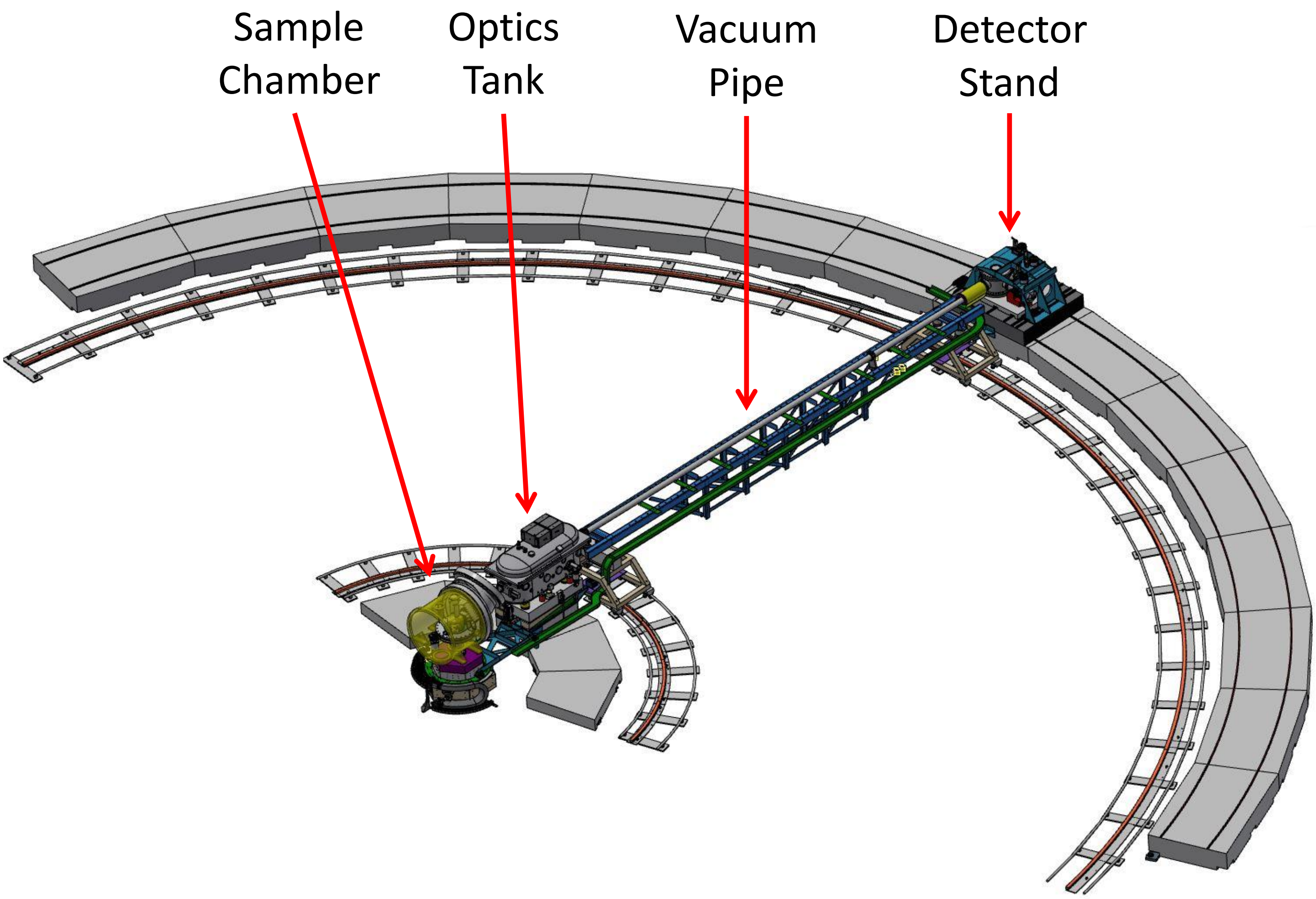
NSLS-II Experimental Tools (NEXT)

June 2015 Project Activity



Rendering of the SIX Endstation and Soft X-ray Emission Spectrometer at 2-ID, provided by BESTEC GmbH.

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OVERALL ASSESSMENT

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

Two major procurement contracts were awarded during June, for the SIX Sample Manipulator on June 3 and the ISS X-ray Emission Spectrometer on June 5. Upcoming major procurements include the SIX sample chamber vessel and the sample handling system for ISS. As of the end of June, four major procurements remained to be awarded. Monitoring and management of contractor progress on the ~60 major procurement contracts awarded to date is an important ongoing activity, one that is crucial to maintaining project schedule.

Three PCRs were approved in June, all related to contract awards or amendments, with a net cost increase to baseline of $279K: PCR NEXT_15_088 (WBS 2.10.02, SMI Beamline Systems, +$34K change to baseline) implemented contract award of the SMI Vacuum Sample Stages as well as minor revisions to three other SMI contracts that just completed their FDRs. PCR NEXT_15_089 (WBS 2.04.02, 2.04.03, Control Systems, +$19K change to baseline) implemented contract award of Linux servers and purchase of additional controls cable. PCR NEXT_15_083 (WBS 2.03.01, Common Systems Utilities, +$226K change to baseline) implemented purchase and installation of additional equipment racks for SIX.

BAC rose $0.28M in June, to $81.39M. EAC rose $1.7M, to $84.4M. Beginning this month, EAC is now reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), at the individual activity and resource level. The -$3.0M VAC at this point consists of $0.75M cumulative cost overage on work performed to date and $2.25M expected additions, the largest of which are in Common Systems ($0.4M), the ISS Beamline ($0.7M), and in ID/FE Installation and Testing ($1.1M).

As of June 30, 2015, the project is 51.4% complete. Cost contingency is reported at $8.61M, which represents 21.8% of $39.5M BAC work remaining or 20.2% of $42.5M EAC work remaining. If all of estimated VAC were to materialize, contingency would be reduced to $5.6M, which represents 13.2% of $42.5M EAC work remaining. With outstanding commitments totaling $21.5M, the $5.6M contingency on EAC represents 27.6% of $20.3M unobligated EAC work to go.

The cumulative EVMS schedule index fell 0.01 in June, to 0.96. The cumulative EVMS cost index fell 0.01, to 0.98, resulting from a number of accruals and payments processed in June.

An annual Earned Value Management System (EVMS) Surveillance Review was held June 29-July 1 at BNL. The purpose of this review is to certify the BSA EVM system by assessing its implementation on current DOE O413.3b projects at BNL, including NEXT. The review team consisted of EV experts from ANL (Chair), ORNL, JLab, SLAC, and BNL. The final report is expected in July. In their out brief, the review team noted the following best practices implemented by the NEXT Project: (1) The soon to be implemented EAC process on NEXT is excellent, (2) NEXT improvement of monthly reporting cycle, (3) use of Procurement Liaison Engineers, (4) strong project management culture based upon the CAM interviews provided, and (5) knowledge of 1st time CAMs interviewed was impressive, attributed to CAM training program.

Acceptance testing of NEXT shielded enclosures (hutches) made further progress in June, with 97% of the tests completed by the end of the month.

COMMON SYSTEMS

NEXT mechanical and electrical utilities finish work continued in June. ISR utilities are now completely installed, while SMI, 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 continued at SMI and ISR. Hardware installation at ESM started in June, including installation of A and B chain wiring and hardware integration. In addition, the PPS team has been developing plans for rework of hutch interface points for compatibility with PPS hardware. The hutch suppliers have been engaged regarding remediation of mechanical interfaces. The majority (90%) of Personnel Protection System (PPS) components have been received through June. 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 through June, 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 FY2015, as beamline equipment is installed.

Control station furniture for ESM and ISS has been received and the supplier returned to NSLS-II this month to install the furniture at each beamline. SMI furniture has been finalized and the contract awarded.

BEAMLINE CONTROLS

Beamline controls installations made good progress in June, owing to additional technician effort made available to

NEXT. Motor and encoder cables were installed at ESM (21-ID), in the SIX FOE (2-ID-A), and in the ISR C hutch (4-ID-C).

Working with NSLS-II network engineers, the network architecture was finalized for all NEXT beamlines during June. Network technicians began network fiber installation at ISS (8-ID), to be ready for installation of the ISS network switch and storage server. While preparing for this installation, it was discovered that the depth of the new storage server interferes with the power sockets in the heretofore standard computing rack. The electrical group modified the socket location to a new standard for data storage and computing racks. PDUs (Power Distribution Units) were ordered for these racks.

As planned, data storage units for the ESM and SIX beamlines were ordered in June. Data storage requirements for SMI and ISR were finalized this month, with procurement expected to begin in July.

Acceptance tests for 25 Prosilica GT1290 cameras received in late May were performed in June.

In order to increase the number of NSLS-II staff trained to tune Delta Tau motion controllers, NEXT has arranged for on-site training of 10 staff by a Delta Tau controls engineer in July. Preparation of the training stations needed for this course (motion controllers, power supplies, motors, encoders, and cabling) made good progress in June.

The NEXT staffing plan includes increased controls engineering effort (average one FTE controls engineer per beamline) during the testing and commissioning phases of the project, which extend to the internal early project completion date (end of FY16). During June, two control engineers rolling off the ABBIX project began to provide effort for NEXT: Diego Omitto and Bruno Martins were assigned to support ISS and ESM, respectively.

ESM – ELECTRON SPECTRO-MICROSCOPY

Delivery of ESM photon delivery system optics has begun, with receipt in June of the M1 mirror and two of the four gratings.

M1, the first ESM optical element, is crucial to the correct operation of the beamline. Although a simple plane mirror, only deflecting the light inboard 2.5^0, it is more than half a meter long (optical aperture: 560 mm x 16 mm) and the required slope errors are very small (tangential slope error ≤ 0.25 µrad). The M1 mirror needs to withstand the full power of the insertion device (up to 1.5 kW) with minimal thermal deformation, which would be detrimental to the quality of the effective source. This goal is achieved by a mirror design developed and manufactured by InSync, Inc. The mirror substrate is composed of two parts, a Si body and a Si cap piece with the polished mirror surface. Water channels are machined in the body and the cap is affixed to it via a complex Si-Si bonding process. In this way, an "internally water cooled" mirror is realized with cooling channels located very close (~1mm) to the mirror surface. The ESM M1 mirror is shown in Figure 1. The two mini-flanges at the sides of the mirror surround the input and output water connections. In the bottom part of Figure 1 is an example metrology trace of the longitudinal slope error measured along the center line of the mirror. The rms figure error value measured over the entire length of the mirror (560 mm) is 0.238 µrad and meets the required specification. Furthermore, the largest contribution to the slope error comes from the ends of the mirror, so that slightly limiting the length to 540 mm (~3% decrease in the active surface area) reduces the measured rms slope error to below 0.2 µrad. The slope error can also be reduced down to 0.1 µrad if approximately half of the mirror surface is used.

Of the four gratings needed to cover the energy range of the ESM beamline, the two ruled by Shimadzu (Kyoto, Japan) were delivered in June. These gratings are now in the NSLS-II metrology lab for AFM measurements of the grating profile. The other two ESM gratings are being manufactured by Horiba Jobin Yvon in France and will be ready by the end of August. All four gratings will be tested in September at the Soleil Synchrotron Facility. Two types of measurements will be made: (1) LTP measurements in the optical metrology lab to verify the VLS line spacing and (2) a dedicated run at the Soleil metrology beamline to measure the diffraction efficiency in soft X-ray range. These measurements are important for commissioning of the ESM beamline by providing grating diffraction efficiency values independent of the performance of any other part of the ESM beamline.

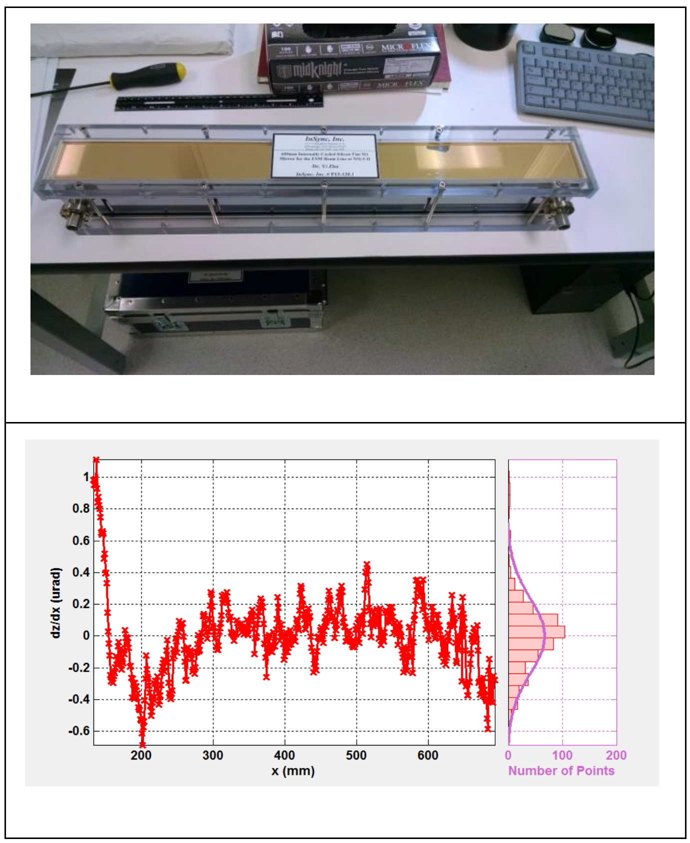


Figure 1: Top: ESM internally water cooled M1 mirror, delivered by InSync, Inc. Bottom: figure metrology test scan (slope error vs. longitudinal position) along the center line of the M1 mirror surface, confirming that it meets specification (0.25 µrad rms).

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.

ISR – IN-SITU AND RESONANT HARD X-RAY

RFQs for the motorized table for the *in-situ* endstation and for high-vacuum slits were posted on FedBizOpps on June 22 and 26, respectively, with purchase orders expected to be placed for both components in early July. Following the successful testing of slides that will be used to translate Hutch C beam pipe into and out of the beam, a purchase order for the final two slides was placed on June 29. A requisition for the differential pump, which will be located between Hutches B and C, was approved on June 29.

Progress on the design of the endstation changeover scheme continued and the locations of the remaining two stands were finalized. One of these stands will support two slides, a set of high-vacuum slits, and a pump-out port. The second stand will support the incident flight path for the 6-circle diffractometer or the downstream beam pipe in Hutch C when the *in-situ* endstation is in use. The second stand will have deployable wheels such that it can be easily removed to provide space for secondary focusing optics, or for any other temporary beam conditioning component or diagnostic, upstream of the 6-circle diffractometer.

The latest iteration of the Toyama mirror bender design was completed, and detailed FEA was carried out for both the HFM and VFM. Vibrational analyses indicate lowest modes near 100 Hz, which is satisfactory. A summary of structural analysis results is shown in Figure 2. For both mirrors, there are two important radius values: (1) for focusing to the secondary source (9 and 6.5 km for the HFM and VFM, respectively) and (2) for focusing directly to the 6-circle diffractometer (12.5 and 11 km for the HFM and VFM, respectively). Toyama calculated the required force to achieve each bending radius and, for the HFM, values with no heat load and with maximum heat load. Note that the heat load on the HFM will vary greatly depending upon the magnitude of the undulator gap and the choice of mirror reflecting surface (silicon or palladium) while the VFM will only be exposed to monochromatic beam with negligible power load. For the VFM, the structural analysis included the effects of gravity as well as compensating springs, which improve the surface figure. A prototype bender was also tested by Toyama. The test results indicate no evidence of twisting, but the bending profile was distinctly asymmetric. Toyama plans to add support pillars on both sides of the single kinematic point and repeat the testing.

Acceptance testing of ion pump controllers for ISR was completed, and the controllers were installed in the control racks. Electrometers and the Dectris Eiger X 1M pixel array detector (see Figure 3) were received.

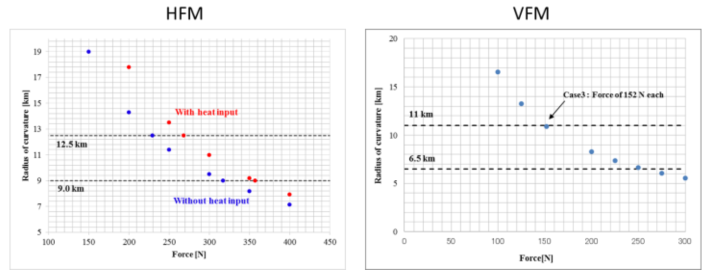


Figure 2: Radius of curvature as a function of bending force for the HFM (left) and VFM (right) mirrors at ISR.

Figure 3: Dectris Eiger X 1M pixel array detector for the ISR Beamline.

ISS – INNER SHELL SPECTROSCOPY

The Factory Acceptance Test (FAT) of the high heat load monochromator was split into two parts: FAT1 included testing of all functions and specifications of the scope defined in the original contract, while FAT2 focused on testing of all scope added to the contract as well as any follow-up actions from FAT1. FAT1, held at the beginning of June at Toyama (see Figure 4), found three performance discrepancies requiring remediation: (1) the first monochromator crystal seal developed a leak during the cool down process of the system, (2) the cooling braid connecting the heat exchanger with the second crystal was too stiff, not allowing proper roll and pitch rotations of the second crystal holder, and (3) reproducibility of the second crystal motions (without connecting the cooling braid) was insufficient. Additionally, significant shortcomings in documentation of test procedures and test results also required remediation. The cryo-cooler system provided by Suzuki Shokan, including all controls and connection hardware, passed all tests without any discrepancies. In particular, the maximum flow rate of 22 l/min at 90 Hz pump speed, an essential requirement to handle the heat load on the first crystal, was achieved.

As a corrective action to provide the required remediation efforts on schedule, Toyama exchanged the project manager and developed, along with the ISS team, a plan to improve the deficient design aspects along with detailed activity strings, logic links, and weekly milestones to measure schedule progress. Toyama was also presented with an example traveler which they adapted to the ISS monochromator requirements. At the end of the month, all necessary mechanical improvements were implemented, which will allow Toyama to fulfill the monochromator specifications. The cooling tests of the first crystal are in full progress; first results show that a change in the sealing concept results in the necessary improvement. The cooling braid was softened by tempering the Cu braid and an additional change in the coupling between the actuator and the tilt stages of the second crystal was implemented. Tests show that this system is now fulfilling the ISS specifications. The next ISS visit to Toyama, on July 6, will be devoted to the progress of the vacuum tests and on all activities necessary to fulfill FAT2, which is scheduled for the end of July.

The PDR for the higher harmonic rejection mirror system was held during June at Axilon in Cologne. All dimensions and design concepts were finalized so that the FDR can be held on August 3-4. Additionally, the conceptual design of a mechanical system to support all components between the sample chamber and the higher harmonic rejection mirror system was discussed. The various mirror and monochromator configurations, with their varying beam heights and beam angles relative to the ring plane, the associated space restrictions, and the large flexibility in required movements of the sample chamber create a significant design challenge. Axilon will provide a design concept and a quotation for provision of these mechanics.

The ISS spectrometer package was awarded to PI/Micos on June 5. This company will also supply the ISS sample chamber. A kick-off meeting for the spectrometer package was held in Munich, at which the major design concepts were discussed. To speed up the design process, PI/Micos and ISS agreed to split PDR into two phases: PDR1 for the spectrometer design will be held on July 20-21 and PDR2 for the interface parts connecting the spectrometers to the sample chamber on August 12-13. This staggered approach will allow PI/Micos to make all major design decisions for the spectrometers in July and proceed with long lead procurements to minimize overall schedule risk.

The first phase of installation of the Gas Handling System was completed in June, consisting of two fully automatic gas cabinets, two semi-automatic cabinets, and four manual gas panels. The second part of the FAT was also performed at AES this month, during which two fully automatic gas cabinets (for toxic gases), the gas distribution box, the mass-flow controller box, all safety features, and the power distribution box with the controls PLC were successfully tested. All instruments successfully passed this testing, and the remainder of installation will be performed in July.

Further progress on infrastructure installation was made in June. These include the fiber optic system which will broadcast the global time stamp from the NSLS-II accelerator to all ISS controls units, and electrical installations on the support structure inside the enclosure 8-ID-B1.

Figure 4: Test setup for the ISS monochromator FAT at Toyama. From left to right: The controls rack of cryo-cooler system (containing the PLC system and all necessary controllers and power distribution systems), the cryo-cooler pump, the phase separator, and the high heat load monochromator with the housing for the bremsstrahlung stop. In the foreground, the laser interferometer system which was used to characterize vibrations and motions of the first and second crystals can be seen.

SIX – SOFT INELASTIC X-RAY

The initial installation and alignment of the VLS-PGM and exit slit by Bestec, which started on May 28 jointly with the installation of the VLS-PGM and exit slits for ESM, was successfully completed on June 5. The photo in Figure 5 shows the SIX PGM undergoing bake-out on the experimental floor of 2-ID. All other PDS procurement contracts with Bestec are currently in the production phase.

Given the unusually large scale of the scope of work for the spectrometer arm system package, SIX and Bestec decided to hold a pre-FDR a couple of weeks prior to the FDR in order to resolve several pending design and EPS issues. At this pre-FDR, held at Bestec's site from June 17-19, solutions were proposed and agreed upon for most of the issues. Two examples of solutions proposed by Bestec are shown in

Figures 6 and 7. Figure 6 shows switches to detect asynchronous motor actuation of the rotation of the arm, which is critical since the arm rotation will eventually rely on a synchronized actuation of five motors. Figure 7 shows mechanical switches to detect contact between the detector stand and the arm carriage. These will be used to ensure there is no contact during measurement, to avoid transmitting vibrations to the detector. 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 and routed for approval. Approval of the corresponding contract amendment will allow for timely sub-contract of the M7 mirror by Bestec without being held up by FDR approval of the entire spectrometer arm system contract.

Regarding the optics, the second of the two internally cooled mirrors contracted to InSync, M1, is still awaiting verification of the 200 nrad longitudinal slope error by the NSLS-II metrology group. Production of the elliptical mirror M3 and the ellipsoidal mirror M4 by JTEC Corp. is on schedule. The cylindrical mirror M6 was received on June 25 and is also awaiting optical metrology.

The low bid for the sample chamber and triple rotating flange (TRF) system was received on June 19. It was confirmed that the bid meets all of the technical requirements on June 25. The requested schedule of milestone payments was approved, and the award is slated to take place early in July.

Figure 5: SIX PGM installed on the 2-ID experimental floor, undergoing bake-out.

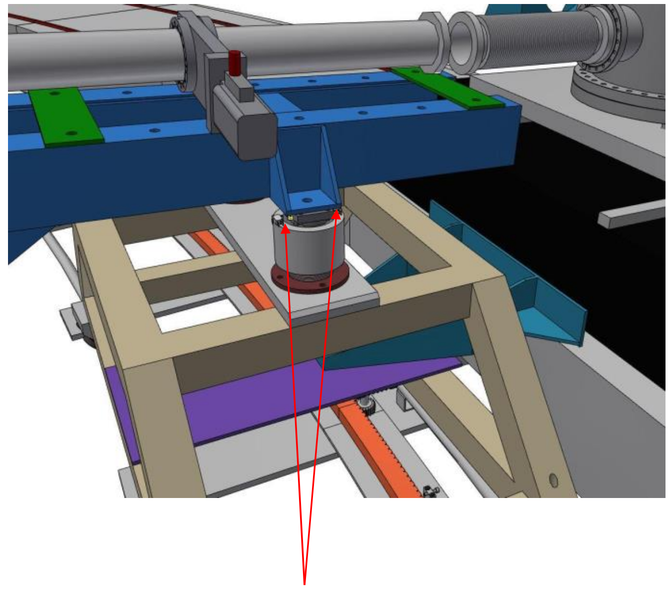


Figure 6: Rendering of the switches proposed by Bestec to be used for detection of asynchronous motor actuation of the rotation of the spectrometer arm.

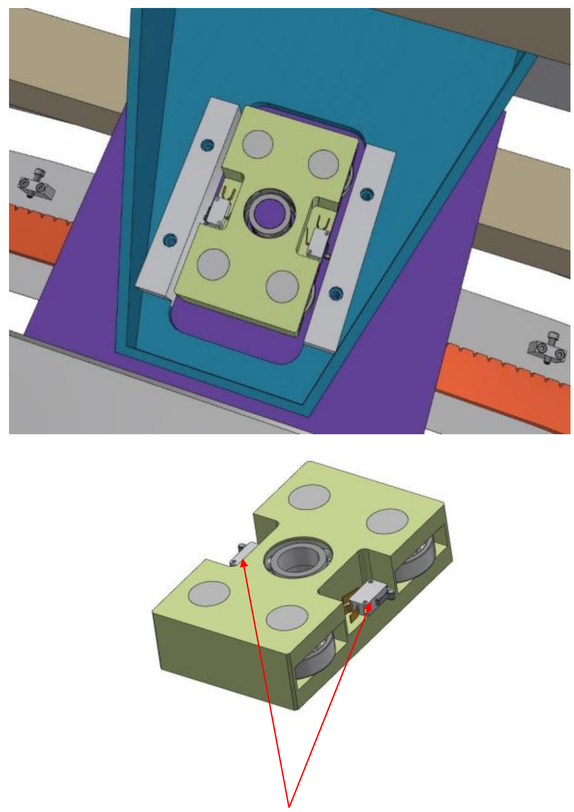


Figure 7: Rendering of the mechanical switches proposed by Bestec to detect contact between the detector stand and the arm carriage.

SMI – SOFT MATTER INTERFACES

With fabrication of the first photon delivery system components nearing completion, SMI completed its first factory acceptance test this month. One SMI team member traveled to GNB in Elk Grove, CA, to inspect the Sample Vacuum Chamber. In addition to inspection of the components and confirmation of the design, tests of vacuum chamber wall deflection under vacuum were conducted and the procedure for opening the clam-shell top with the crane was reviewed. One lesson learned was that completely fastening the flange bolts, while not required to mechanically secure the chamber, is critical to apply the correct forces to the flange to enable it to satisfy the deflection specification. Without the bolts, the chamber bottom plate exceeded its spec of < 0.020” deflection, measured by a dial indicator. With the bolts fastened, the chamber satisfied the requirement, with 0.013” measured deflection. The chamber top, which will support a microscope to view the sample through a viewport, also passed its test, with measured deflection < 0.010”. It is necessary to isolate this measurement from other forces lifting the plate, such as vacuum compression of the O-ring seals between chamber sections. Figure 8 shows the top plate deflection measurement, which was made by supporting a steel rail across tooling blocks positioned at the stiffeners, to which the dial indicator was secured with its magnetic base.

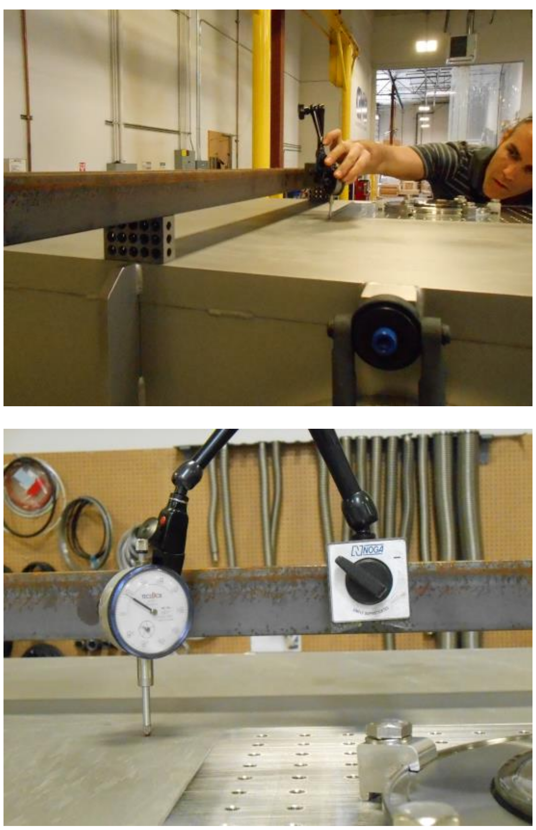


Figure 8. Deflection measurements of the SMI Sample Vacuum Chamber performed by GNB and SMI during Factory Acceptance Test. Left: GNB Project Manager Eric Raymond adjusting the dial indicator. Right: Measurement of top plate during vacuum cycling. The Sample Vacuum Chamber meets the specified <0.020” deflection of the top and bottom plates: the measurements showed 0.013” (0.009”) deflection of the bottom (top) plate.

Good progress continues to be made on fabrication of the largest photon delivery system procurement packages: White Beam Components (IDT) and H-V Mirrors (Cinel). For the Cryo-Cooler, SMI purchased cryo-lines from a third party vendor, Acme, rather than from IDT or Bruker, suppliers of the DCM and Cryo-Cooler respectively. The custom cryo-lines provide extra flexibility and thermal isolation for the DCM's long scattering angle range arising from the 2.1 to 24 keV x-ray energy extremes. The completed cryo-lines shipped this month, and await upcoming installation of the Cryo-Cooler and DCM. Regarding the cryo-cooler contract, Bruker encountered problems in May with a batch of ~6 cryo-coolers being fabricated in parallel for several different customers, including SMI. In June, Bruker successfully diagnosed the problem, which involved unstable line pressures due to turbulent flow in tubing with internal welds. The welds had been made by a subcontractor, who did not satisfy the specifications. As of late June, one device had been re-fabricated and operated properly. Bruker advised that the re-worked cryo-cooler for SMI will arrive at Bruker in July for testing and will be delivered to BNL, installed, and tested in August. While delivery will be one month behind the contract schedule, the cryo-cooler will still be ready for incorporation with the DCM, which is to be shipped in late August and installed in September.

Other SMI activities in June included finalization of the specifications for the shielded removable beam transport enabling the time-sharing mode between the two endstations; the kick-off meeting with PI-miCos for the Vacuum Sample Stages contract; and a visit to a laboratory SAXS facility at the U. Mass. Amherst. The laboratory SAXS facility, designed and built by Molmex Scientific, Inc., shares many design elements with the SMI SAXS assembly, including Dectris detectors with sensor electronics in the sample vacuum space and implementation of a beam tube of similar diameter to the SMI design. This visit allowed ideas to be shared that will enable SMI to complete the SAXS assembly design review in July with a high degree of confidence in its functionality.

INSERTION DEVICES

Members of the Insertion Devices Group (one scientist, two mechanical engineers, and one electrical engineer), accompanied by one QA engineer, travelled to the site of the contractor for the NEXT EPUs (Kyma) from June 8-12 for (1) the Final Design Review of the long EPUs (2.8m-long EPU105 for ESM and 3.5m-long EPU57 for SIX) contract and (2) to inspect the mechanical frame and electrical cabling of the short EPU (1.4m-long EPU57 for ESM), recently delivered to Kyma from a sub-contractor.

The long-EPU FDR focused mainly on the mechanical design, documentation to be provided, and the acceptance tests to be performed. During this review, a minor physical interference between the support of the vacuum chamber and the magnetic coils for field integral correction was identified. These coils are fixed to the side of EPU girder. Although the Final Design of the NEXT EPUs Vacuum chamber is already complete and was approved this month, the vacuum chamber contractor (FMB Berlin) agreed to modify the supports for this chamber to eliminate the interference.

In addition to receiving the mechanical frame and cabling for the short EPU, Kyma also received all the mechanical components of the magnetic holders in June. The platen on which magnet holders are to be affixed will be delivered in July prior to the Preliminary Mechanical Acceptance Test. A few corrective items related to the electrical cabling were identified and communicated to the contractor. Figure 9 shows the mechanical frame of the short ESM device upon arrival at contractor's site on June 8. Figure 10 shows cabling work performed for this device and the temporary electronics rack. The temporary rack will be incorporated in a standard NSLS-II rack after delivery of the device to BNL.

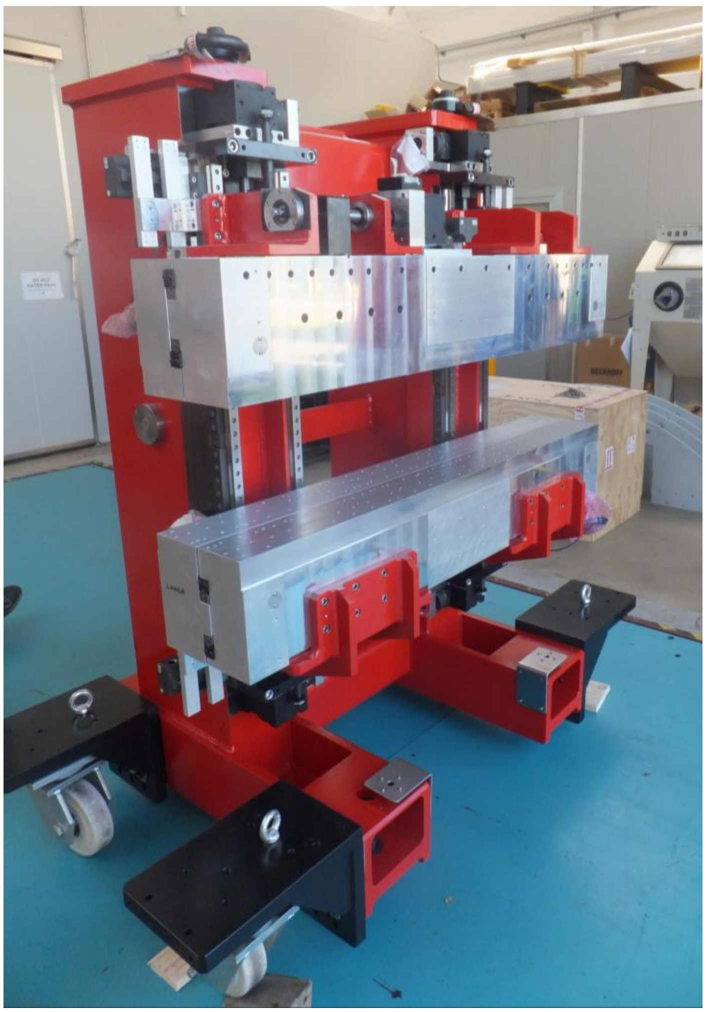


Figure 9. Mechanical frame of the short EPU57 insertion device for ESM delivered to the contractor's location on June 8. The platen, motors, and electrical cabinet were not installed when this photo was taken.

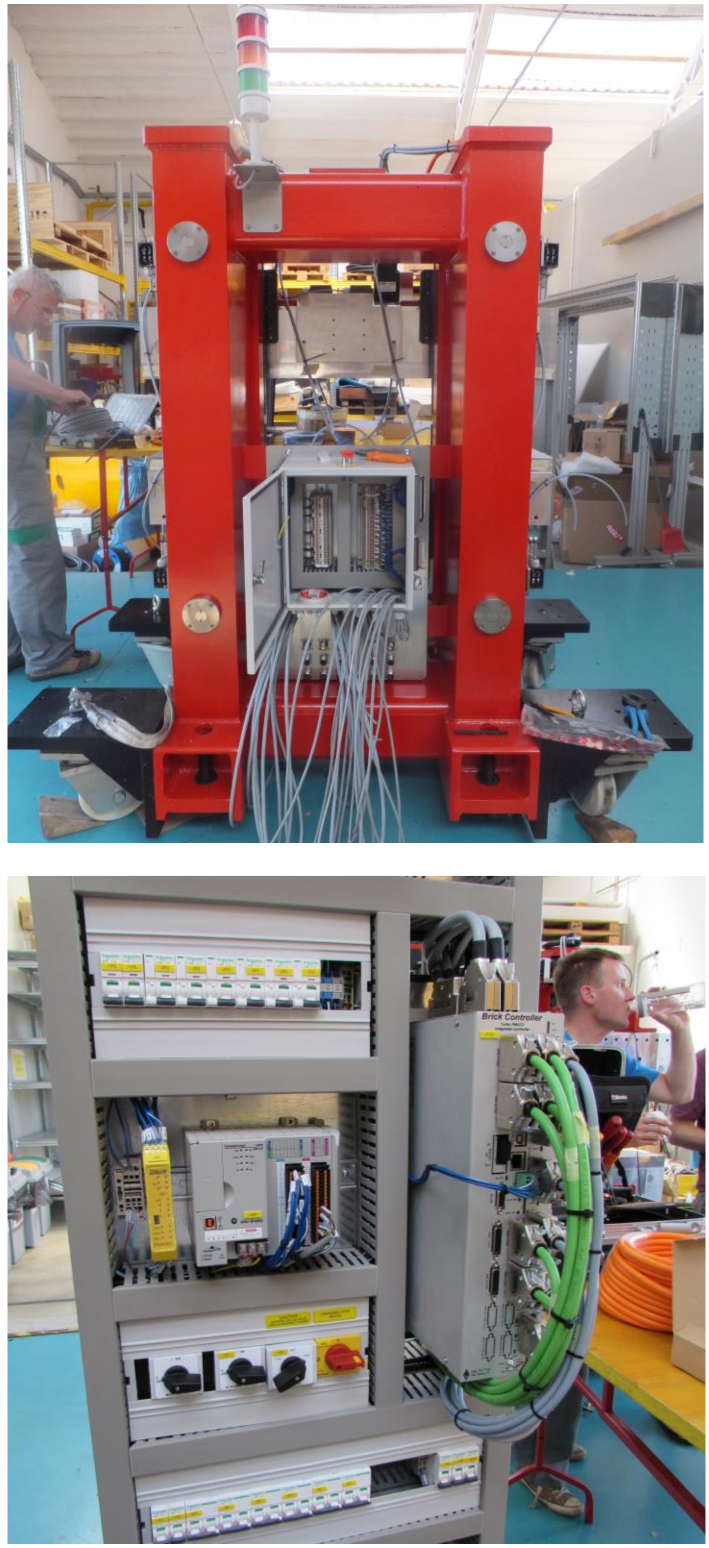


Figure 10. Cabling (top) and temporary electronics rack (bottom) for the short EPU57 insertion device for ESM. The temporary rack will be incorporated in a standard NSLS-II rack after delivery of the device to BNL.

The manufacturing of the 57mm-period magnets for the EPU57's (1.4m-long EPU57 for ESM and 3.5m-long EPU57 for SIX) is complete and Kyma is awaiting receipt of magnetic measurement test reports from the manufacturer prior to approving shipping of the magnets to their site.

ID/FE INSTALLATION

During this month, the terminating of the vacuum cables and the pulling of the diagnostic cables for the NEXT front ends was started. The fixed mask, slit, and photon shutter stands assemblies were installed in the SR tunnel for SIX and ESM. Plumbing and connection work is ongoing on 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.

During June there was no NEXT insertion device installation, as the IVU23 devices were still being measured in the magnetic measurement lab. During the latest phase of magnetic measurements, additional fine adjusters have been added to the devices to improve their spectral performance. The measurement of the first IVU23 has been completed and the second one is in process. 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

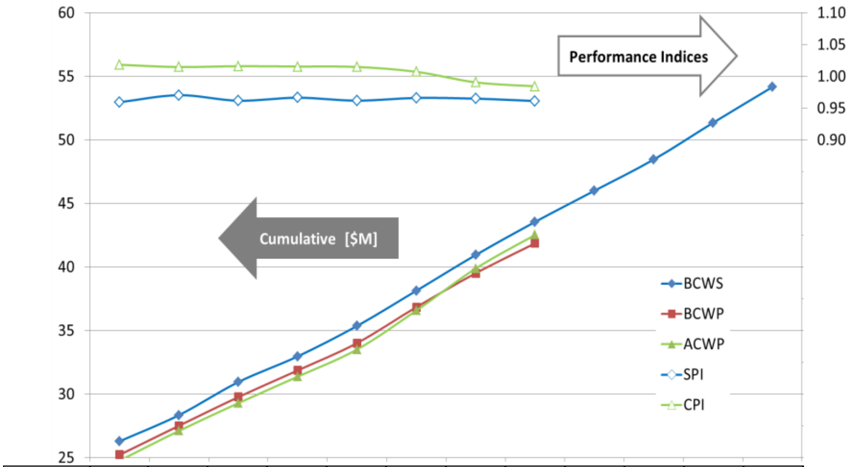
DOE/SC Status Review	November 3-4, 2015

Acronyms and Abbreviations

ABBIX	Advanced Beamlines for Biological Investigations with X-rays
ACWP	Actual Cost of Work Performed
AES	Applied Energy Systems
AFM	Atomic Force Microscope
ANL	Argonne National Laboratory
APP	Advanced Procurement Plan
APS	Advanced Photon Source
BAC	Budget at Completion
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CAM	Cost Account Manager
CD	Critical Decision
CPI	Cost Performance Index
CV	Cost Variance
DCM	Double Crystal Monochromator
DOE	Department of Energy
EAC	Estimate at Completion
EPS	Equipment Protection System
EPU	Elliptically Polarizing Undulator
ESM	Electron Spectro-Microscopy beamline
ETC	Estimated Cost to Complete
EV	Earned Value
EVMS	Earned Value Management System
FAT	Factory Acceptance Test
FDR	Final Design Review
FE	Front Ends
FEA	Front End Apertures
FOE	First Optics Enclosure
FPGA	Field-programmable Gate Array
FTE	Full Time Equivalent
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
HFM	Horizontal Focusing Mirror
ID	Insertion Device
IDT	Insertion Device Team
ISR	Integrated In-Situ and Resonant X-ray Studies
ISS	Inner Shell Spectroscopy beamline
IVU	In-Vacuum Undulator
LTP	Long Trace Profiler
M&S	Material & Supplies
NEXT	NSLS-II Experimental Tools project
NSLS-II	National Synchrotron Light Source ll
OPC	Other Project Costs
PCR	Project Change Request
PDR	Preliminary Design Review
PDS	Photon Delivery System
PDU	Power Distribution List
PGM	Plane Grating Monochromator
PLC	Programmable Logic Controller
PMB	Performance Management Baseline
PPS	Personnel Protection System
QA	Quality Assurance
RFQ	Request for Quote
SAXS	Small Angle X-ray Scattering
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
TRF	Triple Rotating Flange
UB	Undistributed Budget
VAC	Variance At Completion
VFM	Vertical Focusing Mirror
VLS	Vapor Liquid Solid
WBS	Work Breakdown Structure
XES	X-ray Emission Spectrometer

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	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15
BCWS	26.3	28.4	31.0	33.0	35.4	38.1	41.0	43.6	46.0	48.5	51.4	54.2
BCWP	25.2	27.5	29.8	31.9	34.0	36.9	39.5	41.9				
ACWP	24.8	27.1	29.3	31.4	33.5	36.6	39.9	42.5				
SPI	0.96	0.97	0.96	0.97	0.96	0.97	0.97	0.96				
CPI	1.02	1.01	1.02	1.02	1.01	1.01	0.99	0.98				
ETC								41.9	38.2	35.1	32.6	29.0

The NEXT project Schedule Variance (SV) for June 2015 is -$254K, with an associated monthly Schedule Performance Index (SPI) of 0.90 (green status). The cumulative SPI is 0.96 (green status), 0.01 lower than it was in May 2015. The negative current month schedule variance is the net result of a number of contributors, both positive and negative. The largest are: -$391K in WBS 2.07 (ISR Beamline) resulting from delays in the receipt of the FDR report for the Dual Phase Plate Assembly and in holding the FAT for the ISR Gas Handling System as well as some other smaller-value SV contributors, and +$109K in WBS 2.08 (ISS Beamline) resulting from delivery of the ISS Gas Handling System in June.

The NEXT project Cost Variance (CV) for June 2015 is -$287K, with an associated monthly Cost Performance Index (CPI) of 0.89 (yellow status). The primary contributors to the monthly CV in June are: -$463K in WBS 2.05 (ESM Beamline) resulting from payments and accruals for work earned in earlier months and -$180K in WBS 2.06 (FXI Beamline) resulting from a milestone payment for the FXI Shielded Enclosure contract which was earned in an earlier month, as well as smaller positive CVs in a number of WBS Level 2 areas. The cumulative CPI is 0.98 (green status).

As of June 30, 2015, the project is 51.4% complete with 21.8% contingency ($8.6M) for $39.5M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through June 2015.

The project EAC for June is reported at $84,395K against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $81,391K. The Variance At Completion (VAC) is given by VAC = BAC – EAC, with EAC = ACWP + ETC. Through June 2015, VAC is -$3,004K, of which 25% ($0.75M) comes from actual cost overages to date and 75% ($2.25M) represents contributors to EAC which have not been added to the project baseline. The major contributors to the $2.25M portion of VAC at the end of June include: -$0.42M 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 and additional PPS coding effort, and additional material for EPS systems; -$0.65M 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; and -$1.14M in WBS 2.12 (ID & FE Installation & Testing) for additional effort needed in this WBS in FY16 to complete ID and FE installation for all NEXT beamlines.

The contingency ($8.6M) is 20.2% of $42.6M EAC work remaining.

3 PCRs were approved and implemented in June.

PCR	PCR Level	Baseline Change [$]	Description
PCR-15-088	L3	33,724	APP094NX Contract Award & Contract Amendments
PCR-15-089	L3	19,387	Linux Servers Award & Additional Cables
PCR-15-083	L3	226,363	Additional Equipment Racks for SIX

Forthcoming PCRs include (i) a Level 3 PCR (NEXT_15_092) to implement award of the XES Spectrometer System contract in WBS 2.08 (ISS Beamline), (ii) a Level 3 PCR (NEXT_15_093) to implement an amendment to the Gas Handling System contract in WBS 2.07 (ISR Beamline), and (iii) a Level 3 PCR (NEXT_15_094) for additional labor and material for ID and FE installation and testing in WBS 2.12 (ID & FE Installation & Testing).

NEXT as of 5/31/2015	Current Period	Cum-to-Date
Plan (BCWS) $K	2,606	43,557
Earned (BCWP) $K	2,352	41,870
Actual (ACWP) $K	2,639	42,529
SV $K	-254	-1,687
CV $K	-287	-659
SPI	0.90	0.96
CPI	0.89	0.98
Budget at Completion $K (PMB [UB])		81,391
Planned % Complete (BCWS/BAC)		53.5%
Earned % Complete (BCWP/BAC)		51.4%
Contingency $K		8,609
Contingency / (BAC – BCWP)		21.8%
EAC $K		84,395
Contingency / (EAC – BCWP)		20.2%
(Contingency + VAC) / (EAC – BCWP)		13.2%
TPC = PMB + Contingency		90,000

SPI Project to Date*:

0.96

CPI Project to Date*:

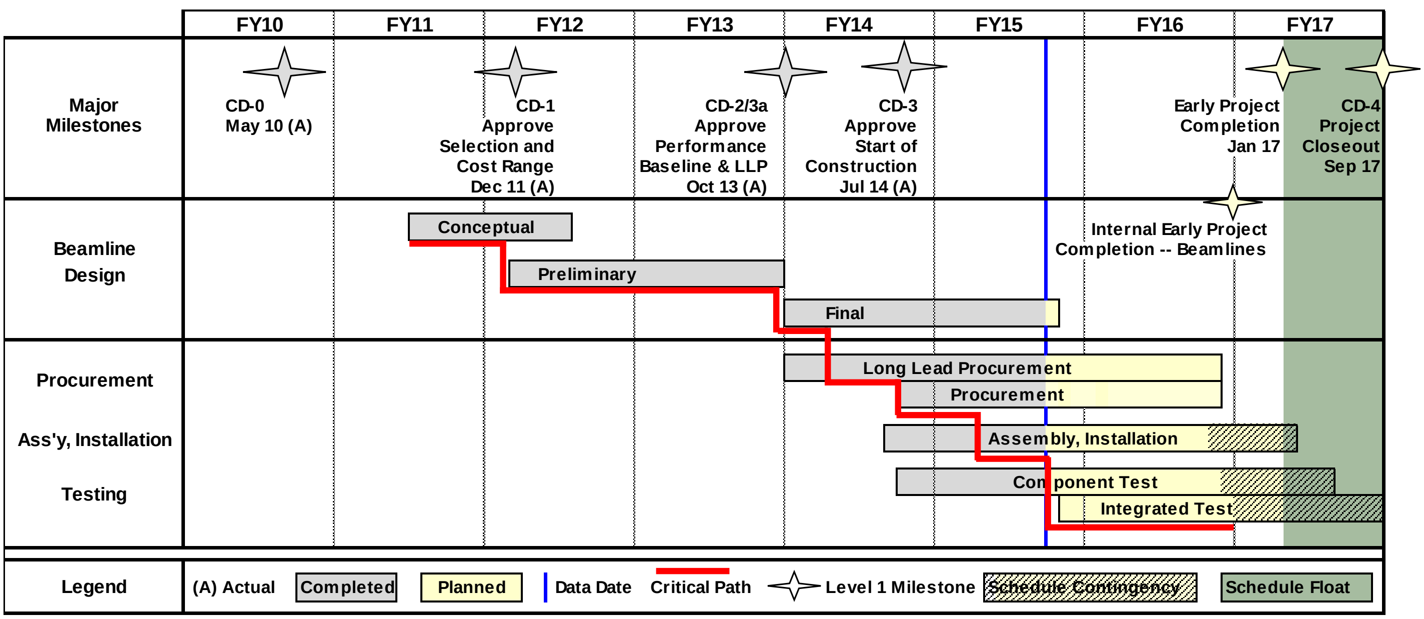
0.98

**Cause & Impact:* No reportable variance

Corrective Action: None required

Milestones – Near Term		Planned	Actual	Notes
L2,L3	Receive ISS Gas Handling System	17-Mar-15		1st delivery June, expect 2nd delivery July
L3	SIX – Award Spectrometer Grating Chamber	17-Mar-15	4-Feb-15	
L3	ISS – Award XES Spectrometer	21-May-15	5-Jun-15	

PROJECT SCHEDULE



The project critical path runs through activities in WBS 2.10 (SMI beamline). As of June 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 6/30/2015	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	0.72	28.19	27.02
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	1.75	0.63 *	12.43	5.02 *
WBS 2.04 Control System	0.70	0.72	10.16	9.57
WBS 2.05 ESM Beamline	0.17	0.57	9.48	9.92
WBS 2.06 FXI Beamline	0.00	0.08	4.62	4.47
WBS 2.07 ISR Beamline	0.44	0.30	9.88	9.09
WBS 2.08 ISS Beamline	0.20	0.33	9.08	9.26
WBS 2.09 SIX Beamline	0.34	0.58	12.80	13.65
WBS 2.10 SMI Beamline	0.39	0.28	8.73	8.95
WBS 2.11 Insertion Devices	0.32	0.20	3.17	2.18
WBS 2.12 ID & FE Installation	0.08	0.67	2.09	2.24
Total	5.46	5.08	119.36	110.11

** Based on the NEXT working schedule

* Utilities installation is being performed by contractors (mostly M&S) rather than staff as originally planned

Number of individuals who worked on NEXT during June 2015: 125

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 / 06 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER	b. PHASE	b. TO *(YYYYMMDD)* 2015 / 06 / 30
	c. TYPE / d. SHARE RATIO	c. EVMS ACCEPTANCE X YES	

WBS (3)	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE		BUDGETED	ESTIMATED	VARIANCE
ITEM	WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST	WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(14)	(15)	(16)
2.01.01 Project Management	81,896	81,896	64,885	0	17,011	3,175,403	3,175,403	3,052,823	0	122,580	4,657,379	4,534,792	122,586
2.01.02 Project Support	116,816	116,816	132,192	0	-15,376	3,401,299	3,401,299	3,991,714	0	-590,415	5,135,530	5,946,979	-811,448
2.02.02 Conceptual Design and Analysis of Photon Delivery Systems	0	0	0	0	0	849,881	849,881	849,881	0	0	849,881	849,881	0
2.02.04 ESM Advanced Conceptual Design	0	0	0	0	0	101,376	101,376	101,376	0	0	101,376	101,376	0
2.02.05 FXI Advanced Conceptual Design	0	0	0	0	0	120,634	120,634	120,634	0	0	120,634	120,634	0
2.02.06 ISR Advanced Conceptual Design	0	0	0	0	0	210,700	210,700	210,700	0	0	210,700	210,700	0
2.02.07 ISS Advanced Conceptual Design	0	0	0	0	0	163,508	163,508	163,508	0	0	163,508	163,508	0
2.02.08 SIX Advanced Conceptual Design	0	0	0	0	0	179,533	179,533	179,533	0	0	179,533	179,533	0
2.02.09 SMI Advanced Conceptual Design	0	0	0	0	0	181,684	181,684	181,684	0	0	181,684	181,684	0
2.03.01 Utilities	162,563	200,437	130,792	37,874	69,645	3,337,026	2,927,184	3,454,119	-409,842	-526,935	3,692,703	4,434,844	-742,142
2.03.02 Personnel Protection System (PPS)	49,694	33,312	89,199	-16,383	-55,887	508,739	503,643	833,883	-5,096	-330,241	1,323,218	1,815,316	-492,098
2.03.03 Equipment Protection System (EPS)	5,333	17,454	88,472	12,121	-71,017	267,483	211,331	421,982	-56,152	-210,651	594,451	861,856	-267,405
2.03.04 Control Station	1,567	9,551	11,937	7,984	-2,386	28,584	26,676	54,862	-1,908	-28,186	295,394	324,060	-28,666
2.03.05 Common Beamline Systems Management	9,251	9,251	14,307	0	-5,056	369,066	369,066	448,150	0	-79,084	476,689	555,840	-79,151
2.04.01 Control System Management	6,803	6,803	7,377	0	-574	203,393	203,393	147,810	0	55,583	294,427	238,844	55,583
2.04.02 Control System Design & Implementation	133,884	128,278	115,596	-5,606	12,682	2,001,381	1,508,948	1,643,798	-492,433	-134,850	2,913,586	2,998,104	-84,518
2.04.03 Control System Equipment	103,692	90,220	21,689	-13,472	68,531	1,170,172	1,016,155	912,867	-154,017	103,288	1,350,223	1,247,591	102,632
2.05.01 ESM Management	11,509	11,509	6,446	0	5,062	400,469	400,469	383,386	0	17,083	692,100	671,068	21,033
2.05.02 ESM Beamline Systems	227,068	274,811	742,722	47,743	-467,911	5,149,441	5,164,659	5,146,182	15,219	18,477	8,505,536	8,630,792	-125,256
2.06.01 FXI Management	0	0	12,279	0	-12,279	409,359	409,359	465,358	0	-55,999	409,359	465,358	-55,999
2.06.02 FXI Beamline Systems	37,250	44	267,777	-37,206	-267,733	1,022,137	1,088,164	818,637	66,027	269,527	1,408,965	1,139,439	269,525
2.07.01 ISR Management	27,545	27,545	21,710	0	5,835	682,717	682,717	670,821	0	11,896	1,076,573	1,063,924	12,649
2.07.02 ISR Beamline Systems	653,157	261,856	180,208	-391,301	81,648	2,888,239	2,403,890	2,367,836	-484,348	36,054	9,119,886	9,168,974	-49,089
2.08.01 ISS Management	19,913	19,913	25,037	0	-5,125	485,656	485,656	483,052	0	2,604	838,199	834,162	4,037
2.08.02 ISS Beamline Systems	180,632	289,516	174,701	108,884	114,815	4,940,805	4,884,359	4,603,734	-56,446	280,625	9,049,177	9,418,247	-369,070
2.09.01 SIX Management	18,847	18,847	22,936	0	-4,089	431,047	431,047	439,029	0	-7,982	845,551	850,354	-4,803
2.09.02 SIX Beamline Systems	288,274	242,495	205,667	-45,779	36,828	4,727,799	4,729,515	4,906,752	1,716	-177,236	11,344,363	11,136,219	208,144
2.10.01 SMI Management	24,636	24,636	13,167	0	11,470	520,062	520,062	453,140	0	66,922	918,583	851,662	66,921
2.10.02 SMI Beamline Systems	233,510	189,072	104,805	-44,438	84,267	3,631,380	3,676,300	3,707,204	44,920	-30,904	8,844,866	8,966,206	-121,340
2.11.01 ESM EPU Insertion Device	111,184	118,656	63,313	7,472	55,343	1,326,184	1,308,149	685,256	-18,035	622,893	4,562,016	3,946,836	615,181
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	2,565	0	135	52,559	52,559	29,691	0	22,868	100,460	77,593	22,868
2.12.01 ID & FE Installation & Testing Management	2,704	2,704	987	0	1,717	13,029	13,029	5,799	0	7,230	31,153	44,733	-13,581
2.12.02 ID Installation & Testing	0	35,987	68,264	35,987	-32,277	87,733	80,461	220,553	-7,272	-140,092	423,921	1,422,462	-998,541
2.12.03 FE Installation & Testing	95,275	137,336	49,868	42,061	87,468	401,092	271,985	302,490	-129,106	-30,504	562,708	871,495	-308,788
Total Project Baseline	2,605,705	2,351,647	2,638,898	-254,057	-287,251	43,556,707	41,869,931	42,528,620	-1,686,776	-658,688	81,391,470	84,395,443	-3,003,973
Undistributed Budget													
Management Reserve													
Performance Management Baseline -- PMB	2,605,705	2,351,647	2,638,898	-254,057	-287,251	43,556,707	41,869,931	42,528,620	-1,686,776	-658,688	81,391,470	84,395,443	-3,003,973