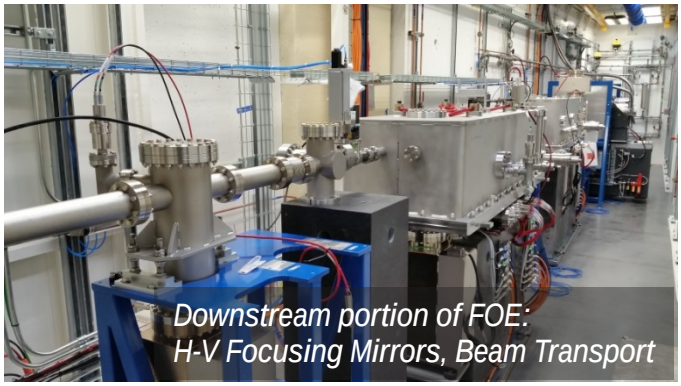
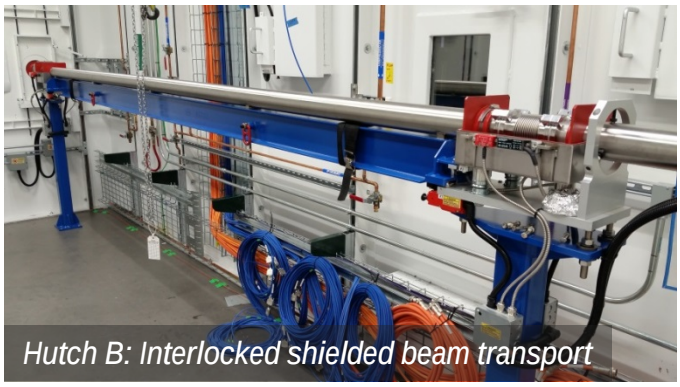
NSLS-II Experimental Tools (NEXT)

August 2016 Project Activity
Report due date: September 20, 2016

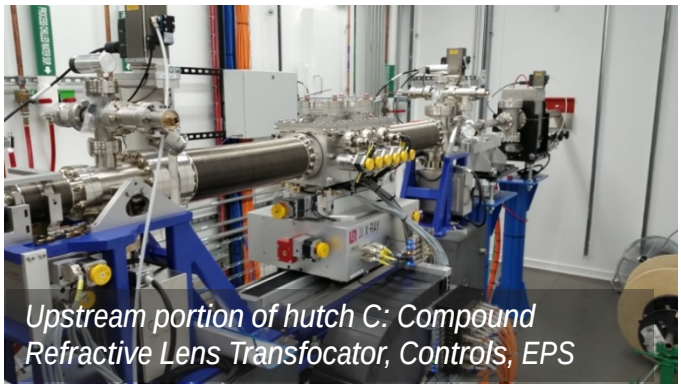
Upstream portion of FOE:
PPS aperture, gas handling system



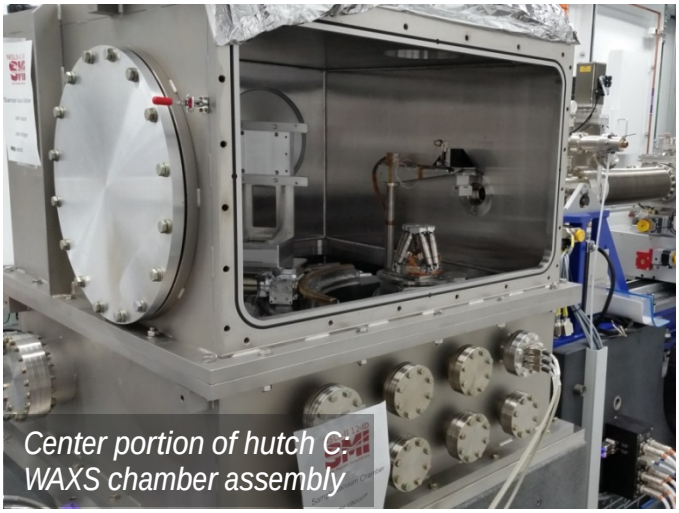
Downstream portion of FOE:
H-V Focusing Mirrors, Beam Transport



Hutch B: Interlocked shielded beam transport



Upstream portion of hutch C: Compound
Refractive Lens Transfocator, Controls, EPS



Center portion of hutch C:
WAXS chamber assembly

WAXS chamber close-up: bounce-down mirror,
hexapods, goniometer, detector mounting bracket

SMI photon delivery system and endstation components

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NEXT Project Manager

BROOKHAVEN NATIONAL LABORATORY

OVERALL ASSESSMENT

The objective beamline flux KPPs for ISR and ESM were achieved during August. Science commissioning experiments continued at ISS.

PDS installation and testing at SMI and SIX continued in August along with radiation shielding analysis and advancing travelers and other IRR documentation toward completion. These two beamlines are on track for IRRs planned for October (SMI) and November (SIX).

Endstation installation and testing progressed well at all beamlines during August, in particular at SMI and SIX.

Magnetic shimming of the SIX EPU57 insertion device was completed during August, ready for installation in the 2-ID straight in the September maintenance period. Magnetic sorting and shimming of ESM EPU105, the final insertion device to be completed for NEXT, will begin in September.

Six major procurements were completed in August: the M1/M3 mirrors package for ESM and SIX, three other major procurements for SIX (PGM, grating rulings package A, and sample manipulator), and two for SMI (SAXS tube and sample stages). Monitoring and management of contractor progress on the 13 remaining major procurement contracts are important ongoing activities that are crucial to maintaining project schedule. Four of these contracts are for SIX, 4 are for ISR, 3 are for ISS, 1 is shared between ESM and SIX, and 1 is for ESM.

As of August 31, 2016, the project is 91.5% complete based on base scope performance earned to date. The cumulative EVMS schedule index rose 0.01 to 0.96 and the cumulative cost index remained at 0.94.

No PCRs were processed in August and none are planned for September. BAC remained at $82.97M.

Cost contingency is $7.03M, which is 99.6% of $7.06M BAC work remaining. The EAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), is $87.68M, $0.24M greater than the July value. As of the end of August, contingency on EAC is $2.32M, which represents 32.0% of $7.24M EAC work remaining, or 102.1% of $2.27M unobligated work to go ($4.97M of the remaining work is obligated to fixed-price equipment contracts). ETC will continue to be assessed monthly through project completion to understand and contain costs while maintaining the good schedule performance that the project has demonstrated to date.

COMMON SYSTEMS

Utilities installation is nearing completion. Mechanical utilities installation work in the SIX Satellite Building is now completed, other than hookups to not-yet-delivered hardware. Delivery and installation of the SIX endstation systems are expected later in the calendar year, after which the utility connections will be completed.

PPS progress in August was focused at the SMI beamline. Installation and integration of the hardware was completed this month. Final testing began this month and is expected to be completed, along with certification, in October. At SIX, development of the PPS logic made significant progress during August and installation began. PPS activity at SIX will accelerate in October, as PPS resources roll off of the SMI beamline.

EPS installation effort in August focused on SMI and will continue through September. Installation work started at SIX this month, with installation of I/O boxes and some EPS cables, and will continue through November.

All remaining control station furniture has been delivered for the NEXT beamlines. Integration of AC power to the ISR control station was completed this month.

BEAMLINE CONTROLS

The remaining beamline controls effort for NEXT is concentrated on SMI and SIX and is on track to support the IRRs for these beamlines in October and November, respectively.

At SMI, effort during August focused on motion tuning and testing for various beamline components. Tuning of some motion axes is quite time consuming, especially in-vacuum motors which have very limited heat dissipation and for which optimized tuning goes a long way to ensuring controls reliability and repeatability.

The controls engineer who just completed controls effort for the IRR and initial commissioning of ESM is now dedicated to SIX. With SIX PDS on track for IRR in November, the current focus is on preparing for the FAT of the SIX endstation contracts (spectrometer and sample chamber).

ESM – ELECTRON SPECTRO-MICROSCOPY

After first light and initial commissioning of the beamline in July, the monochromatic flux was measured downstream of the exit slit this month, achieving the objective KPP flux value. In addition to further PDS commissioning with beam, effort was also devoted to endstation testing activities during August.

Although the entire ARPES endstation system has been assembled, functional performance tests remain to be performed. A crucial component of this endstation is the sample manipulator. This manipulator allows for: 1) receiving the sample from air via a load-lock system, 2) transporting the sample from the preparation chamber to the main analysis chamber, 3) accurately positioning the sample with respect to the light and the electron analyzer, and 4) accurately controlling the temperature of the sample (in the range 30 K to 1000 K). Functions 1), 2), and 4) were successfully tested during August. Function 3) can be tested after baking of the analysis chamber, currently underway, is completed. The only problem with this manipulator that has been observed so far is an excessive vibration of the sample induced by the

compressor of the closed cycle liquid-He cryostat. These vibrations can be reduced to what appears to be an acceptable level by strongly clamping the liquid-He lines close to the manipulator. This solution will impose some limitations on the movements of the sample, which needs to be optimized.

Progress was also made this month in the calibration of the monochromator exit slits, the need for which was apparent during initial commissioning. These slits operate at gap openings of a few microns and are crucial in controlling the energy resolution of the monochromator. A common method for calibration of few-micron gap openings is to record the diffraction pattern of visible light (about 0.5 micron wavelength) and to compare the pattern with the sinc function that describes the diffraction from an ideal incident plane wave. Laser light is a very good approximation of a pure plane wave and therefore the comparison can be quantitatively accurate. A HeNe laser (632 nm) was used to record the diffraction pattern at a distance of 255 mm from the slits. Typical results for three nominal gap openings are shown in Figure 1. A discrepancy of 12-13 microns between the nominal and measured slit opening values was found, confirming our suspicions that the calibration had changed during shipment or baking.

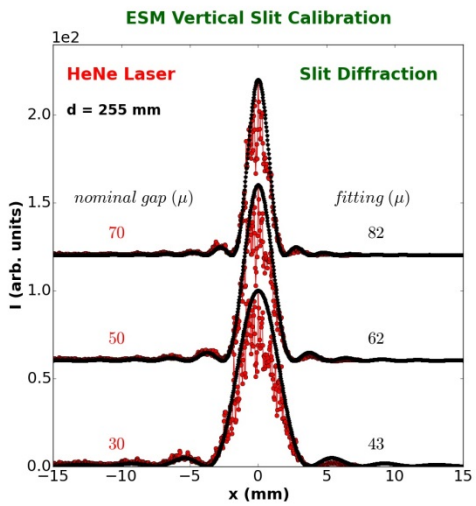


Figure 1. ESM: Calibration of the monochromator exit slit. The apparent "noise" in the data is due to intense speckle patterns resulting from the high degree of spatial coherence of the laser light.

ISR – IN-SITU AND RESONANT HARD X-RAY

A purchase order for the fabrication, installation, and pressure testing of beryllium magnet windows was placed with Materion on August 1, with an expected delivery in late October. A customer approval print (Figure 2) was received and approved on August 26.

The Final Design Report for the Instrumented 6-Circle Diffractometer was received on August 9. FDR approval will require a design modification to accommodate the 20-30 mm floor deviation from the nominal height at the endstation's location.

Stand components for the secondary bremsstrahlung shield were assembled, and the base of the stand was surveyed into place and bolted down inside Hutch 4-ID-A. The base diffractometer for large magnets was installed in its final location in Hutch 4-ID-C, and XY stages were mounted near the downstream wall of Hutch 4-ID-D (Figure 3).

Applied Energy Systems continued commissioning of the Gas Handling System during August. In mid-August, testing of toxic gas sensors revealed a defective sensor, which was replaced on August 29. Functionality testing of the HMI panel and system logic (e.g., purge cycle, system faults, etc.) was successful, and a defective pressure sensor was replaced on August 31. Remaining tasks expected to be completed in the September timeframe include an update of the HMI software with improved visual icon labeling, and user training.

A comprehensive radiation survey was carried out at ISR on August 8 at a ring current of 85 mA and the IVU gap set to 8 mm. The flux measured during this studies period at the seventh IVU harmonic surpassed the threshold KPP of 2×10^{11} photons/s (Figure 4, blue curve). Optics commissioning and vacuum conditioning continued throughout the month during normal operations at a ring current of 250 mA, and the IVU gap was closed to its minimum value of 6.1 mm on August 26. The flux measured at the tenth IVU harmonic surpassed the objective KPP flux value of 2×10^{12} photons/s (Figure 4, green curve).

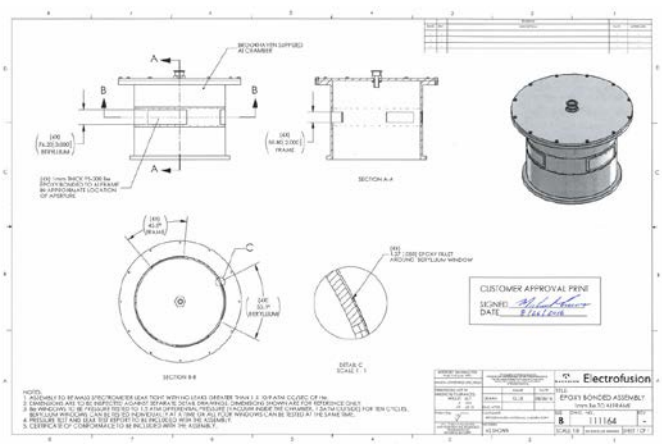


Figure 2. ISR: Customer approval print for the magnet beryllium windows.

Figure 3. ISR: XY stages installed near the downstream wall of Hutch 4-ID-D.

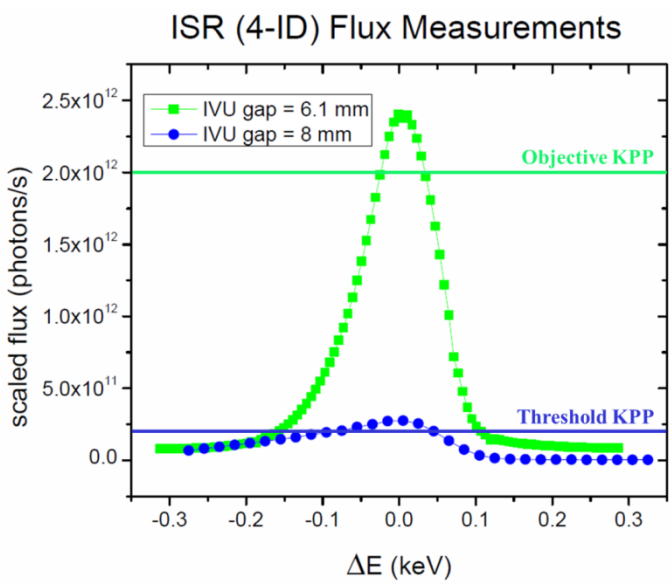


Figure 4. ISR: Flux measurements, scaled to a ring current of 500 mA, centered on the undulator harmonic closest to 10 keV at a given IVU gap value.

ISS – INNER SHELL SPECTROSCOPY

ISS activities during August were focused on endstation equipment integration and testing. Purchases were made for the articulated bellows system which will integrate the sample chamber with the higher harmonics rejection mirror system. In-house manufacturing of the ionization chamber began this month. It is expected that all endstation components will be available at the beginning of October.

All procurement packages of the ISS PDS have been delivered in full and closeout of the contracts is in progress. This is also true of all endstation procurement packages other than the sample transfer system and the spectrometer package. To ensure timely delivery of the remaining two packages, ISS is working closely with the suppliers on details of installation and delivery.

During August, ISS experimental capabilities were demonstrated and baselined as the first two operando experiments were conducted, one on batteries and the other on fuel cells.

SIX – SOFT INELASTIC X-RAY

Termination of the PDS motion cables was completed over the course of August, both in the racks and at the beamline components. Vacuum cables along the upstream half of the PDS, down to the PGM area, have been terminated. The termination of the vacuum cables along the downstream half of the PDS is slated for mid-September completion.

18 of 22 granite blocks that will support the angular tracks of the SIX emission spectrometer were delivered to the SIX satellite building on August 5 (Figure 5). Installation of these granite blocks will require 162 anchors to be epoxied into holes drilled in the satellite building floor. A strategy for drilling the holes within the specified placement and angular tolerances is currently being developed. The spectrometer contractor, Bestec, installed four of the granite blocks on the assembly floor at their facility in preparation for the FAT (Figure 6).

The beam pipe section that connects the upstream portion of the PDS on the ring experimental floor with the downstream portion of the PDS in the satellite building was installed during the week of August 22. This section, ~17m in length, is comprised of pipe sections and bellows linkages, ~2/3 of which is located outdoors, between the ring building and the satellite building (Figure 7). Heater tapes, to be used for baking, are coiled around the pipe, in advance of installation of a weatherproof enclosure for the outdoor pipe section.

A few major endstation components were delivered at the end of the month, starting with the in-vacuum sample diffractometer from SmarAct which was received on August 24. Motion tests are scheduled for September and interferometry measurements of the vibrational properties are planned for October. On August 25, both cryostats purchased from ColdEdge (the open cycle flow and the pulse tube devices) were received. Finally, the XCAM CCD detector was received on August 26. XCAM is scheduled to come to NSLS-II for a full week of tests starting September 1.

Further progress was made by Bestec during August in assembly of the sample chamber and spectrometer mechanical and electrical components, as illustrated in the photos shown in Figures 8-10. A site visit to Bestec by SIX staff has been scheduled for September 27-28.

Figure 5. SIX: Spectrometer granite blocks stored on the floor of the SIX satellite building.

Figure 6. SIX: Granite blocks forming part of the track for the detector chamber, shown during installation on the assembly floor at Bestec.

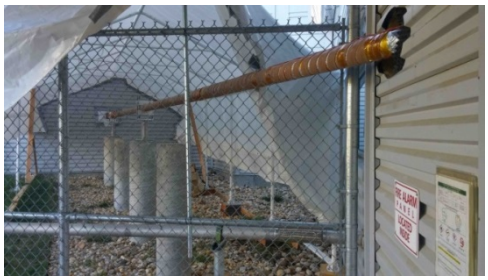


Figure 7. SIX: Outdoor pipe section installed between the ring building (right) and the SIX satellite building (left).

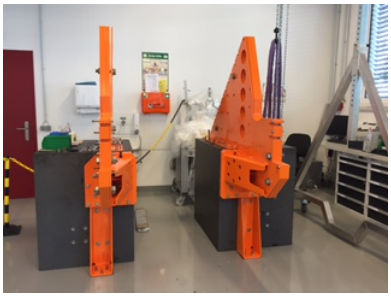


Figure 8. SIX: Sample chamber steel and granite stands at Bestec.

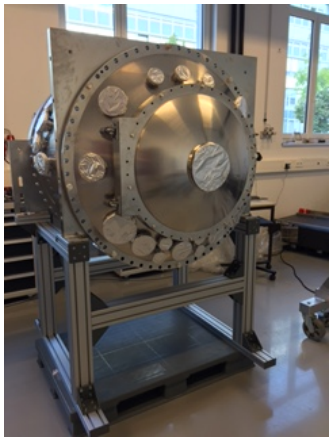


Figure 9. SIX: Backside view of the sample chamber vessel at Bestec.

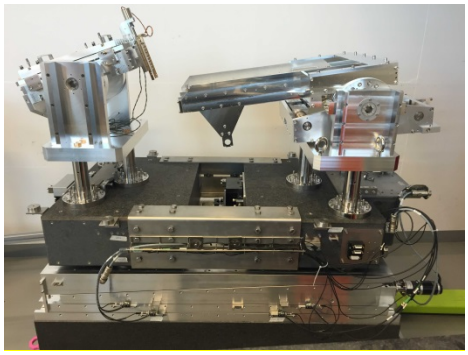


Figure 10. SIX: Internal mechanics of the spectrometer optics tank at Bestec.

SMI – SOFT MATTER INTERFACES

With final deliveries of the SAXS Beam Chamber and the Vacuum Sample Stages during August, all major SMI procurement contracts have been completed. The SAXS Beam Chamber was shipped to BNL in sections, along with the stands (Figure 11). Assembly of this equipment will be undertaken in concert with assembly of the internal components (SAXS Detector X, Y, and Z translations). The process will begin with surveying, marking, drilling, and anchoring the steel stands. Next, the furthest upstream chamber module will be set into place on the stand. Each module has ports through which a separate set of feet will protrude from within the vessel onto a movable support on the stands. This separate set of feet will support the long Z translation rail inside, which will necessarily be installed in overlapping sections, alternating with placement of the next chamber vessel.

The Vacuum Sample Stages (Figure 12) consist of two coaxial hexapods with a 360° rotation stage mounted between them. Following receipt of these stages, the system was bench tested with the supplied controllers, found to be operating correctly, and subsequently installed within the WAXS chamber. Tests will continue through September to ensure proper operation through the patch boxes assembled by the NSLS-II Controls Group, both in air and in vacuum. Design of the patch boxes was done in tandem with design of similar patch boxes for the SAXS system, so that now all SMI Controls hardware layout tasks are completed.

Warranty replacement of faulty DCM thermocouples was completed successfully by the contractor (IDT) during August. IDT also installed some redundant thermocouples and a new encoder cover. In addition, minor electronic improvements were made to the Pinhole Aperture assembly and the White Beam Stop by the suppliers of these components.

The PPS Aperture, a radiation safety component, was installed and surveyed into place this month. Surveys were also completed for the fixed and removable beam pipes delivered with the H-V Mirrors and SSA package. The PDS has been under vacuum now for several months and is

operating well, with only a few minor traveler tasks remaining to be completed.

At this juncture, the remaining SMI activities fall into three categories. The first is installation and testing of all components in the WAXS vessel, expected to be completed in September, including: the vessel vacuum chamber itself, the Vacuum Sample Stages, the WAXS Goniometer (under load), the Bounce-Down Mirror, and the Pilatus 300K-W detector. The other two groups of tasks to be completed are: (i) fabrication of the SAXS assembly and (ii) preparation for Instrument Readiness Review.

Figure 11. SMI: Upper panel: SMI SAXS Beam Chamber shipment, with support stands in foreground, chamber modules in back. Lower panel: Side view of one of the 1m diameter × 2m long segments on its pallet.

Figure 12. SMI: Within the SMI WAXS chamber, the topmost HP-140 Hexapod is visible upon the platform of the PRS-200 rotation stage. Below the chamber front lid sightline is the larger HP-430 hexapod. The Bounce-Down Mirror, to the right, can intercept the beam just upstream of the sample position. The arc of the WAXS Goniometer and a bracket to hold the Pilatus 300K-W detector are seen at the left, downstream and inboard of the sample position.

INSERTION DEVICES

Magnetic correction (shimming) of the SIX EPU57 was completed this month. Figure 13 shows before-and-after comparisons of the first field integral in linear horizontal polarization. The final work performed in August yielded a factor of two reduction in magnetic field integral error compared to the value achieved during July, which itself was a significant reduction of the errors compared to the as-received device. These field integral comparisons highlight the superior performance of the in-house magnetic correction technique: the magnetic errors have been reduced to a negligible level.

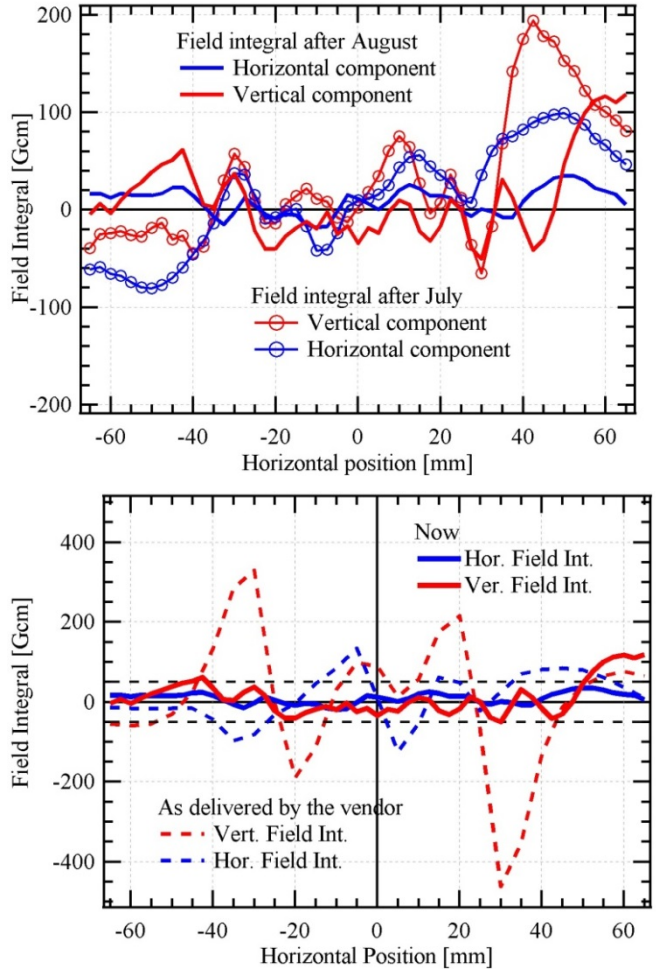


Figure 13. Insertion Devices: Upper panel: Comparison of the horizontal and vertical field in linear polarization after the correction performed in August. Lower panel: Comparison of the field integral measured after in-house computer-aided (IDBuilder) shimming with the field integral of the device as delivered by Kyma, which clearly illustrates the advantages of the in-house process.

One of the main challenges in magnetic shimming of APPLE-II EPUs is to minimize variation of the magnetic field integral with respect to the phase of these devices. This variation alters the magnetic multipole content associated with this device and, once installed in the accelerator, may introduce deleterious effects such as introduction of coupling between horizontal and vertical motion of the electron beam, tune shift variation, beam size changes, or reduction of

dynamic aperture. When these effects occur, the accelerator physicists are forced to perform sometimes difficult tuning of the magnetic lattice in order to minimizing these effects.

In the magnetic measurements laboratory, the practical method of magnetic characterization is to use the magnetic field integral, rather than the multipoles, to quantify the magnetic errors. During shimming of APPLE-II EPUs, the field integral of the device is measured, at minimum gap, for several phase values, in order to capture the variation of the field integral as function of phase. The phase values commonly selected are $-\lambda_0/2$, $-\lambda_0/4$, 0, $\lambda_0/4$, and $\lambda_0/2$, where λ_0 is the EPU period length. With three types of APPLE-II type EPUs installed in the NSLS-II storage ring (CSX EPU49s (2), ESM EPU57, and SIX EPU57), a comparison of the phase dependence of their magnetic field integrals can inform the benefits of the in-house magnetic correction technique utilized for SIX EPU57.

The table below lists the basic geometrical parameters for the three types of EPU devices currently installed at NSLS-II. The CSX EPU49 and SIX EPU59 insertion devices are more challenging, from the magnetic correction point of view, than ESM EPU57, owing to their large number of periods and/or smaller minimum gap.

	CSX EPU49		SIX EPU57	ESM EPU57
Length [m]	2		3.5	1.4
Period λ_0 [mm]	49.2		57	57
Number of periods	38		59	24
Min. gap g [mm]	11.5	15	16	16
Ratio g/λ_0	0.234	0.305	0.281	0.281

Since the period length (λ_0) and the minimum gap (g) of the different devices are quite different, it is useful to compare the field integrals of different devices at similar values of the ratio g/λ_0. Figure 14 compares the horizontal and vertical field integral of SIX EPU57 at minimum gap (g/λ_0=0.281) to those of CSX at 15mm gap (g/λ_0=0.305). The vertical integrals of the three devices (SIX EPU57, CSX EPU49-1, and CSX EPU49-2) are comparable and well within NSLS-II requirements. The variation of the SIX EPU57 horizontal field integral is smaller than that achieved with either CSX EPU49-1 or EPU49-2, despite the SIX device having 50% more periods. This comparison illustrates the tour de force results provided by use of IDBuilder during the shimming of an APPLE-II type undulator. It also demonstrates that the in-house shimming technique can produce state-of-the-art EPU insertion devices beyond the turnkey capability of our industrial suppliers.

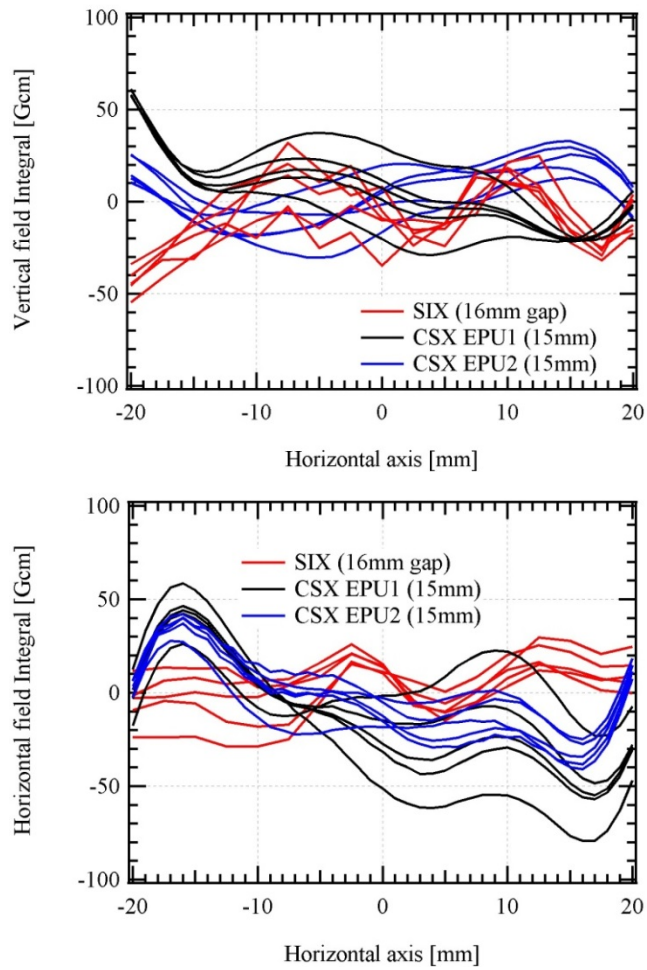


Figure 14. Insertion Devices: Comparison of the vertical (upper panel) and horizontal (lower panel) field integrals of SIX EPU57 at minimum gap (g/λ_0 = 0.281) with the corresponding field integrals of CSX at 15mm gap (g/λ_0 = 0.305).

During August, we performed the on-axis local field and field integral magnetic measurements of SIX EPU57 at a large selection of gaps and phases. The measured undulator field profiles over this fine mesh will be used as inputs to SRW computations to determine initial user parameter tables (energy, polarization, and flux vs. gap and phase). Following these measurements, the SIX EPU57 device was prepared for transfer to the ring building. The correction coils were installed, the encoder offset was recorded, and the Lexan guard re-installed. The NEXT scope for SIX EPU57 is complete; transport to the ring (scheduled for the first week of September), installation, and commissioning are NSLS-II operations tasks.

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
Early Project Completion:	Jan. 31, 2017	
CD-4 (Project Completion):	Sept. 29, 2017	

RECENT AND UPCOMING EVENTS

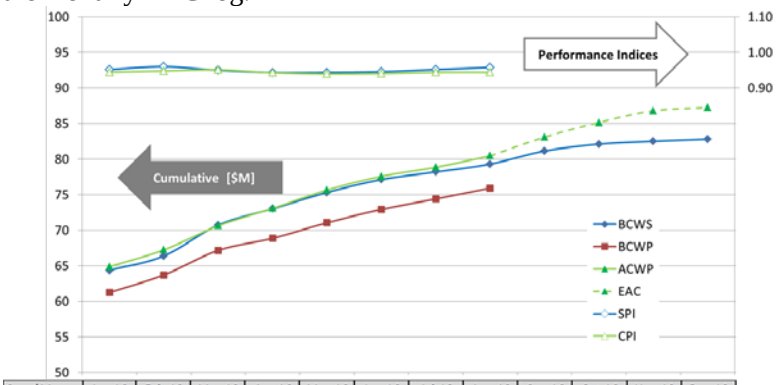
DOE OPA EVMS Review (BNL)	October 4-5, 2016

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
BDN	Beamlines Developed by NSLS-II
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CAM	Cost Account Manager
CCD	Charge-Coupled Device
CD	Critical Decision
CPI	Cost Performance Index
CSX	Coherent Soft X-ray beamline
CV	Cost Variance
DCM	Double Crystal Monochromator
DOE	Department of Energy
DHRM	Double Harmonic Rejection Mirror
EAC	Estimate At Completion
EPS	Equipment Protection System
EPU	Elliptically Polarizing Undulator
ES&H	Environment, Safety & Health
ESM	Electron Spectro-Microscopy beamline
ETC	Estimated Cost to Complete
EVMS	Earned Value Management System
FAT	Factory Acceptance Test
FDR	Final Design Review
FE	Front End
FOE	First Optics Enclosure
FTE	Full Time Equivalent
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
HeNe	Helium Neon
HMI	Human Machine Interface
H/V	Horizontal / Vertical
ID	Insertion Device
I/O	Input / Output
IRR	Instrument Readiness Review
ISR	Integrated In-Situ and Resonant X-ray Studies
ISS	Inner Shell Spectroscopy beamline
IVU	In-Vacuum Undulator
KPP	Key Performance Parameter
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
PEMP	Performance Evaluation and Measurement Plan
PGM	Plane Grating Monochromator
PMB	Performance Management Baseline
PPS	Personnel Protection System
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
SSA	Secondary Source Aperture
SV	Schedule Variance
TEC	Total Estimated Cost
TPC	Total Project Cost
UB	Undistributed Budget
VAC	Variance At Completion
WAXS	Wide Angle X-ray Scattering
WBS	Work Breakdown Structure
WS	Working Schedule

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	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
BCWS	64.3	66.4	70.7	73.0	75.3	77.1	78.2	79.3	81.1	82.1	82.5	82.8
BCWP	61.2	63.7	67.2	68.9	71.0	72.9	74.4	75.9				
ACWP	64.9	67.2	70.6	73.1	75.6	77.6	78.8	80.4				
SPI	0.95	0.96	0.95	0.94	0.94	0.95	0.95	0.96				
CPI	0.94	0.95	0.95	0.94	0.94	0.94	0.94	0.94				
ETC									7.2	4.6	2.6	0.9

NEXT as of 8/31/2016	Current Period	Cum-to-Date
Plan (BCWS) $k	1,109	79,288
Earned (BCWP) $k	1,520	75,913
Actual (ACWP) $k	1,602	80,442
SV $k	411	-3,375
CV $k	-82	-4,529
SPI	1.37	0.96
CPI	0.95	0.94
Budget at Completion $k (PMB [UB])		82,970
Planned % Complete (BCWS/BAC)		95.6%
Earned % Complete (BCWP/BAC)		91.5%
Contingency $k		7,030
Contingency / (BAC – BCWP)		99.6%
EAC $k		87,684
Contingency / (EAC – BCWP)		59.7%
(Contingency + VAC) / (EAC – ACWP)		32.0%
TPC = PMB + Contingency		90,000

The NEXT project Schedule Variance (SV) for August 2016 is +$411k, with an associated monthly Schedule Performance Index (SPI) of 1.37 (red status). The largest contributors to the current month schedule variance are provided in the table below. The cumulative SPI is 0.96 (green status), 0.01 higher than it was in July.

The NEXT project Cost Variance (CV) for August 2016 is -$82k, with an associated monthly Cost Performance Index (CPI) of 0.95 (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 July.

Leading Current Month Variances [$k], August 2016

WBS	Title	PV	EV	AC	Schedule		Cost	
					SV	Issues	CV	Issues
2.01	Project Support	184	184	155	0	--	29	--
2.03	Common Systems	45	93	155	48	Utilities (2.03.01): +$22k, PPS (2.03.02): +$36k (performance of work scheduled earlier); EPS (2.03.03): -$15k (delays as PEMP notable & partner beamlines have been given priority, plus shortage of EPS engineers); Control Station (2.03.04): +$5k	-62	Utilities (2.03.01): -$8k (nearly all labor cost overage), PPS (2.03.02): -$39k (80% labor); EPS (2.03.03): +$6k; Control Station (2.03.04): -$21k (90% M&S)
2.04	Controls	95	70	90	-26	--	-21	--
2.05	ESM Beamline	91	85	115	-6	--	-30	Accrual/payment for value earned in earlier months: material (-$7k) and machining (-$6k) of the white and pink beam masks; NEG pumps to achieve ultra-high vacuum in the M1 and PGM chambers (-$24k). Offset by few $k labor savings this month.

Leading Current Month Variances [$k], August 2016								
WBS	Title	PV	EV	AC	Schedule		Cost	
					SV	Issues	CV	Issues
2.07	ISR Beamline	49	249	232	200	Primarily from 3 activities earned this month, scheduled earlier: integrated testing of the photon delivery system (+$46k), Gas Handling System commissioning and training (+$89k), and receipt of the 6-Circle Diffractometer FDR report (+$76k). Offset slightly by IRR-related management activities scheduled this month that were performed earlier.	17	--
2.08	ISS Beamline	28	93	143	66	Current Period Schedule Variance (+$66k), resulting from earlier-scheduled activities performed this month: Sample Handling System activities (+$10k), Lens package fabrication activities (+$9k), spectrometer mechanics activities (net +$16k), and endstation assembly, installation, and testing activities (+$32k).	-50	The largest contributor to the current period cost variance in ISS beamline systems (WBS 2.08.02), -$54k, is accrual/payment for receipt and acceptance of the Sample Handling System contract (-$82k), earned last month.
2.09	SIX Beamline	358	424	345	66	The current period schedule variance (+$66k) is the net sum of the following principal contributors: White Beam Mask received, scheduled earlier (+38k), endstation spectrometer activities performed this month, scheduled earlier (+$84k), receipt of cryostat low vibration interface, scheduled earlier (+$20k), detector activities scheduled this month, to be performed and earned next month (-$99k), and DAQ activities earned this month, scheduled earlier (+$16k).	79	The current period cost variance in SIX beamline systems (WBS 2.09.02), +$72k, is dominated by earned value on SIX contracts that will be accrued or paid next month.
2.10	SMI Beamline	141	264	293	123	The current period schedule variance (+$123k) is driven by three principal activities earned this month, but scheduled earlier: Receipt, assembly, installation, and acceptance of the Vacuum Sample Stages (+$69k), assembly and installation of the Vacuum Sample Chamber (+$14k), and receipt and acceptance of the SAXS chamber (+$68k); less activities scheduled this month, to be performed later, including assembly and testing of the SAXS chamber (-$48k).	-29	--
2.11	Insertion Devices	118	57	73	-62	The current period schedule variance (-$62k) results from the net sum of a few contributors: SIX EPU57 shimming scheduled earlier (+$33k), ESM EPU105 shimming scheduled this month but not yet performed (-$87k), and current strip power supply activities (net -$5k).	-17	--
	Total	**1109**	**1520**	**1602**	**411**	**Total**	**-82**	

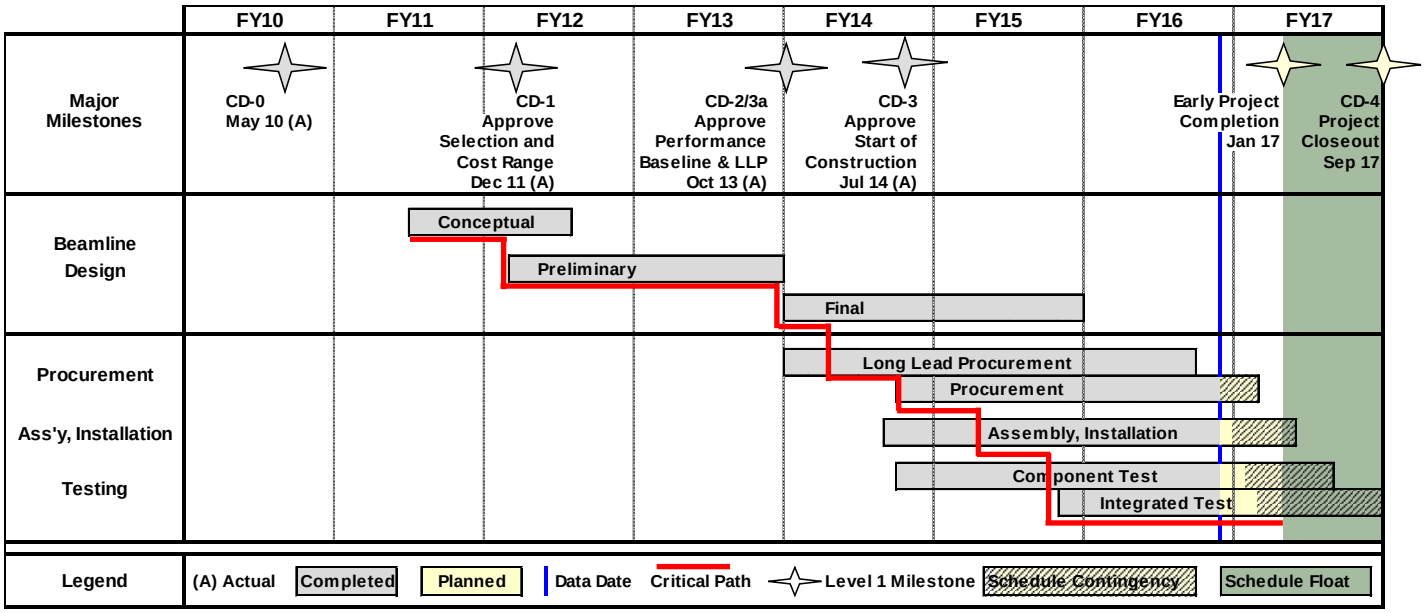
As of August 31, 2016, the project is 91.5% complete with 99.6% contingency ($7.03M) for $7.1M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through August 2016. The project EAC for August is reported at $87,684k against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $82,970k. The Variance At Completion (VAC) is given by VAC = BAC – EAC, with EAC = ACWP + ETC. Through August 2016, the VAC (-$4,714k) is dominated by the cumulative cost variance (-$4,529k), which is in turn dominated by labor cost overage on work performed to date.

The August 2016 EAC ($87.68M) is $0.24M higher than the July value. The major drivers of EAC growth in August were: (i) labor overages in utilities (WBS 2.03.01), PPS (WBS 2.03.02), SIX beamline systems (WBS 2.09.02), and SMI beamline systems (WBS 2.10.02) and (ii) accrual gap on a non-major SIX endstation component procurement. As of the end of August, contingency on EAC is $2.32M, which represents 32.0% of $7.24M EAC work remaining. Outstanding commitments on fixed-price equipment contracts total $4.97M, so the $2.32M contingency on EAC represents 102.1% of $2.27M 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 approved or implemented in August and no PCRs are planned for September.

Milestones – Near Term		Planned	Actual
L3	SIX - Testing Monochromator and Slits complete	1-Mar-16	Expect September
L2, L3	Common Beamline Systems: Mechanical Utilities Installed	31-May-16	29-Aug-16
L3	ISR – Installation of Beamline Components Complete	29-Jun-16	Expect December
L3	SIX - Testing of Spectrometer Detector Complete	23-Aug-16	Expect September
L3	WBS 2.04 – Beamline Control Systems Complete	14-Sep-16	Expect December
L3	SMI – Installation of Beamline Components Complete	16-Sep-16	Expect December
L3	ESM – Installation of Beamline Components Complete	29-Sep-16	Expect November
L3	SIX – Installation of Beamline Components Complete	30-Sep-16	Expect December
L3	Common Beamline Systems: EPS Installed	30-Sep-16	Expect December
L2, L3	Complete Installation of Common Beamline Systems PPS	30-Sep-16	Expect December
L2	Early Project Completion – incl. IRR	31-Jan-17	Expect January

PROJECT SCHEDULE



As of August 2016, the critical path runs through PPS design, software development, testing, and integration for the SIX beamline (WBS 2.03.02, Common Systems PPS).

Staffing Report

Staffing as of 8/31/2016	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	0.66	0.45	38.69	34.95
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	1.13	0.64	30.43	16.49
WBS 2.04 Control System	0.44	0.51	20.82	19.39
WBS 2.05 ESM Beamline	0.15	0.32	15.69	18.45
WBS 2.06 FXI Beamline	0.00	0.00	4.77	4.60
WBS 2.07 ISR Beamline	0.35	0.32	17.01	15.21
WBS 2.08 ISS Beamline	0.38	0.23	14.63	14.63
WBS 2.09 SIX Beamline	0.49	0.59	18.51	21.47
WBS 2.10 SMI Beamline	0.63	0.47	15.70	14.78
WBS 2.11 Insertion Devices	0.39	0.40	6.84	6.16
WBS 2.12 ID & FE Installation	0.00	0.00	3.88	7.97
Total	4.63	3.93	195.71	182.84

** Based on the NEXT working schedule

* A large fraction of utilities installation has been performed by contractors (M&S) rather than staff as originally planned

Number of individuals who worked on NEXT during August 2016: 118

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

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FORM APPROVED
OMB No. 0704-0188

1. CONTRACTOR	2. CONTRACT	3. PROGRAM	4. REPORT PERIOD
a. NAME	a. NAME	a. NAME	a. FROM (YYYYMMDD)
Brookhaven National Laboratory	NEXT	NSLS-II Experimental Tools (NEXT) Project	2016 / 08 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER	b. PHASE	b. TO (YYYYMMDD)
	c. TYPE / d. SHARE RATIO	c. EVMS ACCEPTANCE: X YES	2016 / 08 / 31

WBS (2)	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
WBS (3)	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 Project Management and Support	184,034	184,034	155,318	0	28,716	9,084,039	9,084,039	9,860,508	0	(776,468)	9,918,232	10,626,526	(708,293)
2.01.01 Project Management	78,883	78,883	70,149	0	8,734	4,233,620	4,233,620	3,926,141	0	307,479	4,598,029	4,312,002	286,026
2.01.02 Project Support	105,151	105,151	85,169	0	19,982	4,850,419	4,850,419	5,934,367	0	(1,083,948)	5,320,204	6,314,524	(994,320)
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	45,089	93,306	154,813	48,216	(61,507)	7,180,465	6,667,649	8,032,937	(512,816)	(1,365,288)	7,340,417	8,592,833	(1,252,416)
2.03.01 Utilities	0	22,319	29,888	22,319	(7,568)	4,209,423	4,123,021	4,375,406	(86,401)	(252,385)	4,210,031	4,385,190	(175,159)
2.03.02 Personnel Protection System (PPS)	6,589	43,104	82,038	36,515	(38,934)	1,491,766	1,136,276	2,021,938	(355,490)	(885,662)	1,620,824	2,463,337	(842,513)
2.03.03 Equipment Protection System (EPS)	26,488	11,239	5,557	(15,248)	5,683	680,294	630,589	848,274	(49,705)	(217,685)	680,294	903,782	(223,488)
2.03.04 Control Station	0	4,631	25,889	4,631	(21,259)	306,744	285,524	206,108	(21,220)	79,417	306,744	227,539	79,204
2.03.05 Common Beamline Systems Management	12,013	12,013	11,442	0	571	492,238	492,238	581,212	0	(88,974)	522,524	612,985	(90,461)
2.04 Control System	95,467	69,713	90,311	(25,754)	(20,598)	4,540,351	4,440,173	4,671,495	(100,178)	(231,322)	4,648,844	4,888,377	(239,533)
2.04.01 Control System Management	5,437	5,437	2,067	0	3,370	278,969	278,969	244,075	0	34,895	294,427	259,412	35,015
2.04.02 Control System Design & Implementation	90,031	61,780	76,562	(28,250)	(14,781)	2,911,158	2,806,820	3,113,676	(104,338)	(306,856)	2,929,314	3,244,501	(315,187)
2.04.03 Control System Equipment	0	2,496	11,682	2,496	(9,186)	1,350,223	1,354,383	1,313,744	4,160	40,639	1,425,103	1,384,464	40,639
2.05 ESM Beamline	90,954	85,257	115,132	(5,697)	(29,874)	9,391,979	9,243,032	9,998,191	(148,947)	(755,159)	9,422,464	10,176,844	(754,380)
2.05.01 ESM Management	14,720	30,959	969	16,239	29,991	580,259	600,311	474,027	20,051	126,284	610,744	484,219	126,525
2.05.02 ESM Beamline Systems	76,234	54,298	114,163	(21,936)	(59,865)	8,811,720	8,642,721	9,524,164	(168,999)	(881,443)	8,811,720	9,692,624	(880,905)
2.06 FXI Beamline	0	0	0	0	0	1,818,324	1,818,324	1,793,425	0	24,899	1,818,324	1,793,425	24,899
2.06.01 FXI Management	0	0	0	0	0	409,359	409,359	470,908	0	(61,549)	409,359	470,908	(61,549)
2.06.02 FXI Beamline Systems	0	0	0	0	0	1,408,965	1,408,965	1,322,516	0	86,448	1,408,965	1,322,516	86,448
2.07 ISR Beamline	48,770	249,190	231,983	200,420	17,207	9,732,178	8,992,730	9,128,452	(739,448)	(135,723)	10,392,425	10,512,756	(120,331)
2.07.01 ISR Management	46,786	17,582	17,315	(29,204)	267	1,080,195	1,080,195	1,018,289	(0)	61,906	1,105,394	1,033,100	72,295
2.07.02 ISR Beamline Systems	1,984	231,608	214,667	229,623	16,941	8,651,983	7,912,535	8,110,164	(739,448)	(197,629)	9,287,031	9,479,657	(192,626)
2.08 ISS Beamline	27,509	93,167	142,712	65,657	(49,545)	10,321,924	10,150,068	10,870,188	(171,856)	(720,119)	10,472,212	11,203,493	(731,281)
2.08.01 ISS Management	14,159	14,159	9,333	0	4,826	688,865	816,273	672,176	127,408	144,097	838,199	676,615	161,584
2.08.02 ISS Beamline Systems	13,350	79,008	133,379	65,657	(54,371)	9,633,059	9,333,795	10,198,011	(299,264)	(864,216)	9,634,013	10,526,879	(892,865)
2.09 SIX Beamline	357,877	424,012	344,794	66,135	79,218	10,180,105	9,115,429	9,564,267	(1,064,675)	(448,838)	11,764,836	12,744,045	(979,210)
2.09.01 SIX Management	19,959	19,959	12,687	0	7,272	690,670	690,670	659,723	0	30,946	729,841	698,453	31,388
2.09.02 SIX Beamline Systems	337,918	404,053	332,107	66,135	71,946	9,489,435	8,424,760	8,904,544	(1,064,675)	(479,784)	11,034,995	12,045,592	(1,010,597)
2.10 SMI Beamline	141,032	264,242	293,378	123,210	(29,137)	9,035,047	8,572,793	8,879,486	(462,255)	(306,694)	9,126,837	9,341,230	(214,393)
2.10.01 SMI Management	12,325	12,325	22,511	0	(10,186)	718,198	718,198	647,921	0	70,276	805,656	726,912	78,744
2.10.02 SMI Beamline Systems	128,706	251,916	270,867	123,210	(18,950)	8,316,850	7,854,595	8,231,565	(462,255)	(376,970)	8,321,181	8,614,319	(293,138)
2.11 Insertion Devices	118,444	56,807	73,475	(61,638)	(16,669)	4,743,650	4,568,793	4,382,450	(174,857)	186,343	4,805,392	4,544,081	261,312
2.11.01 ESM EPU Insertion Device	115,622	53,984	69,583	(61,638)	(15,599)	4,537,135	4,362,278	4,225,752	(174,857)	136,526	4,587,795	4,405,363	182,433
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	2,823	2,823	3,893	0	(1,070)	89,378	89,378	86,323	0	3,054	100,460	68,344	32,117
2.12 ID & FE Installation & Testing	0	0	0	0	0	1,452,816	1,452,816	1,452,960	0	(143)	1,452,816	1,452,960	(143)
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	0	0	0	584,560	584,560	584,560	0	(0)	584,560	584,560	(0)
2.12.03 FE Installation & Testing	0	0	0	0	0	847,517	847,517	847,660	0	(143)	847,517	847,660	(143)
Total Project Baseline	1,109,177	1,519,727	1,601,915	410,549	(82,188)	79,288,194	75,913,162	80,441,675	(3,375,032)	(4,528,513)	82,970,116	87,683,886	(4,713,770)
Management Reserve													
Undistributed Budget													
Performance Management Baseline (PMB)	1,109,177	1,519,727	1,601,915	410,549	(82,188)	79,288,194	75,913,162	80,441,675	(3,375,032)	(4,528,513)	82,970,116	87,683,886	(4,713,770)