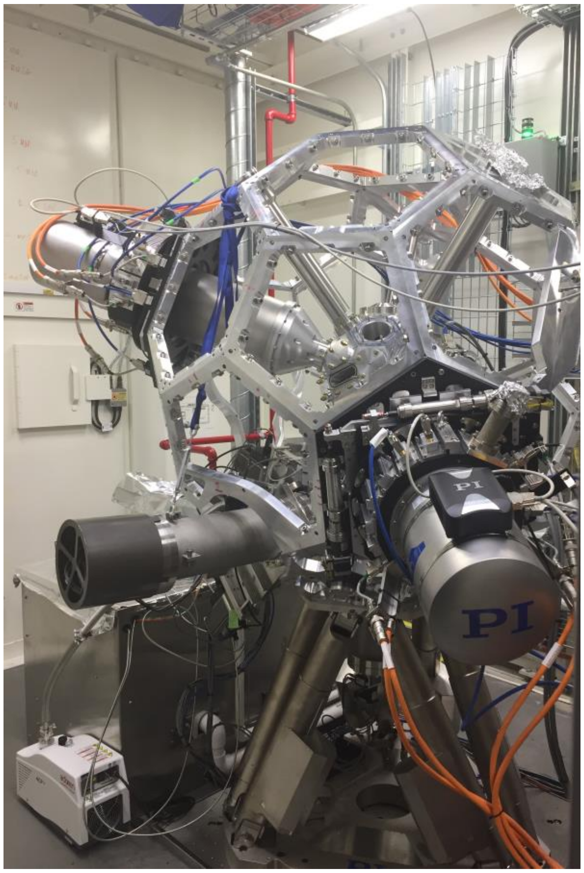
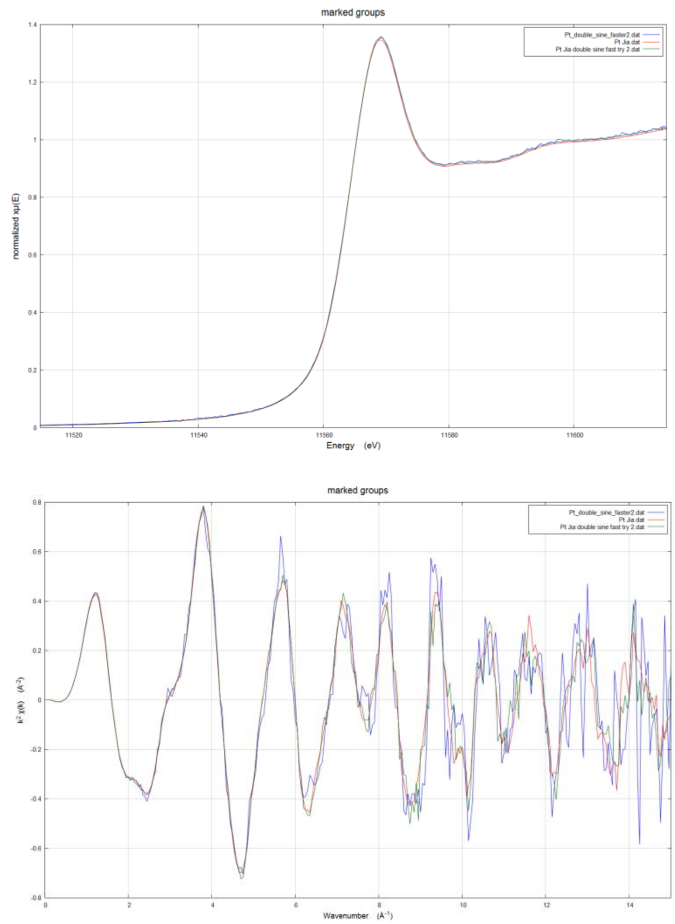
NSLS-II Experimental Tools (NEXT)

October 2016 Project Activity

Report due date: November 20, 2016



ISS Endstation, with two Von Hamos XES spectrometers (PI) installed. The remaining 16 ports will be outfitted with spectroscopy detectors (integrating PIN diodes and silicon drift diodes) or other (future) types of spectrometers such as the spherical backscattering analyzer type.



ISS: Comparison of the near edge region (upper panel) and the EXAFS (lower panel) signals measured in total fluorescence mode from a Pt-nanoparticle-loaded cathode/anode membrane such as those typically used in low temperature fuel cells. With 50μg/cm^2 loading, ~10^{14} Pt atoms (~10 monolayer coverage) were probed by the X-ray beam. The blue, green, and red scans were taken with total measurement times of 3s, 6s, and 30s respectively.

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NEXT Project Manager

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OVERALL ASSESSMENT

Preparations for SMI IRR #1, which covered all PDS scope other than PPS certification, were completed and the IRR was held on October 19 with no pre-start findings. PPS certification was completed on October 19 and SMI IRR #2 was held on November 3 to review documentation of PPS certification, after which approval to take first light was granted.

SIX beamline PDS installation, testing, and preparation of IRR documentation continued in October, in preparation for the November 8-9 SIX PDS IRR #1.

All remaining ISS scope was completed in October. ESM has completed all scope other than final aspects of two remaining contracts, both of which are expected to be completed in December. Endstation installation and testing activities continued at ISR and SMI during October. SIX endstation fabrication and testing at the supplier's site (Bestec) made good progress this month, in advance of the FAT scheduled for November.

Final preparations for the SIX ID/FE IRR were completed, the IRR was held on October 19, and commissioning began on October 25. Sorting and installation of magnet modules on the mechanical girders of ESM EPU105, the final NEXT insertion device, was completed this month. Final assembly of this device, consisting of virtual shimming, quasi-periodic adjustment of specified magnets, and magic finger correction of the magnetic field integral, are planned for November.

Of the 65 major procurements in NEXT, 2 were completed in October (ISS XES spectrometer and ISS Sample Handling System) and 9 remain: 1 (M4 mirror optics) shared between ESM and SIX, 4 for ISR (Dual Phase Plate Assembly, KB mirror optics, Gas Handling System, and 6-circle Diffractometer), 3 for SIX (Emission Spectrometer, Sample Chamber, and Grating Rulings), and 1 is for ESM (electron energy analyzer software update). Delivery of all materials for the remaining contracts is expected in November and December.

As of October 31, 2016, the project is 94.9% complete on base scope performance earned to date. The cumulative EVMS schedule index remains at 0.96 and cost indices increased by 0.01 to 0.95.

No PCRs were processed in October and none are planned for November. BAC remained at \$82.97M. Cost contingency is \$7.03M, compared to \$4.19M BAC work remaining.

The EAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), is \$88.90M, \$0.97M greater than the September value. Details are provided in the Cost and Schedule section. As of the end of October, contingency on EAC is \$1.10M, which represents 19.8% of \$5.57M EAC work remaining, or 57.9% of \$1.91M unobligated work to go (\$3.67M 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

Final utilities testing and preparations for the October 19 SMI IRR were completed successfully this month. Mechanical utilities installation work in the SIX Satellite Building has been 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 effort was focused at the SMI and SIX beamlines during October. At SMI, final PPS testing and certification were successfully completed. At SIX, PPS hardware installation continued this month and is expected to be completed in November, followed by testing. PPS certification, including reachbacks, is scheduled to occur during the December maintenance period.

EPS installation work continued at SIX during October, with a focus on the wiring and integration to the photon delivery system. EPS testing began this month and will continue into early November. All testing needed for Phase I of the SIX IRR will be completed before November 8.

BEAMLINE CONTROLS

All controls scope for the SMI photon delivery system and WAXS endstation chamber was completed in October, in advance of the October 19 IRR. SMI controls activities include full range testing of all motion axes, vacuum and diagnostic controls, and their respective operator interface (OPI) screens. The SMI control system is ready for first light scheduled in early November.

For SIX beamline, controls work is on track for IRR on Nov. 8-9.

ESM – ELECTRON SPECTRO-MICROSCOPY

Commissioning of the ESM beamline continued in October. All optics and diagnostic units of the beamline have been tested and refinements of optics alignment are well under way. During October, beam was propagated through the refocusing KB mirrors to the ARPES endstation. The electron spectrometer was baked and the first photoemission spectra, from reference samples, have been taken. Photoemission is the principal experimental technique at ESM.

Figure 1 shows sample XPS spectra from polycrystalline Au, a typical reference sample for photoemission. As expected, the most intense feature originates from the 4*f* core levels at a binding energy of 86 eV. Also visible is the 5*d* emission close to the Fermi level. Angle-resolved photoemission (ARPES) spectra have been acquired from HOPG crystals, demonstrating that the angular resolved mode of the Scienta DA30 electron energy analyzer is working properly. Notably, the static parallel angle-resolved collection mode using electrostatic deflectors is operating correctly.

The ESM wave front reconstructor (Imagine Optic) has been installed in the endstation analysis chamber and will be tested in the next few weeks. This diagnostic instrument will provide a means to quantitatively measure the size of the X-ray spot at the sample location.

Looking ahead, only a very few ESM activities remain to be completed in the NEXT project. The most important of these are receipt and installation, by the supplier, of the M4 mirror for the XPEEM branch. The work remaining for M4 is minimal: the M4 chamber has been installed and its motions tested already a few months ago.

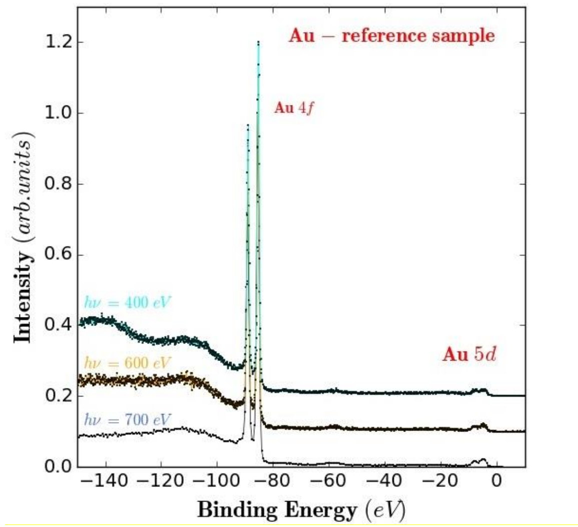


Figure 1. ESM: X-ray Photoelectron Spectra (XPS) collected from polycrystalline Au at photon energy values: 400 eV, 600 eV, and 700 eV. Au is a typical reference material used in photoemission spectroscopy. It is a good metal, with intense emission at the Fermi level. The spectra are dominated by the Au 4f core levels.

ISR – IN-SITU AND RESONANT HARD X-RAY

The assembly drawing for the Eiger pixel array detector mounted on the XY stages, which are installed in Hutch 4-ID-D, was released (Figure 2). A vendor item control drawing for the five degree-of-freedom table was also released.

The ultra-clean nitrogen gas compressor was received on October 17 and lifted into place on the roof of Hutch 4-ID-D on October 26 (Figure 3).

Both sets of diamond phase plates were tested using the analyzer 2-circle, which is a sub-component of the base diffractometer in Hutch 4-ID-C. Rocking curves were measured using an ion chamber (Figure 4) and the crystallographic orientations of all eight diamonds were verified. A keeper plate is being designed to secure the phase plates in case of glue failure. The keeper plates will be fabricated and attached to the phase plate holders prior to their installation in the Dual Phase Plate Assembly, which is planned to take place during the NSLS-II maintenance period in December.

Preparations for the installation of the Dual Phase Plate Assembly stacks continued, with the fabrication and installation of a gate valve support. The stacks were received on October 31, and installation is scheduled for November 2-4.

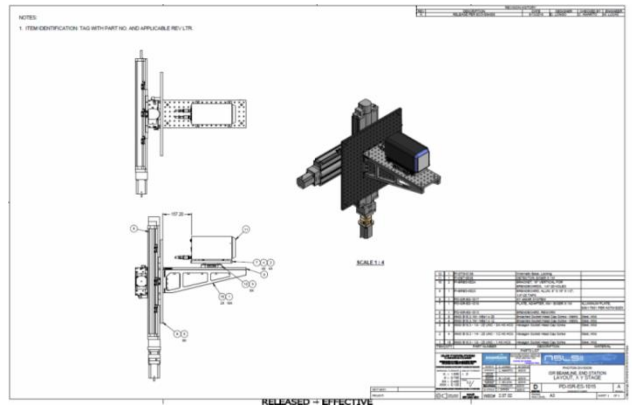


Figure 2. ISR: Assembly drawing of the Eiger pixel array detector mounted on the XY stages.

Figure 3. ISR: Ultra-clean nitrogen gas compressor installed on the roof of Hutch 4-ID-D.

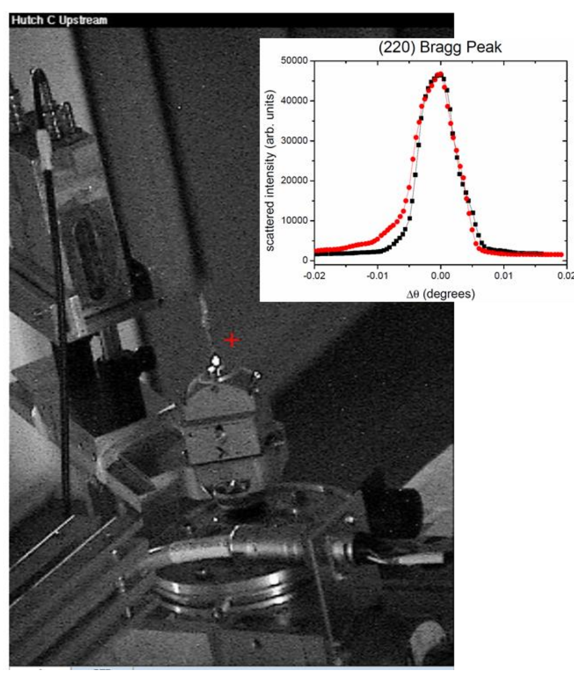


Figure 4. ISR: Testing of diamond phase plates in hutch 4-ID-C. Inset shows (220) Bragg rocking curves of two 1 mm-thick diamonds.

ISS – INNER SHELL SPECTROSCOPY

The three ISS endstation procurement contracts remaining at the end of September were completed in October, thereby completing all technical scope for ISS. The final endstation milestones achieved this month were: (1) approval of the commissioning report for the sample chamber (PI), (2) approval of the commissioning report for the emission spectrometer mechanics (PI), and (3) final installation of the sample transfer system (Square One).

SIX – SOFT INELASTIC X-RAY

Pressure testing of all 19 DI water circuits plumbed to the various water-cooled PDS optics and safety components was successfully completed this month. Following the installation of new relief valves operating at 100-psi pressure threshold, all measured water flows were found to meet the target values determined by FEA thermal analyses. Green labels showing the water circuit number and supply/return indication were attached to each water line as shown in Figure 5.

Bakeout has been completed for all 18 vacuum sections of the SIX PDS. Vacuum is in the mid to low 10^{-9} mbar for all sections except the gas cell spool piece, which is in the mid 10^{-8} mbar range and will need further baking to improve.

The EPS system monitoring layouts were developed by the EPS group. As shown in Figures 6 and 7, water flow, pressure and thermal sensor information, and vacuum levels are now conveniently accessible from Control System Studio (CSS).

The radiation safety components have been surveyed in place, and are now under configuration control (Figure 8). A configuration control checklist was developed in collaboration with ES&H, and labels were appropriately placed on all the components under configuration control.

Regarding installation of the granite blocks that will support angular travel of the 15m-radius detector arm, hole drilling and installation of the threaded anchors was completed for 20 blocks out of a total of 22 during October. The 18 granite blocks currently at NSLS-II were roughly positioned by NSLS-II technicians (Figure 9) and will be finely aligned by Bestec staff during the week from November 9 to 16. The remaining 4 granite blocks are currently at Bestec and will be shipped to NSLS-II after the FAT, in late November.

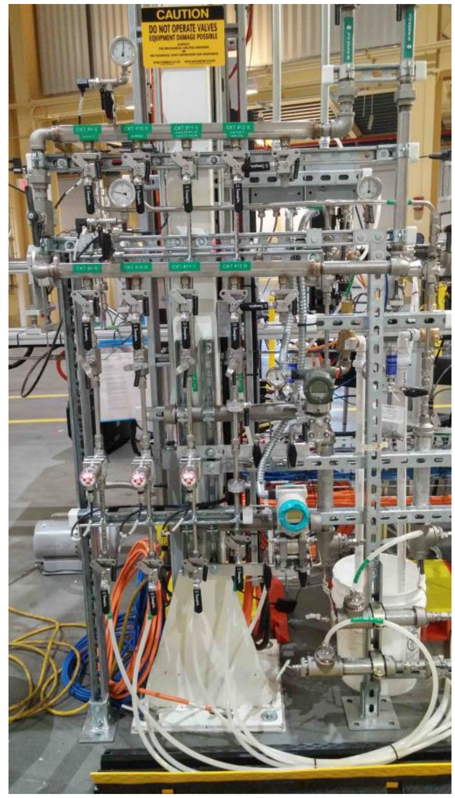


Figure 5. SIX: DI water line manifold located next to the PGM.

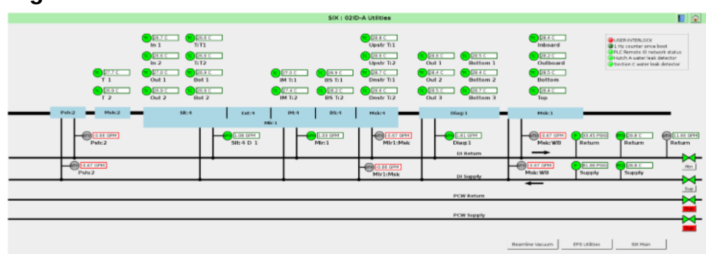


Figure 6. SIX: CSS EPS screen showing the water flow, pressure, and thermal sensors.

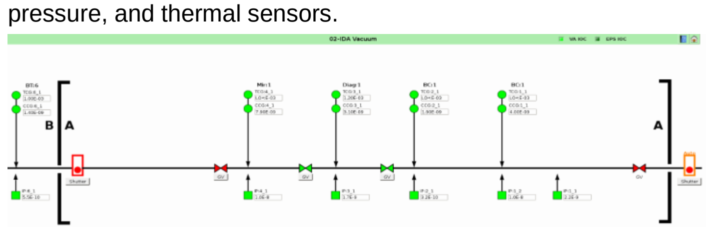


Figure 7. SIX: CSS EPS screen showing the vacuum levels for the upstream six vacuum sections of the PDS.

Figure 8. SIX: Radiation safety components, such as this Bremsstrahlung stop and collimator assembly, are now under configuration control.

Figure 9. SIX: Granite blocks roughly positioned to form the 15m-radius detector chamber track.

SMI – SOFT MATTER INTERFACES

All hands were on deck through October to prepare SMI for IRR on October 19 and documentation of PPS certification on November 3. Approval to begin commissioning was provided on November 7 and first light was taken later that day. The SMI team is grateful for all of the very hard work by the staff, crews, and review teams that led to a smooth review with no pre-starts. SMI team members, suppliers, and Partners were joined by NEXT and Program management for the first shift of beam (Figure 10). As of this writing, SMI Commissioning is taking place during studies shifts and also during operations periods, with restrictions on undulator gap and front end slit opening during operations.

Remaining scope for SMI consists of assembly of the SAXS Beam Chamber and completion of remaining ancillary equipment. The first stands and modules of the SAXS Beam Chamber have been installed (Figure 11). The remaining modules await fabrication of the internal and support mechanics. All these shop jobs have now been sourced. The completion of fabrication will be staggered from late November through early January.

Fabrication and small parts orders are complete for the Attenuators, which are being assembled now (Figure 12). A large part of the work is complete for the Beam Stop assembly, and the XBPMs have been completed and will be assembled in November.

The NSLS-II data acquisition package, Bluesky, is being used for commissioning, and thus the NEXT scope for SMI Controls has all been completed. As the SMI team becomes more familiar with its functions, the code will be customized further for the SMI components and science requirements. Continuation of this work is supported by operations.

Figure 10. SMI: Snapshot of the SMI control station during the first light beam shift.

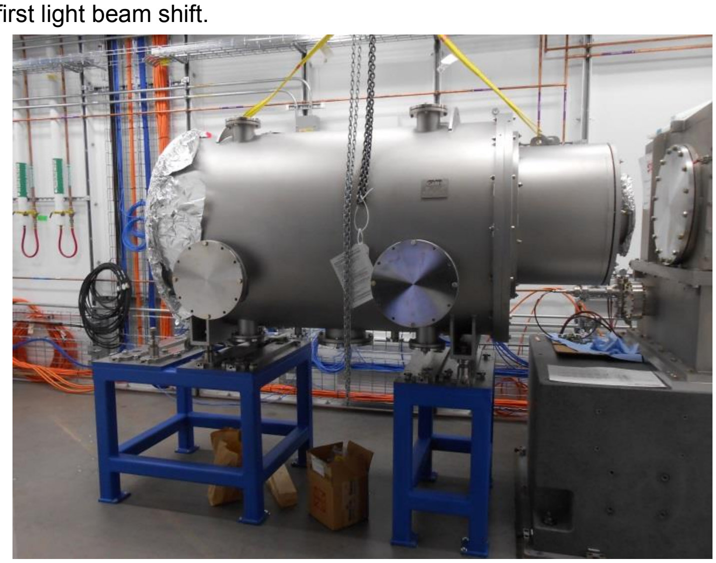


Figure 11. SMI: Installation of the first stands and modules of the SAXS Beam Chamber in hutch 12-ID-C.

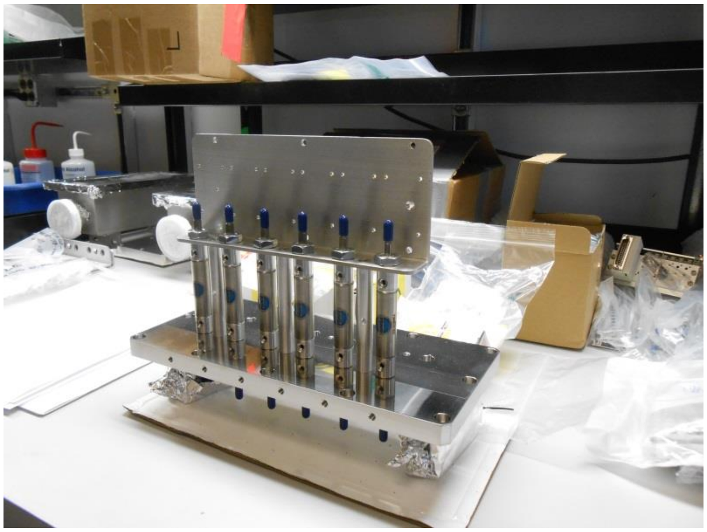


Figure 12. SMI: Bench assembly of attenuators.

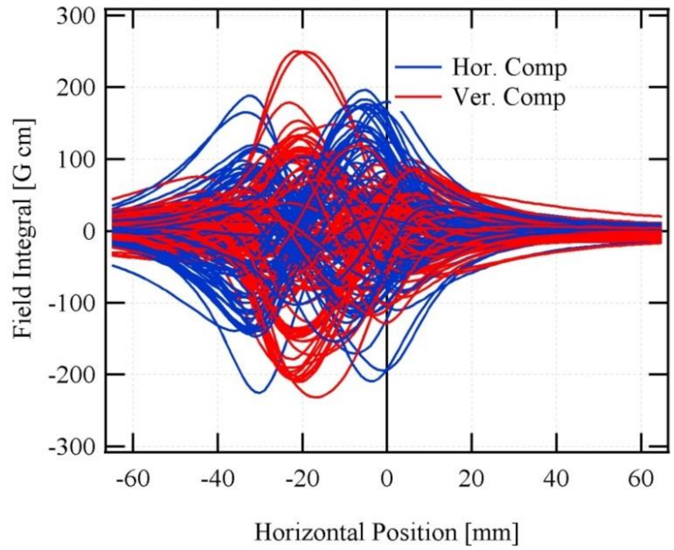


Figure 13. Insertion Devices: First field integral of all (~110) magnet modules provided by the ESM EPU105 contractor (Kyma). Horizontal (blue) and vertical (red) components are shown.

INSERTION DEVICES

Assembly of ESM EPU105, the final insertion device for NEXT, was completed in October. The assembly process consists of successive and repetitive installation of M3 and M5 magnet modules onto the mechanical frame in order to build up the 24 periods of the EPU. Each step of this process consisted of the following steps: (i) assembly of 2 periods of the device, i.e. one M3 and one M5 magnet module on each array of the mechanical frame, (ii) measurement of the magnetic field integral of all assembled modules, and (iii) this integral, along with previously measured individual field integrals of each module, are used as inputs to IDBuilder, which optimizes the selection of the next 2 sets of M3/M5 modules to be installed. Performing the iteration for each successive installation of 2 magnet modules permits IDBuilder to minimize the magnetic field integral for the fully assembled EPU.

The measured field integrals of the (~110) M3 and M5 magnet modules provided by the ESM EPU105 contractor (Kyma), as one of the contract deliverables, are shown in Figure 13. The field integrals of the individual modules, which can easily exceed 50 Gcm, were used as a figure of merit to assess the quality of the assembled EPU during the assembly/sorting process.

Before beginning the assembly process, the individual field integrals of a few modules were measured to confirm the contractor's measured data. Figure 14 compares the field integral of module M3 #51 measured by Kyma with that measured at BNL. The fairly good agreement permitted usage of the individual M3 and M5 field integrals provided by Kyma for the IDBuilder computations, as well as expediting the assembly and sorting process.

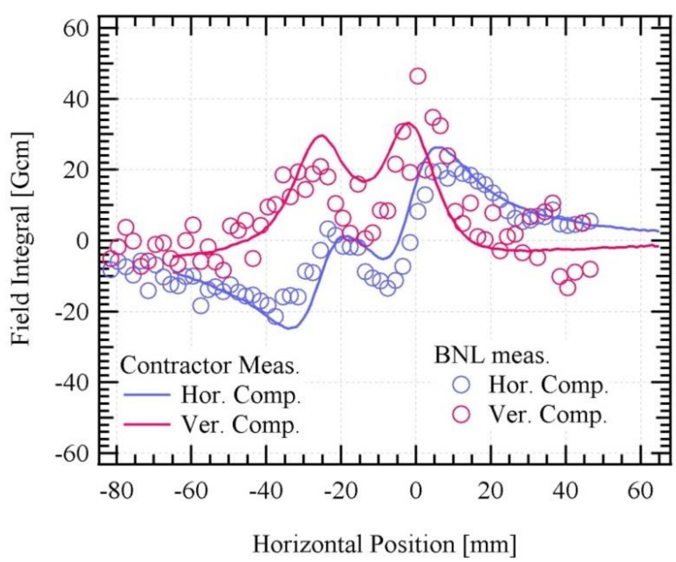


Figure 14. Insertion Devices: First field integral of the M3 #51 measured by Kyma (solid lines) and BNL (circles). Horizontal (blue) and vertical (red) components are shown.

A pace of one step per day was maintained during the EPU105 assembly process, completing it in less than 3 weeks. Photos of the device at various stages of assembly are shown in Figure 15.

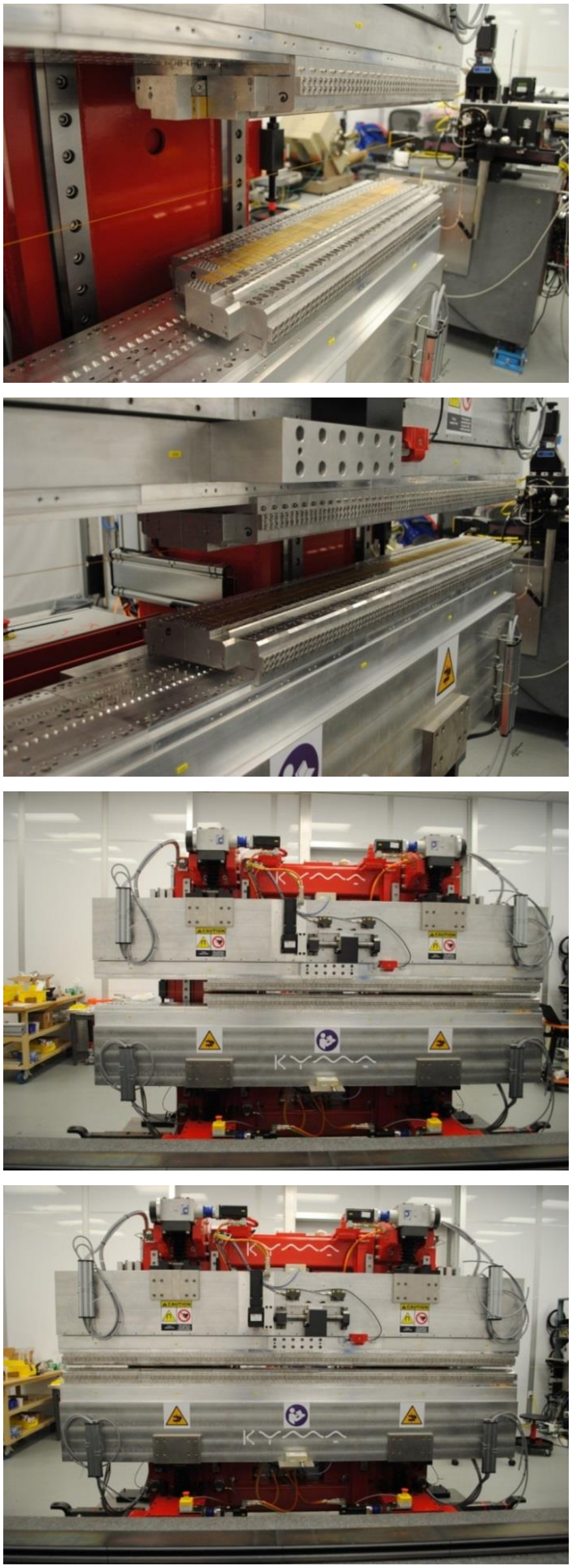


Figure 15. Insertion Devices: Photos of ESM EPU105 at 25% (a), 50% (b), 75% (c), and at the end (d) of the assembly and sorting process in the NSLS-II Magnetic Measurement Laboratory.

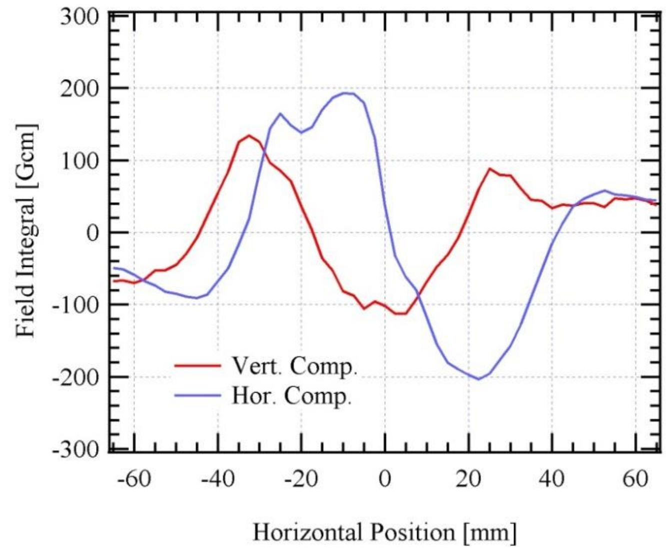


Figure 16. Insertion Devices: First field integral of ESM EPU105 magnet module M3 #51, as measured at Kyma and BNL. Horizontal (blue) and vertical (red) components are shown.

The first field integral of the ESM EPU105 insertion device achieved after the assembly and sorting is shown in Figure 16. The horizontal field integral is within ±2 Gm while the vertical field integral is within ±1 Gm. These results demonstrate that the assembly/sorting process guided by IDBuilder has been very effective: the field integral of the fully-assembled device (consisting of 48 M3 and 48 M5 magnet modules) is comparable to the field integral of the individual modules shown in Figure 13.

The ESM EPU105 field integral will be reduced further during the shimming process (virtual shimming followed by magic finger correction), in order to meet requirements for installation in the NSLS-II accelerator. This process will be conducted in November.

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

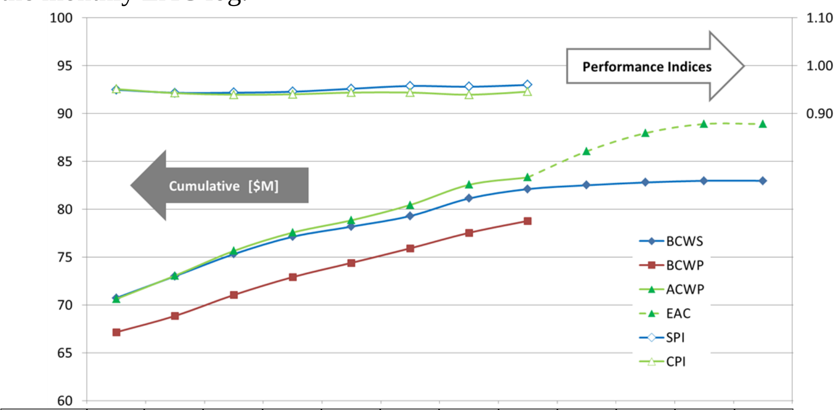
NEXT ETC Round Table Discussion	November 2016

Acronyms and Abbreviations

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
CD	Critical Decision
CPI	Cost Performance Index
CSS	Control System Studio
CV	Cost Variance
DI	De-Ionized
DOE	Department of Energy
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
FE	Front End
FEA	Finite Element Analysis
FOE	First Optics Enclosure
FTE	Full Time Equivalent
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
HOPG	Highly Oriented Pyrolytic Graphite
ID	Insertion Device
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
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 ll
OPA	Office of Project Assessment
OPC	Other Project Costs
OPI	Operator Interface
PCR	Project Change Request
PDS	Photon Delivery System
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
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
XBPM	X-ray Beam Position Monitor
XPEEM	X-ray photoemission electron microscopy
XPS	X-ray Photoelectron Spectroscopy

COST AND SCHEDULE STATUS

Cost and schedule progress is being tracked using an Earned Value Management System (EVMS) against the cost and schedule baseline established on October 1, 2013. All baseline changes are being controlled through the NEXT Change Control Board. Cost and schedule revisions are being managed using Project Change Control procedures. From June 2015 forward, EAC is reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), at the individual activity and resource level, 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	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17
BCWS	70.7	73.0	75.3	77.1	78.2	79.3	81.1	82.1	82.5	82.8	83.0	83.0
BCWP	67.2	68.9	71.0	72.9	74.4	75.9	77.5	78.8				
ACWP	70.6	73.1	75.6	77.6	78.8	80.4	82.5	83.3				
SPI	0.95	0.94	0.94	0.95	0.95	0.96	0.96	0.96				
CPI	0.95	0.94	0.94	0.94	0.94	0.94	0.94	0.95				
ETC									5.6	2.9	1.0	0.0

NEXT as of 10/31/2016	Current Period	Cum-to-Date
Plan (BCWS) $k	979	82,098
Earned (BCWP) $k	1,244	78,777
Actual (ACWP) $k	775	83,332
SV $k	264	-3,321
CV $k	469	-4,544
SPI	1.27	0.96
CPI	1.60	0.95
Budget at Completion $k (PMB [UB])		82,970
Planned % Complete (BCWS/BAC)		98.9%
Earned % Complete (BCWP/BAC)		94.9%
Contingency $k		7,030
Contingency / (BAC – BCWP)		167.7%
EAC $k		88,896
Contingency / (EAC – BCWP)		69.5%
(Contingency + VAC) / (EAC – ACWP)		19.8%
TPC = PMB + Contingency		90,000

The NEXT project Schedule Variance (SV) for October 2016 is +$264k, with an associated monthly Schedule Performance Index (SPI) of 1.27 (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), the same as it was in October.

The NEXT project Cost Variance (CV) for October 2016 is +$469k, with an associated monthly Cost Performance Index (CPI) of 1.60 (red status). The significant contributors to the current month CV are provided in the table below. The cumulative CPI is 0.95 (green status), 0.01 higher than it was in October.

Leading Current Month Variances [$k], October 2016

WBS	Title	PV	EV	AC	Schedule		Cost	
					SV	Issues	CV	Issues
2.01	Project Support	161	161	90	0	--	70	Principal contributor is the short time-charging month of October, ~30% below the average month.
2.03	Common Systems	26	163	118	137	Greater work performed than planned, especially in PPS, in order to catch up on delayed work. Utilities (WBS 2.03.01): +$7k, PPS (2.03.02): +$113k; EPS (2.03.03): +$15k; Control Station (2.03.04): +$2k	44	Dominated by CV in PPS, from labor efficiencies realized this month. Utilities (WBS 2.03.01): -$1k, PPS (2.03.02): +$64k; EPS (2.03.03): -$17k; Control Station (2.03.04): -$1k
2.04	Controls	82	47	50	-35	Greater work than planned in Control System design & implementation (WBS 2.04.02, +$39k) offset by not earning motion controllers in Control System Equipment (WBS 2.04.03, -$75k). The controllers will be received in November.	-3	--
2.05	ESM Beamline	0	25	52	25	--	-27	Accruals or payments for value earned earlier.

Leading Current Month Variances [$k], October 2016								
WBS	Title	PV	EV	AC	Schedule		Cost	
					SV	Issues	CV	Issues
2.07	ISR Beamline	273	186	35	-86	Scheduled activities for the 6-circle diffractometer only partially earned this month (-$258k), offset by catch-up work on activities that were scheduled earlier: changeover components, phase plate holder, and magnet windows fabrication (+$7k); changeover components installation (+$3k); phase plate and integrated testing (+$35k); and receipt of the dual phase plate assembly stacks (+$127k).	152	Earned value past the October accrual deadline for progress on 2 contracts: receipt of 15% of the 6-circle diffractometer (+$12k) and receipt of the dual phase plate assembly stacks (+$127k). These accruals will be processed in November.
2.08	ISS Beamline	51	49	5	-3	--	43	Earned value past the October accrual deadline.
2.09	SIX Beamline	343	467	298	124	Sum of activities performed in October and scheduled earlier [delivery of lead collimators (+$7k), delivery of vacuum pumps (+$11k), delivery of cooling braids (+$5k), sample chamber assembly and FAT activities (+$27k), spectrometer fabrication, FAT and receipt activities (+$338k), gratings FAT and delivery (+$62k)] and activities scheduled but not performed in October [SEB2 door opening (-$2k, performed earlier), delivery of roughing vacuum pump (-$10k, not performed yet), sample chamber installation and commissioning activities (-$10k, not performed yet), spectrometer receipt, installation and commissioning activities (-$310k, not performed yet)].	169	Predominantly (~+$300k) from accruals which will be processed in November for performance earned in October. Offset by labor cost overage in October (~-$130k).
2.10	SMI Beamline	25	81	107	55	SMI Beamline Systems (WBS 2.10.02, +$55k): catch up on work scheduled earlier.	-26	--
2.11	Insertion Devices	19	66	21	47	--	45	--
	Total	979	1244	775	264	**Total**	469	

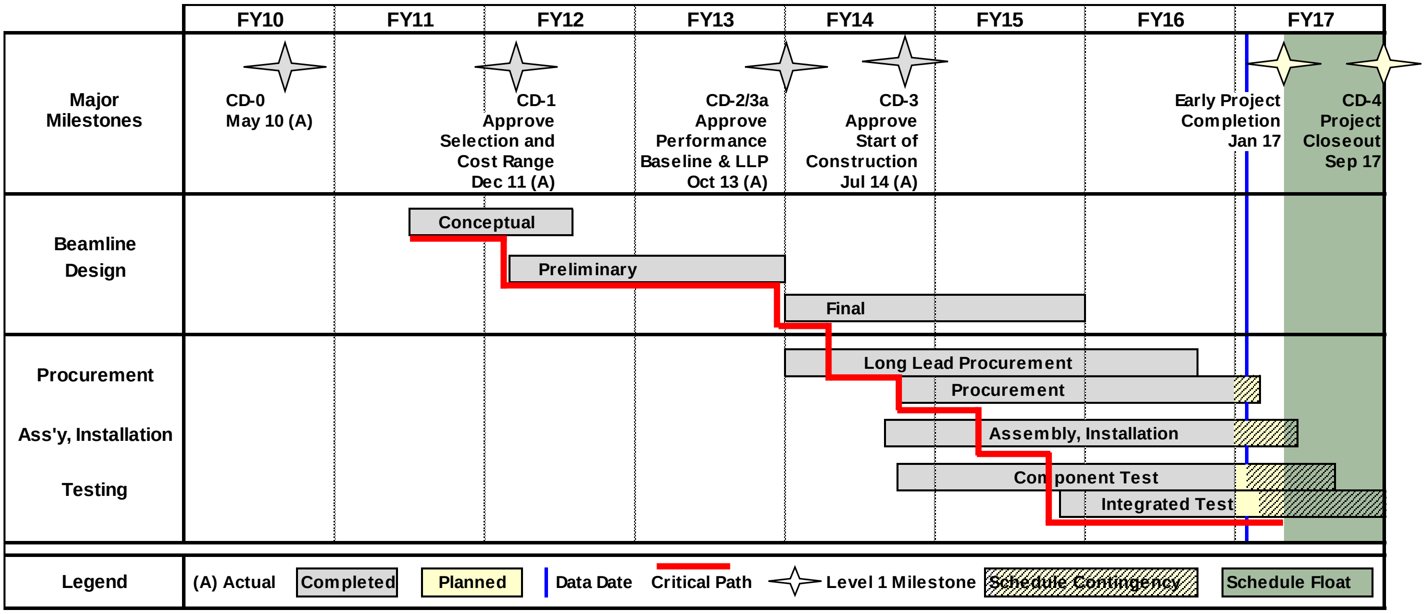
As of October 31, 2016, the project is 94.9% complete with 167.7% contingency ($7.03M) for $4.2M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through October 2016. The project EAC for October is reported at $88,896k against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $82,970k. The Variance At Completion (VAC) is given by VAC = BAC – EAC, with EAC = ACWP + ETC. Through October 2016, the VAC (-$5,926k) is driven by the sum of the cumulative cost variance (-$4,544k, dominated by labor cost overage on work performed to date), and the estimated additional labor required to complete remaining work ($1.35M).

The October 2016 EAC ($88.90M), obtained after a thorough bottom-up ETC analysis, is $0.97M higher than the September value. $0.36M of this increase is assigned to the sum of the October monthly cost variance (-$0.47M) and adjustments for the short (30% lower) time-charging month (+$0.30M) and the monthly difference in earned vs. accrued value (+$0.53M). The remainder ($0.60M increase) results from a bottom-up resource-loaded estimate of activities during the 3 remaining months prior to Early Project Completion. The Level 2 WBS elements leading this increase are: SIX beamline ($0.20M), SMI beamline ($0.12M), Control Systems ($0.05M), and Project Management & Support ($0.20M). As of the end of October, contingency on EAC is $1.10M, which represents 19.8% of $5.57M EAC work remaining. Outstanding commitments on fixed-price equipment contracts total $3.67M, so the $1.10M contingency on EAC represents 57.9% of $1.91M 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 October and no PCRs are planned for November.

Milestones – Near Term		Planned	Actual	Projected
L3	SIX - Testing Monochromator and Slits complete	1-Mar-16	21-Oct-16	
L3	ISR – Installation of Beamline Components Complete	29-Jun-16		December 2016
L3	WBS 2.04 – Beamline Control Systems Complete	14-Sep-16		January 2017
L3	SMI – Installation of Beamline Components Complete	16-Sep-16		January 2017
L3	ESM – Installation of Beamline Components Complete	29-Sep-16		December 2016
L3	SIX – Installation of Beamline Components Complete	30-Sep-16		January 2017
L3	Common Beamline Systems: EPS Installed	30-Sep-16		December 2016
L2, L3	Complete Installation of Common Beamline Systems PPS	30-Sep-16		December 2016
L2	Early Project Completion – incl. IRR	31-Jan-17		January 2017

PROJECT SCHEDULE



As of October 2016, the critical path runs through delivery, installation, and commissioning (without beam) of the sample chamber and spectrometer arm system for the SIX beamline (WBS 2.09.02.03, SIX Beamline Systems Endstation Equipment).

Staffing Report

Staffing as of 10/31/2016	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	0.65	0.26	40.07	35.89
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	0.74	0.76	32.12	18.42
WBS 2.04 Control System	0.25	0.31	21.48	20.45
WBS 2.05 ESM Beamline	0.01	0.00	15.74	18.52
WBS 2.06 FXI Beamline	0.00	0.00	4.77	4.60
WBS 2.07 ISR Beamline	0.14	0.12	17.42	15.76
WBS 2.08 ISS Beamline	0.01	0.00	14.94	14.91
WBS 2.09 SIX Beamline	0.59	0.66	19.61	23.49
WBS 2.10 SMI Beamline	0.47	0.36	16.83	15.81
WBS 2.11 Insertion Devices	0.22	0.13	7.44	6.62
WBS 2.12 ID & FE Installation	0.00	0.00	3.88	7.97
Total	**3.07**	**2.60**	**203.04**	**191.18**

** 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 October 2016: 101

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	a. NAME		a. NAME	a. FROM *(YYYYMMDD)*
Brookhaven National Laboratory	NEXT		NSLS-II Experimental Tools (NEXT) Project	2016 / 10 / 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 / 10 / 31

WBS (2) / 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 Project Management and Support	160,632	160,632	90,149	0	70,483	9,421,039	9,421,039	10,233,735	0	(812,696)	9,918,232	10,860,591	(942,359)
2.01.01 Project Management	70,559	70,559	31,071	0	39,488	4,379,632	4,379,632	4,041,717	0	337,915	4,598,029	4,241,665	356,363
2.01.02 Project Support	90,073	90,073	59,078	0	30,995	5,041,408	5,041,408	6,192,018	0	(1,150,611)	5,320,204	6,618,926	(1,298,722)
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	25,953	162,564	118,205	136,611	44,358	7,232,087	7,056,402	8,302,684	(175,685)	(1,246,282)	7,340,417	8,581,260	(1,240,843)
2.03.01 Utilities	0	7,329	8,580	7,329	(1,251)	4,210,031	4,155,935	4,327,940	(54,096)	(172,005)	4,210,031	4,398,029	(187,998)
2.03.02 Personnel Protection System (PPS)	21,374	133,914	69,444	112,539	64,470	1,526,667	1,432,333	2,230,418	(94,335)	(798,085)	1,620,824	2,393,500	(772,676)
2.03.03 Equipment Protection System (EPS)	0	14,990	32,272	14,990	(17,282)	680,294	672,507	936,409	(7,787)	(263,902)	680,294	947,660	(267,366)
2.03.04 Control Station	0	1,752	2,535	1,752	(783)	306,744	287,276	212,940	(19,467)	74,336	306,744	233,031	73,713
2.03.05 Common Beamline Systems Management	4,579	4,579	5,374	0	(795)	508,351	508,351	594,976	0	(86,625)	522,524	609,040	(86,516)
2.04 Control System	82,301	46,833	49,539	(35,468)	(2,706)	4,641,062	4,553,096	4,841,437	(87,967)	(288,342)	4,648,844	4,997,764	(348,920)
2.04.01 Control System Management	2,476	2,476	782	0	1,694	286,645	286,645	251,057	0	35,589	294,427	258,750	35,677
2.04.02 Control System Design & Implementation	4,945	44,357	47,962	39,412	(3,605)	2,929,314	2,909,571	3,271,015	(19,743)	(361,444)	2,929,314	3,351,425	(422,111)
2.04.03 Control System Equipment	74,880	0	794	(74,880)	(794)	1,425,103	1,356,879	1,319,365	(68,224)	37,514	1,425,103	1,387,589	37,514
2.05 ESM Beamline	0	25,278	52,133	25,278	(26,855)	9,422,464	9,338,207	10,099,130	(84,257)	(760,923)	9,422,464	10,195,534	(773,070)
2.05.01 ESM Management	0	0	0	0	0	610,744	610,744	474,027	0	136,718	610,744	474,027	136,718
2.05.02 ESM Beamline Systems	0	25,278	52,133	25,278	(26,855)	8,811,720	8,727,463	9,625,104	(84,257)	(897,641)	8,811,720	9,721,507	(909,788)
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	272,571	186,331	34,525	(86,241)	151,805	10,332,760	9,433,247	9,392,913	(899,513)	40,334	10,392,425	10,544,835	(152,410)
2.07.01 ISR Management	2,023	2,023	0	0	2,023	1,099,035	1,099,035	1,034,389	0	64,646	1,105,394	1,034,389	71,005
2.07.02 ISR Beamline Systems	270,548	184,307	34,525	(86,241)	149,782	9,233,725	8,334,212	8,358,524	(899,513)	(24,312)	9,287,031	9,510,446	(223,415)
2.08 ISS Beamline	51,409	48,712	5,302	(2,697)	43,410	10,387,830	10,465,853	11,154,797	78,023	(688,945)	10,472,212	11,230,289	(758,077)
2.08.01 ISS Management	51,409	2,023	119	(49,386)	1,904	753,817	831,840	681,035	78,023	150,805	838,199	681,035	157,164
2.08.02 ISS Beamline Systems	0	46,689	5,183	46,689	41,506	9,634,013	9,634,013	10,473,763	0	(839,750)	9,634,013	10,549,255	(915,242)
2.09 SIX Beamline	342,759	467,035	297,863	124,276	169,172	11,703,222	9,912,541	10,637,402	(1,790,680)	(724,861)	11,764,836	13,298,167	(1,533,332)
2.09.01 SIX Management	2,023	2,023	3,528	0	(1,505)	711,784	711,784	690,698	0	21,086	729,841	751,497	(21,656)
2.09.02 SIX Beamline Systems	340,736	465,012	294,334	124,276	170,678	10,991,438	9,200,757	9,946,705	(1,790,680)	(745,947)	11,034,995	12,546,670	(1,511,675)
2.10 SMI Beamline	25,160	80,517	106,539	55,357	(26,022)	9,080,404	8,851,470	9,144,179	(228,933)	(292,708)	9,126,837	9,567,910	(441,073)
2.10.01 SMI Management	25,160	41,064	21,084	15,904	19,980	759,223	775,127	691,570	15,904	83,557	805,656	703,007	102,649
2.10.02 SMI Beamline Systems	0	39,453	85,454	39,453	(46,001)	8,321,181	8,076,343	8,452,608	(244,838)	(376,265)	8,321,181	8,864,903	(543,722)
2.11 Insertion Devices	18,581	65,643	20,572	47,061	45,071	4,799,033	4,666,876	4,461,595	(132,157)	205,281	4,805,392	4,565,675	239,717
2.11.01 ESM EPU Insertion Device	16,558	63,619	19,639	47,061	43,980	4,587,795	4,455,638	4,301,605	(132,157)	154,033	4,587,795	4,399,398	188,397
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	2,023	2,023	933	0	1,090	94,101	94,101	89,616	0	4,485	100,460	95,903	4,558
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	979,367	1,243,544	774,826	264,177	468,718	82,098,358	78,777,189	83,321,574	(3,321,170)	(4,544,386)	82,970,116	88,895,727	(5,925,611)
Management Reserve													
Undistributed Budget													
Performance Management Baseline (PMB)	979,367	1,243,544	774,826	264,177	468,718	82,098,358	78,777,189	83,321,574	(3,321,170)	(4,544,386)	82,970,116	88,895,727	(5,925,611)