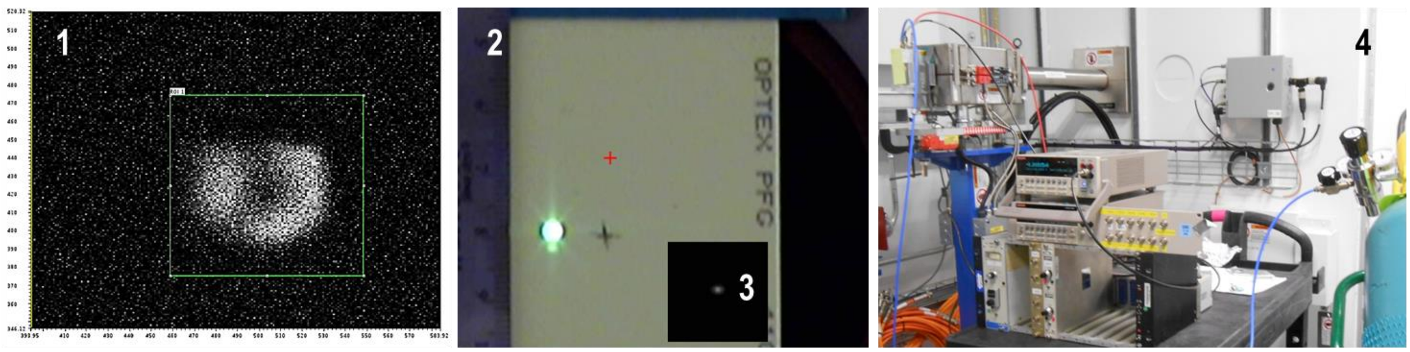
NSLS-II Experimental Tools (NEXT)

November 2016 Project Activity
Report due date: December 20, 2016

SMI First Light: 1×10^{12} ph/s @ 250mA



KPP achieved

1. Mono beam, 16keV (15th IVU harmonic). Asymmetrical shape shows that IVU needs optimization
2. Beam after FOE mirrors, in B endstation: main beam (upper) saturating camera, vertically unreflected beam (lower) visible. E = 7.5 keV
3. Comparable scale to 2, camera iris reduced.
4. Ion chamber (w/N_2) after Be window
5. Measure 6.8µA

<u>Conversion:</u> 1.5×10^{17}ph/s/A $\times$ 6.8µA = 1.0×10^{12} photons/s

SMI commissioning progress: first light, beam propagation through FOE to 12-ID-B endstation, and achievement of flux KPP. 1. Beam profile 4m downstream of the monochromator, showing asymmetrical lobes, prior to optimization of the IVU. 2. Beam in 12-ID-B, reflected from and bypassing the vertical mirrors (upper and lower spots respectively). 3. Image with smaller camera iris better represents the beam size. 4. Ion chamber setup after Be window in 12-ID-B. 5. Maximum ion chamber current of 6.8µA corresponds to 1×10^{12} photons/sec, measured at 250mA.

Steve Hulbert
NEXT Project Manager

OVERALL ASSESSMENT

The SMI IRR was completed on November 3, first light was taken on November 7, and the threshold KPP value for flux measured at an SMI endstation position (B-hutch was used) was achieved on December 3 (cover figure). Progress was made this month on all remaining SMI endstation scope, including sourcing of all SAXS beam chamber parts for fabrication.

The first phase of the SIX PDS IRR, held on November 8-9, confirmed the readiness for operations of the PDS optical and diagnostic elements, mechanical and electrical utilities, controls, and EPS. The second phase IRR, covering all PDS systems, is planned for January 2017. Assembly and testing of the SIX endstation chamber and emission spectrometer were completed by the supplier (Bestec) this month, culminating in a successful FAT at Bestec's site on November 22-23. Regarding SIX radiation shielding, calculations completed in November indicated the need for additional shielding of the SIX pink beam transport section. A plan to implement the required changes in the most schedule-efficient manner will be developed in December.

Good progress on remaining ISR endstation systems was made in November, including installation of the Dual Phase Plate Assembly stacks during the first week and successful FAT of the 6-circle diffractometer during the final week.

Magnetic shimming of the ESM EPU105 insertion device was completed during November, including quasi-periodic adjustment of specified magnets, and magic finger correction of the magnetic field integral began. This EPU is expected to be ready for installation at 21-ID in December.

One major procurement was completed in November (ISR Gas Handling System) and 8 remain: 1 (M4 mirror optics) shared between ESM and SIX, 3 for ISR (Dual Phase Plate Assembly, KB mirror optics, and 6-circle Diffractometer), 3 for SIX (Emission Spectrometer, Sample Chamber, and Grating Rulings), and 1 for ESM (electron energy analyzer software update). Delivery of all materials for the remaining contracts is expected in December or January.

As of November 30, 2016, the project is 96.2% complete on base scope performance earned to date. The cumulative EVMS schedule index increased by 0.01, to 0.97, while the cumulative cost index remained at 0.95.

No PCRs were processed in November and none are planned for December. BAC remained at $82.97M. Cost contingency is $7.03M, compared to $3.14M BAC work remaining.

The EAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), is $88.93M, $0.036M greater than the October value. Details are provided in the Cost and Schedule section. As of the end of November, contingency on EAC is $1.07M, which represents 23.6% of $4.54M EAC work remaining, or 81.5% of $1.31M unobligated work to go ($3.23M 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

All Common Systems work on ISS, ESM, and SMI is now completed.

Completion of the SIX Mechanical utilities installation work in the SIX Satellite Building is pending the delivery and installation of the endstation sample chamber and emission spectrometer. These components are expected to be ready for utilities integration in January.

Installation of the SIX PPS continued to make good progress this month. The hardware integration is expected to be completed in December and testing is expected to begin shortly thereafter. Final certification of the PPS and reach-backs to the storage ring and linac are expected to be completed in early January. At ISR, the laser interlock installation and testing was completed this month; certification of this system is scheduled in December, together with ISR beamline PPS recertification.

EPS installation work on the SIX photon delivery system was completed in early November, ahead of the SIX Phase 1 IRR. This system was reviewed as part of the IRR, and no pre- or post-starts were identified.

BEAMLINE CONTROLS

Control engineers played a critical role in successful completions of IRRs for SMI and SIX (phase 1) in early November, as well as in taking first light at SMI on the 7^{th}.

Controls aspects of endstation development continued to make good progress during November. For SIX, the controls engineer participated in the November 22-23 FAT for the sample chamber and emission spectrometer at Bestec, including all controls-related tests. For ISR, the controls engineer participated in installation of the Dual Phase Plate Assembly, including testing of all motions over their full ranges. Also for ISR, the controls engineer participated in the FAT of the 6-circle diffractometer at Huber during the final week of November, conducting EPICS motion tests of all axes.

Looking ahead, the major portion of beamline controls scope remaining in NEXT is for SIX endstation controls.

ESM – ELECTRON SPECTRO-MICROSCOPY

Commissioning with beam of the ESM beamline and endstation (NSLS-II operations activities) continued in November. Angular-resolved photoelectron spectra at 300 eV photon energy were collected from reference samples (HOPG and $ZrTe_2P$) using the ARPES spectrometer (Scienta). Two typical band dispersions are shown in Fig. 1. The spectra, taken at room temperature, clearly demonstrate the advanced functionality of the Scienta DA30 spectrometer.

Testing of the wave front reconstructor (Imagine Optic) began this month and will continue when beam returns in January. This diagnostic is used to determine the size of the beam at the sample position.

Looking ahead, the M4 mirror, which will provide beam to the photoemission microscope in the XPEEM branch, is expected to ship from the sub-contractor's (JTEC) site at the end of December. Receipt, metrology, and installation in the existing M4 system (including mechanics, vacuum, and controls) are planned for January 2017.

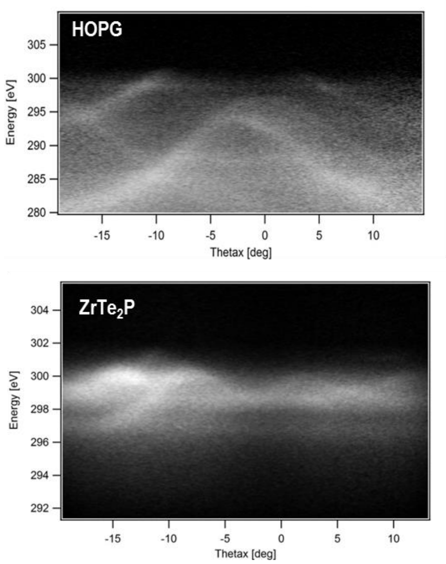


Figure 1. ESM: Measured electronic bands dispersion close to the Fermi level from cleaved single crystals: HOPG (top panel) and $ZrTe_2P$ (bottom). The Angle-Resolved PhotoElectron Spectra (ARPES), taken at 300 eV photon energy, were collected at room temperature using the 2D Scienta spectrometer without moving the sample.

ISR – IN-SITU AND RESONANT HARD X-RAY

The magnet chamber with 1 mm thick beryllium windows (Figure 2) was received on November 16. Prior to shipment, the supplier (Materion) successfully tested each of the four beryllium windows at a differential pressure of 1.5 atm for ten cycles.

Installation of the Dual Phase Plate Assembly stacks was carried out by Huber (Figure 3) during November 2-5. The vacuum chamber was sealed and leak-tested during the week of November 7, and a gentle, 80˚C bake was carried out until November 28.

The manual translation rails for the Instrumented 6-Circle Diffractometer, which were shipped with the Dual Phase Plate Assembly stacks, were installed by Huber in Hutch 4-ID-C during November 4-5. The Factory Acceptance Test for the rest of the Instrumented 6-Circle Diffractometer (Figure 4) was held at Huber during November 29 – December 1. Motion testing using the Geo Brick motion controller was completed for all subassemblies except the cryostat carrier, which was not yet fully assembled. The cryostat carrier is expected to be completed by December 9, and shipped with the rest of the diffractometer in mid-December, with installation planned for early January.

Gas Handling System training was carried out by Applied Energy Systems during November 29-30 for four NSLS-II personnel. The basic functions of the gas cabinets were demonstrated, such as "purge-up" and "purge-down" for toxic gas introduction and removal, respectively.

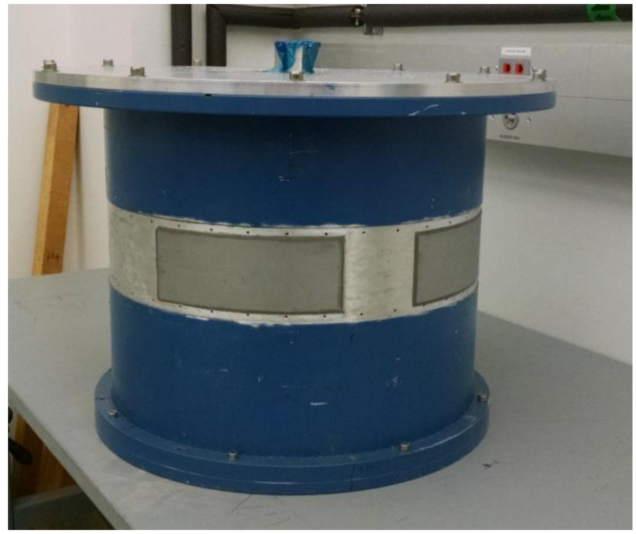


Figure 2. ISR: Magnet chamber with 1 mm thick beryllium windows.

Figure 3. ISR: Installation of the downstream stack of the Dual Phase Plate Assembly.

Figure 4. ISR: Instrumented 6-Circle Diffractometer at the FAT.

Figure 5. SIX: Spectrometer arm at Bestec's site during the November 22-23 FAT, viewed from the downstream end. The detector chamber is in foreground.

SIX – SOFT INELASTIC X-RAY

The phase-1 IRR review of the SIX vacuum, controls system, and EPS took place on November 8-9. Minor comments were collected from the IRR committee, which the SIX beamline team addressed by the end of that week.

The FAT for the endstation spectrometer and sample chamber took place at Bestec's site on November 22-23. All of the hardware was installed in Bestec's assembly room (Figures 5 and 6), which permitted angular rotation of the spectrometer arm over a ~10° range (the full angular range at the SIX endstation will be 112°). Motion test and stability measurement results were all found to be within specifications. Rotation of the arm and motion of mirror axes were tested by the SIX control engineer.

Discussions with the NSLS-II radiation physicist and ES&H regarding shielding of the SIX pink beam transport pipe continued during the month of November. The latest analysis shows that some fortification of the shielding in this section will be needed for operation with 2 EPUs and 500 mA ring current. A plan to implement these improvements, while causing the least disruption to the schedule for first light and the KPP, will be developed in December.

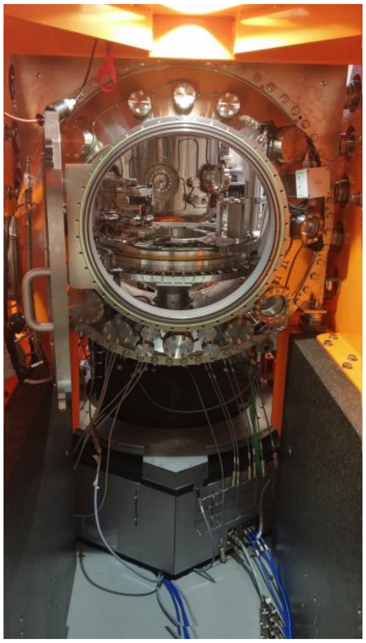


Figure 6. SIX: Sample chamber at Bestec's site during the November 22-23 FAT, viewed from outboard (upper photo) and inboard (lower photo).

SMI – SOFT MATTER INTERFACES

During November, SMI completed the IRR successfully, took first light into the 12-ID-B endstation, and measured flux twice the threshold KPP value (cover images). The beam profile imaged on a fluorescent screen 4m downstream of the monochromator was examined at several photon energies between 7.5 and 16 keV (16 keV image shown in cover figure inset 1). The beam has asymmetrical lobes, indicating that the e-beam steering through the IVU is not yet optimal. Beam on a screen in 12-ID-B (cover figure insets 2, 3) shows a strong reflection from the three mirrors in the FOE, and beneath it a weaker reflection from beam over-filling the vertical focusing mirror. Our estimate of the vertical beam size, prior to optimizing the focus, is < 200µm at the Secondary Source Aperture plane, which is very good performance for the bimorph mirrors prior to applying the voltage matrix to optimize their surface figure. The measured ion chamber current (in N_2 atmosphere, saturation at 3kV, cover figure insets 4,5), was 6.8µA, corresponding to 1×10^{12} photons/sec at the operating ring current of 250mA. This is 2×10^{12} photons/sec when scaled to 500mA ring current, twice the threshold KPP flux value (1×10^{12} photons/sec @ 500mA) and 20% of the objective KPP value (1×10^{13} photons/sec @ 500mA). The objective flux KPP value is expected to be achieved following optimization of the undulator performance in January. During January, SMI beam will be propagated to the 12-ID-C hutch, through the CRL focusing lenses, and into the WAXS endstation chamber.

Progress on remaining endstation scope was also made during November. The attenuators are assembled and ready to be installed. The beam stop parts were all completed and are going through the vacuum cleaning and assembly process. All design work for the SAXS assembly, including cable management, is complete and all parts have been sourced for fabrication. The remaining tasks for SAXS chamber development include placing final orders for off-the-shelf cable handling items and monitoring fabrication and shipping of the other internal components. All SAXS assembly parts, both those sourced commercially and those being provided by BNL Central Shops, have delivery dates prior to the end of January 2017.

INSERTION DEVICES

Significant progress was made this month towards completing magnetic shimming of the ESM EPU105 insertion device. The first three iterations of virtual shimming were performed to reduce the first magnetic field integral and ensure a straight electron beam trajectory as it passes through the undulator. Then Quasi-Periodicity (Q-P) in the magnetic field profile was introduced in order to modify the properties of the emitted photon beam as follows: reduction in intensity of the higher (n>1) harmonics compared to the fundamental (n=1) as well as shifts in energy of these higher harmonics. The energy shifts cause the higher harmonics to no longer be proportional to an integer multiple of the fundamental energy, thereby reducing drastically the amount of unwanted higher harmonic radiation transmitted through the monochromator in the ESM beamline.

Quasi-Periodicity is achieved by reducing the magnetic field strength at six specific locations within the undulator. In practice, the magnet holders at these locations are replaced with special magnet holders that displace the magnets vertically by 13 mm away from the mid-plane. Only magnets with longitudinal magnetization, also called B magnets, are displaced during this process in order to minimize the effects of the Q-P adjustment on the first and second magnetic field integrals.

Figure 7 shows a close-up view of the special magnet holders used for the Q-P modification on the lower girder of ESM EPU105, as well as the first magnetic field integral measured following implementation of Q-P. The field integral will be further reduced in December via magic finger correction (small cylindrical magnets installed at both ends of the undulator).

The calculated spectral flux from ESM EPU105, computed using Synchrotron Radiation Workshop (SRW), based on the measured magnetic field before and after Q-P implementation, is shown in Figure 8. The two Q-P effects described above are clearly visible: reduction in intensity and shift in energy of the higher harmonics. The fundamental flux after Q-P implementation is nearly the same (87%) as without Q-P, confirming the effectiveness of this strategy.

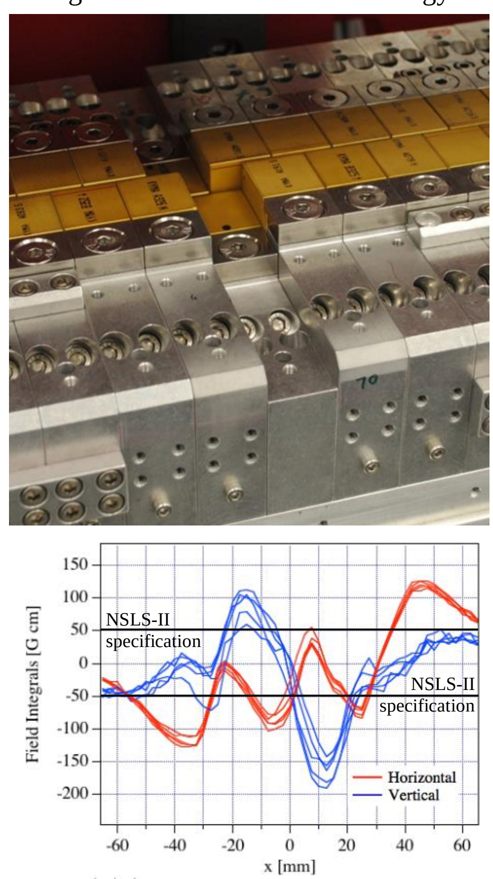


Figure 7. Insertion Devices: Upper panel: Close-up view of the special magnet holder for Quasi-Periodic adjustment of the ESM EPU105 insertion device . Lower panel: Magnetic field integral achieved after Q-P implementation.

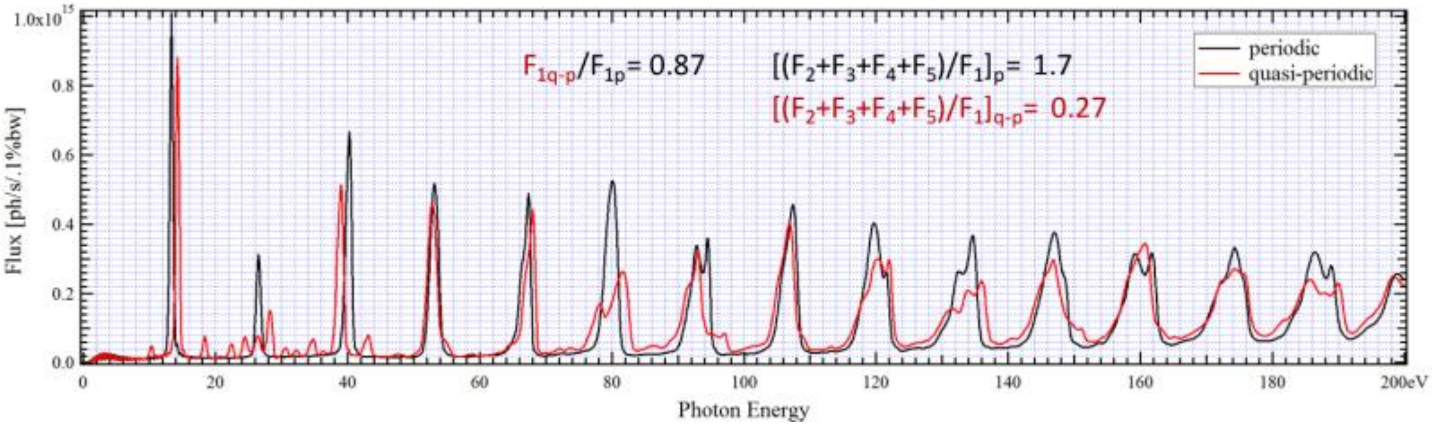


Figure 8. Insertion Devices: Spectral Flux through 0.4 mrad Aperture at 16 mm gap in Linear Horizontal polarization calculated with SRW from the measured magnetic field before shimming (black) and after the Q-P modification (red).

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

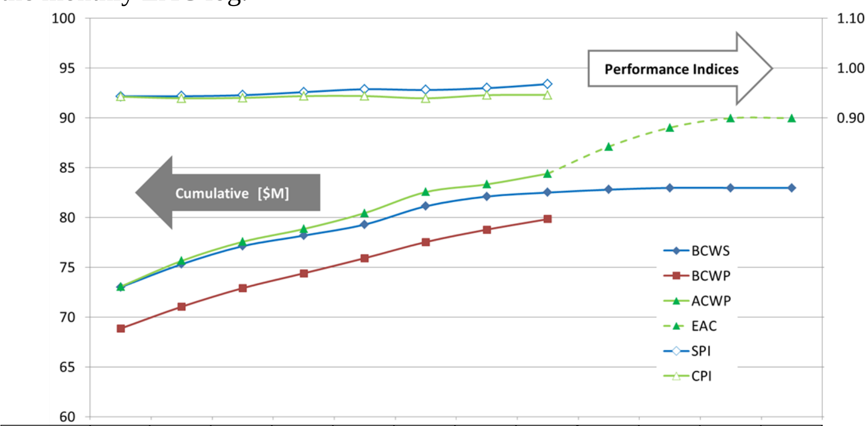
NEXT ETC Round Table Discussion	November 16, 2016
DOE/SC OPA CD-4 Review of NEXT	April 2017

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
CRL	Compound Refractive Lens
CV	Cost Variance
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
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
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

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	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17
BCWS	73.0	75.3	77.1	78.2	79.3	81.1	82.1	82.5	82.8	83.0	83.0	83.0
BCWP	68.9	71.0	72.9	74.4	75.9	77.5	78.8	79.8				
ACWP	73.1	75.6	77.6	78.8	80.4	82.5	83.3	84.4				
SPI	0.94	0.94	0.95	0.95	0.96	0.96	0.96	0.97				
CPI	0.94	0.94	0.94	0.94	0.94	0.94	0.95	0.95				
ETC									4.5	1.5	0.0	0.0

NEXT as of 11/30/2016	Current Period	Cum-to-Date
Plan (BCWS) $k	400	82,499
Earned (BCWP) $k	1,055	79,833
Actual (ACWP) $k	1,073	84,394
SV $k	655	-2,666
CV $k	-17	-4,561
SPI	2.64	0.97
CPI	0.98	0.95
Budget at Completion $k (PMB [UB])		82,970
Planned % Complete (BCWS/BAC)		99.4%
Earned % Complete (BCWP/BAC)		96.2%
Contingency $k		7,030
Contingency / (BAC – BCWP)		224.1%
EAC $k		88,931
Contingency / (EAC – BCWP)		77.3%
(Contingency + VAC) / (EAC – ACWP)		23.6%
TPC = PMB + Contingency		90,000

The NEXT project Schedule Variance (SV) for November 2016 is +$655k, with an associated monthly Schedule Performance Index (SPI) of 2.64 (red status). The largest contributors to the current month schedule variance are provided in the table below. The cumulative SPI is 0.97 (green status), 0.01 higher than it was in November.

The NEXT project Cost Variance (CV) for November 2016 is -$17k, with an associated monthly Cost Performance Index (CPI) of 0.98 (green status). The significant contributors to the current month CV are provided in the table below. The cumulative CPI is 0.95 (green status), the same as it was in October.

Leading Current Month Variances [$k], November 2016								
WBS	Title	PV	EV	AC	Schedule		Cost	
					SV	Issues	CV	Issues
2.01	Project Support	168	168	148	0	--	21	--
2.03	Common Systems	31	109	109	78	Greater work performed than planned, especially in PPS, in order to catch up on delayed work. Utilities (WBS 2.03.01): +$20k, PPS (2.03.02): +$50k; EPS (2.03.03): +$8k; Control Station (2.03.04): +$0k	0	--
2.04	Controls	3	83	59	80	Greater work than planned in Control System design & implementation (WBS 2.04.02, +$13k) plus earning for receipt of motion controllers in Control System Equipment (WBS 2.04.03, +$67k), which planned for October	24	--
2.05	ESM Beamline	0	12	10	12	--	2	--
2.07	ISR Beamline	55	306	325	250	Catch-up work on activities that were scheduled to be completed during prior months [changeover components and magnet windows fabrication (+$5k), laser interlock and integrated testing (+$17k), Gas Handling System commissioning (+$21k), acceptance and installation of Dual Phase Plate Assembly stacks and 6-Circle Diffractometer translation rails (+$101k), and 6-Circle Diffractometer FAT (+$160k)] offset by a delay in commissioning of the 6-Circle Diffractometer (-$53k)	-19	--

Leading Current Month Variances [$k], November 2016									
WBS	Title	PV	EV	AC	Schedule		Cost		
					SV	Issues	CV	Issues
2.08	ISS Beamline	53	2	81	-51	IRR work scheduled in November that was performed earlier (~March 2016)	-79	Costing in November of work performed and earned earlier
2.09	SIX Beamline	57	194	218	137	Sum of earlier-scheduled activities performed in November [spectrometer arm activities, including FAT (+$132k), receipt of 4th grating ruling (+$33k), and vacuum manifold parts received (+$11k)] and one activity scheduled but not performed in November [spectrometer arm commissioning (-$42k)]	-23	--
2.10	SMI Beamline	30	80	70	50	SMI Beamline Systems (WBS 2.10.02, +$53k): completion this month of tasks scheduled for prior months	10	--
2.11	Insertion Devices	2	101	54	99	Catch-up on work scheduled in earlier months	47	Work accomplished more efficiently than planned
	Total	**400**	**1055**	**1073**	**655**	**Total**	**-17**	

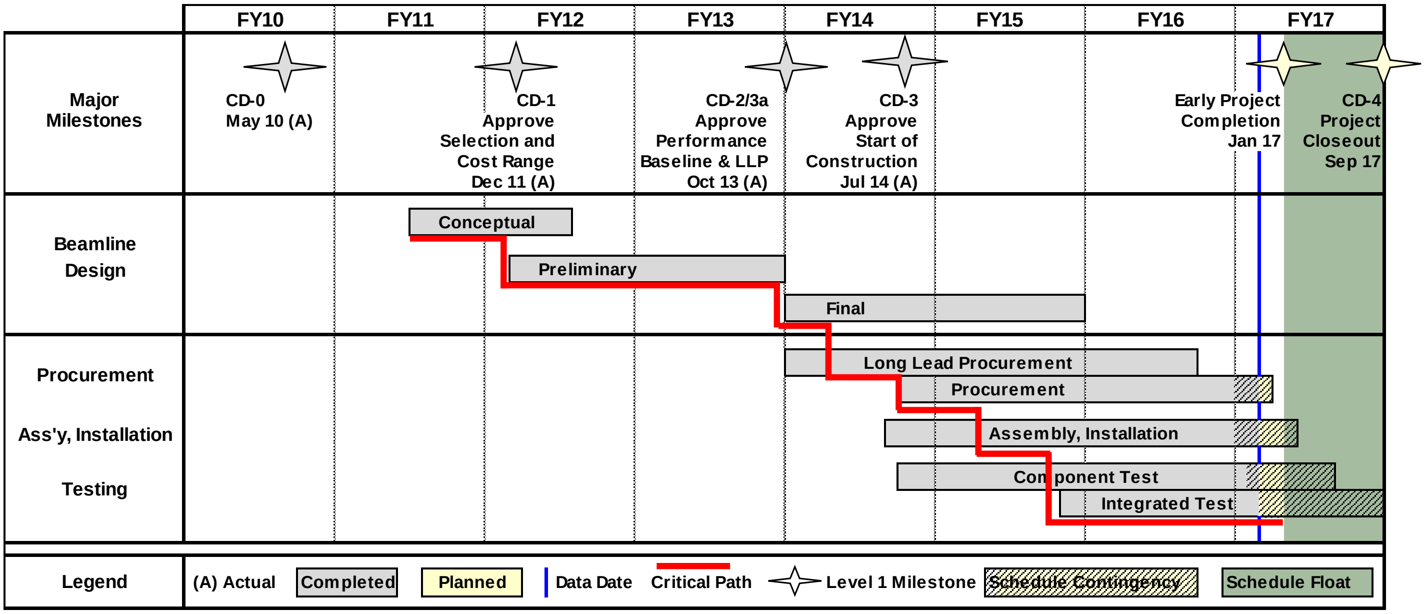
As of November 30, 2016, the project is 96.2% complete with 224.1% contingency ($7.03M) for $3.14M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through November 2016. The project EAC for November is reported at $88,931k against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $82,970k. The Variance At Completion (VAC) is given by VAC = BAC – EAC, with EAC = ACWP + ETC. Through November 2016, the VAC (-$5,961k) is driven by the cumulative cost variance (-$4,561k, dominated by labor cost overage on work performed to date) and the EAC adjustments made as part of the bottom-up assessment last month. Those adjustments were discussed in detail at a NEXT ETC Round Table Discussion held on November 16.

The November 2016 EAC ($88.93M) is $0.036M higher than the October value, resulting in part from the November cost variance ($0.017M) and in part from labor resources added to SIX (WBS 2.09) for analysis of additional radiation shielding requirements. As of the end of November, contingency on EAC is $1.07M, which represents 23.6% of $4.54M EAC work remaining. Outstanding commitments on fixed-price equipment contracts total $3.23M, so the $1.07M contingency on EAC represents 81.5% of $1.31M 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 November and no PCRs are planned for December.

Milestones – Near Term		Planned	Actual	Projected
L3	ISR – Installation of Beamline Components Complete	29-Jun-16		January 2017
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		January 2017
L3	SIX – Installation of Beamline Components Complete	30-Sep-16		January 2017
L3	Common Beamline Systems: EPS Installed	30-Sep-16		January 2017
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 November 2016, the critical path runs through activities related to the Triple Rotating Flange, a component of the SIX endstation sample chamber (WBS 2.09.02.03, SIX Beamline Systems Endstation Equipment).

Staffing Report

Staffing as of 11/30/2016	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	0.54	0.41	40.60	36.30
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	0.52	0.66	32.63	19.08 *
WBS 2.04 Control System	0.20	0.18	21.68	20.63
WBS 2.05 ESM Beamline	0.01	0.00	15.75	18.52
WBS 2.06 FXI Beamline	0.00	0.00	4.77	4.60
WBS 2.07 ISR Beamline	0.12	0.18	17.54	15.94
WBS 2.08 ISS Beamline	0.02	0.01	14.96	14.92
WBS 2.09 SIX Beamline	0.84	0.99	20.45	24.48
WBS 2.10 SMI Beamline	0.33	0.28	17.16	16.09
WBS 2.11 Insertion Devices	0.14	0.28	7.59	6.90
WBS 2.12 ID & FE Installation	0.00	0.00	3.88	7.97
Total	**2.71**	**2.99**	**205.75**	**194.17**

** 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 November 2016: 106

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
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COST PERFORMANCE REPORT

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE

FORM APPROVED
$ OMB No. 0704-0188

1. CONTRACTOR	2. CONTRACT	3. PROGRAM	4. REPORT PERIOD
a. NAME Brookhaven National Laboratory	a. NAME NEXT	a. NAME NSLS-II Experimental Tools (NEXT) Project	a. FROM *(YYYYMMDD)* 2016 / 11 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER	b. PHASE	b. TO *(YYYYMMDD)* 2016 / 11 / 30
	c. TYPE / d. SHARE RATIO	c. EVMS ACCEPTANCE X YES	

WBS (2) / WBS (3) ITEM (1)	CURRENT PERIOD BUDGETED COST WORK SCHEDULED (2)	WORK PERFORMED (3)	ACTUAL COST WORK PERFORMED (4)	VARIANCE SCHEDULE (5)	COST (6)	CUMULATIVE TO DATE BUDGETED COST WORK SCHEDULED (7)	WORK PERFORMED (8)	ACTUAL COST WORK PERFORMED (9)	VARIANCE SCHEDULE (10)	COST (11)	AT COMPLETION BUDGETED (14)	ESTIMATED (15)	VARIANCE (16)
2.01 Project Management and Support	168,281	168,281	147,582	0	20,698	9,589,320	9,589,320	10,381,318	0	(791,998)	9,918,232	10,832,127	(913,895)
2.01.01 Project Management	73,919	73,919	53,167	0	20,752	4,453,551	4,453,551	4,094,884	0	358,667	4,598,029	4,228,187	369,841
2.01.02 Project Support	94,362	94,362	94,416	0	(54)	5,135,769	5,135,769	6,286,434	0	(1,150,664)	5,320,204	6,603,940	(1,283,736)
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
2.02.02 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 Common Beamline Systems	31,447	108,983	109,332	77,535	(350)	7,263,534	7,165,384	8,412,016	(98,150)	(1,246,631)	7,340,417	8,579,049	(1,238,632)
2.03.01 Utilities	0	20,214	14,295	20,214	5,919	4,210,031	4,176,149	4,342,235	(33,882)	(166,086)	4,210,031	4,392,560	(182,529)
2.03.02 Personnel Protection System (PPS)	26,650	76,184	75,143	49,534	1,042	1,553,318	1,508,517	2,305,561	(44,801)	(797,044)	1,620,824	2,392,803	(771,979)
2.03.03 Equipment Protection System (EPS)	0	7,787	11,223	7,787	(3,436)	680,294	680,294	947,632	0	(267,338)	680,294	947,632	(267,338)
2.03.04 Control Station	0	0	2,028	0	(2,028)	306,744	287,276	214,968	(19,467)	72,309	306,744	235,058	71,686
2.03.05 Common Beamline Systems Management	4,797	4,797	6,643	0	(1,846)	513,148	513,148	601,619	0	(88,471)	522,524	610,995	(88,471)
2.04 Control System	2,594	82,720	59,028	80,126	23,692	4,643,656	4,635,816	4,900,465	(7,840)	(264,649)	4,648,844	4,989,675	(340,831)
2.04.01 Control System Management	2,594	2,594	1,835	0	759	289,239	289,239	252,892	0	36,348	294,427	258,021	36,407
2.04.02 Control System Design & Implementation	0	12,734	29,089	12,734	(16,355)	2,929,314	2,922,305	3,300,105	(7,008)	(377,800)	2,929,314	3,359,056	(429,742)
2.04.03 Control System Equipment	0	67,392	28,103	67,392	39,289	1,425,103	1,424,271	1,347,468	(832)	76,803	1,425,103	1,372,598	52,505
2.05 ESM Beamline	0	12,480	10,083	12,480	2,397	9,422,464	9,350,687	10,109,213	(71,777)	(758,526)	9,422,464	10,192,379	(769,915)
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	12,480	10,083	12,480	2,397	8,811,720	8,739,943	9,635,186	(71,777)	(895,243)	8,811,720	9,718,352	(906,633)
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	55,425	305,666	324,543	250,240	(18,877)	10,388,186	9,738,913	9,717,456	(649,273)	21,457	10,392,425	10,492,349	(99,924)
2.07.01 ISR Management	2,120	2,120	0	0	2,120	1,101,155	1,101,155	1,034,389	0	66,766	1,105,394	1,034,389	71,005
2.07.02 ISR Beamline Systems	53,306	303,546	324,543	250,240	(20,997)	9,287,031	8,637,758	8,683,067	(649,273)	(45,309)	9,287,031	9,457,960	(170,929)
2.08 ISS Beamline	53,047	2,120	80,820	(50,927)	(78,700)	10,440,877	10,467,973	11,235,617	27,096	(767,644)	10,472,212	11,236,117	(763,905)
2.08.01 ISS Management	53,047	2,120	0	(50,927)	2,120	806,864	833,959	681,035	27,096	152,925	838,199	681,035	157,164
2.08.02 ISS Beamline Systems	0	0	80,820	0	(80,820)	9,634,013	9,634,013	10,554,582	0	(920,569)	9,634,013	10,555,082	(921,069)
2.09 SIX Beamline	57,374	194,311	217,568	136,936	(23,257)	11,760,596	10,106,852	10,854,970	(1,653,744)	(748,118)	11,764,836	13,441,016	(1,676,180)
2.09.01 SIX Management	13,817	13,817	22,561	0	(8,743)	725,601	725,601	713,258	0	12,343	729,841	781,200	(51,359)
2.09.02 SIX Beamline Systems	43,557	180,493	195,007	136,936	(14,514)	11,034,995	9,381,250	10,141,712	(1,653,744)	(760,461)	11,034,995	12,659,816	(1,624,821)
2.10 SMI Beamline	30,109	79,656	69,546	49,547	10,110	9,110,513	8,931,126	9,213,725	(179,387)	(282,599)	9,126,837	9,573,250	(446,413)
2.10.01 SMI Management	30,109	26,290	15,267	(3,819)	11,023	789,332	801,417	706,837	12,085	94,580	805,656	710,602	95,054
2.10.02 SMI Beamline Systems	0	53,366	54,279	53,366	(913)	8,321,181	8,129,709	8,506,887	(191,472)	(377,178)	8,321,181	8,862,648	(541,467)
2.11 Insertion Devices	2,120	101,238	54,060	99,118	47,178	4,801,153	4,768,114	4,515,655	(33,039)	252,458	4,805,392	4,541,699	263,693
2.11.01 ESM EPU Insertion Device	0	99,118	52,194	99,118	46,924	4,587,795	4,554,756	4,353,799	(33,039)	200,957	4,587,795	4,375,652	212,143
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	2,120	2,120	1,866	0	254	96,221	96,221	91,482	0	4,739	100,460	95,673	4,787
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	**400,397**	**1,055,453**	**1,072,561**	**655,056**	**(17,108)**	**82,498,756**	**79,832,641**	**84,394,136**	**(2,666,114)**	**(4,561,494)**	**82,970,116**	**88,931,362**	**(5,961,246)**
Management Reserve													
Undistributed Budget													
Performance Management Baseline (PMB)	**400,397**	**1,055,453**	**1,072,561**	**655,056**	**(17,108)**	**82,498,756**	**79,832,641**	**84,394,136**	**(2,666,114)**	**(4,561,494)**	**82,970,116**	**88,931,362**	**(5,961,246)**