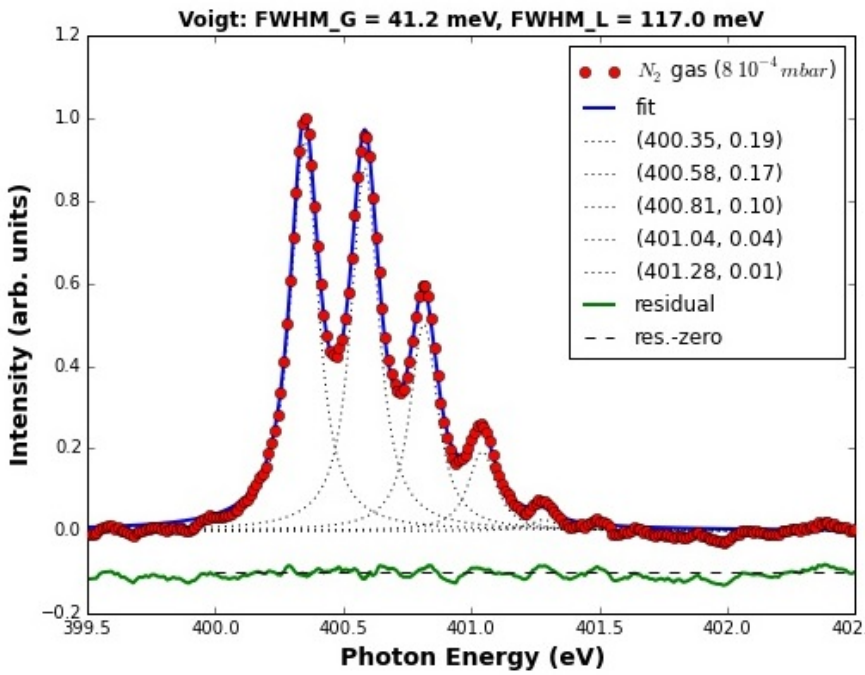
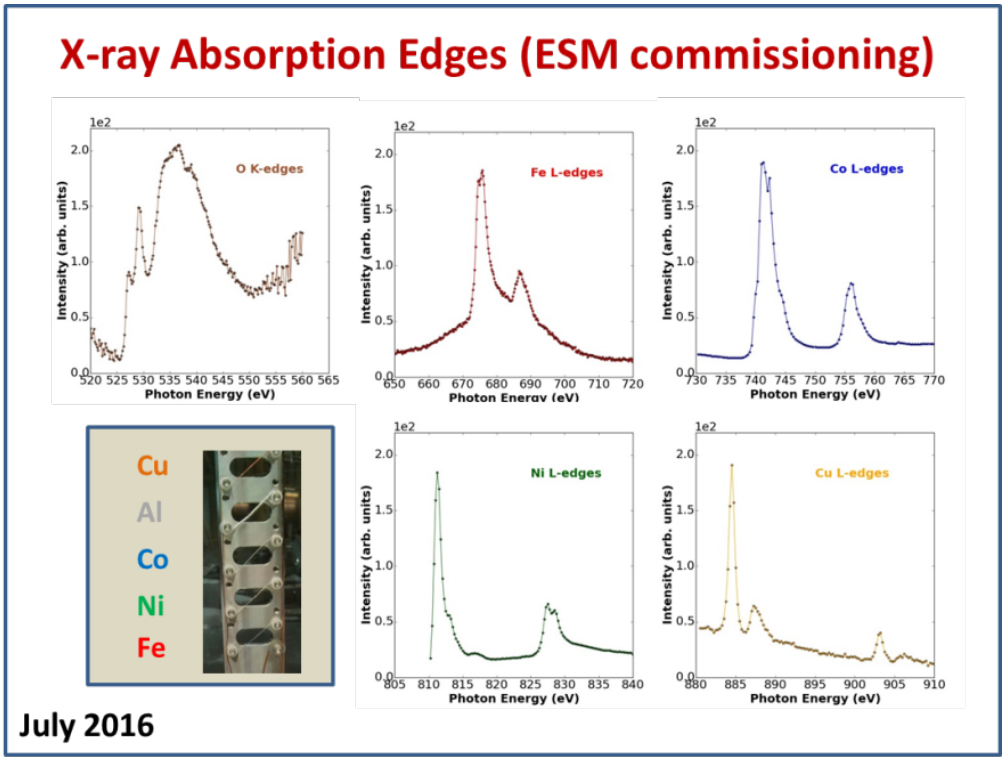
NSLS-II Experimental Tools (NEXT)

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



ESM: Nitrogen K-edge (~400 eV) absorption spectrum of ~1 mbar N_2 gas, one of the standard resolution tests for a soft X-ray monochromator. The spectrum is fit to Voigt functions, which are convolutions of Lorentzians (widths *not* fit, but extracted from N_2 gas vibration properties from the literature) and Gaussians (widths fit for each vibrational peak). The fwhm width of the Gaussian components, which are assigned to the instrumental energy resolution of the ESM monochromator, is 41.2meV, demonstrating the 10^4 resolving power goal for ESM. The quality of the fit is quite good: it becomes visibly worse if the Gaussian widths are changed by 5 meV.



ESM: Absorption edge spectra from reference 3d metals and their oxides. Top row, left to right: oxygen K-edge, Fe $L_{2,3}$-edge, and Co $L_{2,3}$-edge spectra. Bottom row, left to right: photo of sample holder, showing diagonally-mounted wire samples, and Ni $L_{2,3}$-edge, and Cu $L_{2,3}$-edge spectra.

Initial commissioning results from the ESM beamline

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OVERALL ASSESSMENT

On July 11, first light was taken at ISR and commissioning of the ESM EPU57 insertion device commenced. First light was taken at ESM on July 25.

The first science commissioning experiment was conducted at ISS during July.

PDS installation and testing at SMI and SIX continued in July, working toward IRRs for those two beamlines planned for early November. Radiation shielding analysis both beamlines continued, to be completed by September.

Remaining safety system (PPS, EPS) and beamline controls installation and testing activities continued in July.

Iterative shimming and tuning of the SIX EPU57 insertion device was started during July. One iteration of shimming (magnetic field adjustment of selected individual modules accomplished using thin non-magnetic shims) and two iterations of tuning (magnetic field integral adjustments accomplished using so-called "magic fingers" at both ends of the device) were undertaken, using genetic-algorithm-based modeling software IDBuilder. By the end of the month, the magnetic field integral of SIX EPU57 was nearing specification. A few more iterations of shimming and tuning will be performed in August, in advance of installation of this insertion device in the 2-ID straight in the September maintenance period.

Two major procurements were completed in July: the ISR Optical Components and ISR Beam Transport Packages. Monitoring and management of contractor progress on the 19 remaining major procurement contracts are important ongoing activities that are crucial to maintaining project schedule. Seven of these contracts are for SIX, 4 are for ISR, 3 for ISS, 2 for SMI, 2 are shared between ESM and SIX, and 1 is for ESM.

As of July 31, 2016, the project is 89.7% complete based on base scope performance earned to date. The cumulative EVMS schedule index remained at 0.95 and the cumulative cost index remained at 0.94.

Three Level 3 PCRs were approved and implemented in July. One implemented contract amendments for the ESM and SIX beamlines (+$162k). The other two incorporate EAC changes in base scope, one for common systems (+$74k) and the other for the ISR and SMI beamlines (+$49k). These PCRs increased BAC by $0.28M, to $82.97M.

Cost contingency is $7.0M, which is 82.8% of $8.6M BAC work remaining. The EAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), is $87.45M, $0.03M lower than the June value. As of the end of July, contingency on EAC is $2.55M, which represents 29.6% of $8.58M EAC work remaining, or 83.2% of $3.06M unobligated work to go ($5.55M 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 began in June and is expected to be complete, other than hookups to not-yet-delivered hardware, by August. 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 during July was focused at the SMI beamline, where installation of the hardware continues. Installation will continue through August, followed by software integration and testing in September. The SMI PPS is expected to be certified in October.

EPS installation effort in July also focused on SMI, now that ESM and ISR EPS installation and testing is complete. EPS installation at SMI will continue into September.

All remaining control station furniture for ISR was received last month and installed at the beamline this month. Integration of AC power to the ISR control station began this month and is expected to be completed in August.

BEAMLINE CONTROLS

ESM and ISR beamline control engineers provided support to these beamlines through IRR and during the initial commissioning, with light, of these two beamlines. First light was taken at ISR on July 11 and at ESM on July 25. Following first light, control engineering effort is covered by NSLS-II operations. So far, this transition to operations has occurred for the ISS, ISR, and ESM beamlines.

At SMI, the control engineer continued work on motion tuning and EPICS IOC work for the vertical deflection mirror (VDM), horizontal and vertical focusing mirrors (HVFM), and SSA, as well as EPICS support for the Adaptos HV power supply for figure correction of the bi-morph HVFMs. In addition, diagnostic testing of the Prosilica gigE cameras and Axis webcams was underway during July. SMI controls progress is on track to support the PDS IRR currently scheduled in November.

SIX endstation controls installation is making good progress. Network switches, control servers, and data servers have been installed and configured. Motor and encoder cables are pulled and partially terminated.

ESM – ELECTRON SPECTRO-MICROSCOPY

During July, ESM took first light and began commissioning of the photon delivery system. Following ID and FE commissioning for ~2 weeks beginning July 11, first light to the ESM PDS was taken on July 25. After successful completion of scattered bremsstrahlung radiation tests, ESM staff began the process of aligning the optics to propagate SR beam down the beamline, while simultaneously conditioning the vacuum systems to maintain acceptable vacuum levels.

Propagating the beam along ESM optical path was accomplished rather quickly, owing to careful survey of all components into their precise positions and usage of diagnostic components positioned at selected positions along the beamline to capture and analyze the radiation, generally at the entrance and exit of each optical component chamber.

Fig. 1 summarizes ESM commissioning progress made during the first few weeks after taking first light. From right to left in Fig. 1 are shown:

(i) Diagon, upper panel: first image of visible light from the bending magnet recorded in reflection from the mirror surface of the Diagon diagnostic apparatus. This image was obtained at 2 mA ring current and fully-open EPU57 undulator gap. Lower panel: first image of the ESM X-ray beam at 35mm undulator gap, producing fundamental emission at ~700 eV photon energy. This image, also taken at 2 mA ring current, was taken in reflection from a multilayer mirror and subsequently filtered through a YAG crystal. At higher ring current values, the power delivered on the optics by the X-ray beam is large enough that the vacuum pressure is strongly affected and a period of vacuum conditioning is needed. At the standard ring operating current (250 mA), we used the FE slits to limit the radiated power on the optics, slowly closing the undulator gap as vacuum levels improved.

(ii) YAG downstream PGM: The X-ray beam was subsequently propagated through the first mirror (M1) and the PGM monochromator (M2 and 1200l/mm grating). Upper panel: zero order beam from the PGM detected on a YAG crystal located ~10 m downstream. Lower panel: image of first-order diffracted X-ray radiation at the same location, which is dispersed in the vertical plane.

(iii) Horizontally-focused light: First-order beam was then passed through the horizontally focusing M3 mirror. Panel: magnified phosphor screen image at the exit slit plane, demonstrating horizontal focusing of the vertically-dispersed beam. The horizontal dimension is estimated to be less than 30 microns, limited by the phosphor detection method.

(iv) After passing the beam through the exit slit, the first quantitative flux measurement at ESM was made using a calibrated XUV diode. Figure: monochromator scan through the EPU57 fundamental at ~1000eV at a fixed undulator gap (45mm). The peak measured flux, 2×10^{10} photon/sec, easily exceeds the ESM threshold flux KPP value (1×10^{10} photon/sec). Subsequently, at smaller undulator gap values, the measured flux has exceeded the objective KPP value (1×10^{11} photon/sec).

ESM beamline commissioning will continue over the next few weeks, with the goals of (i) calibrating the monochromator and testing its ultimate energy resolution, and (ii) commissioning the final refocusing optics and characterizing quantitatively the focal properties at the sample position in the endstation. In parallel, endstation construction and testing will continue.

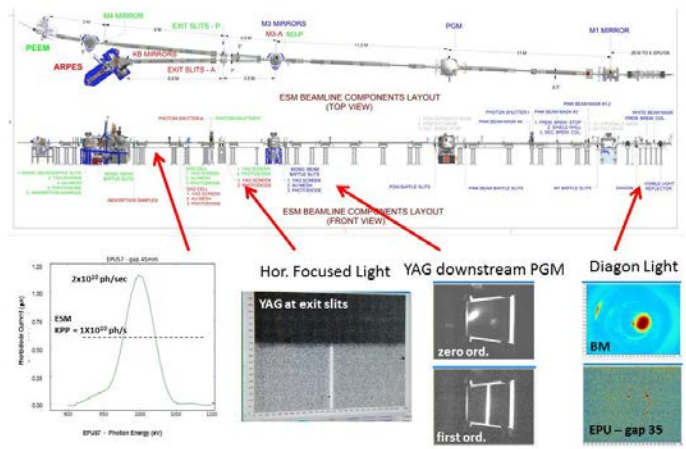


Figure 1. ESM: Propagation of the beam along the ESM photon delivery system and highlights of initial commissioning with light (see text).

ISR – IN-SITU AND RESONANT HARD X-RAY

The beamline component layout drawing for the entire beamline and a vendor item control drawing for the Gas Handling System were released.

On July 1, Toyama personnel ended their 3 week stay for continued installation of the KB Mirrors. In their absence, a gentle bake of the KB Mirrors' vacuum chamber began on July 19 (Figure 2), and continued through the end of the month. Metrology data provided by the NSLS-II Metrology Lab was analyzed by Toyama personnel, and on July 28, Toyama requested that the benders and spare mirrors be returned to them for modification of the benders, and for further measurements. These components are being prepared for shipment.

Lead sheets and stand components for the secondary bremsstrahlung shield arrived, as shown in Figure 3. Stand components will be assembled during August, and the shield, which is only required for operations with ring current >400 mA, will be installed in the FOE during the September maintenance period.

First light was observed at ISR on July 11, at a ring current of 1.6 mA, and the beam was steered to the center of the 3 mm x 3 mm aperture, as shown in Figure 4. With ~11 keV beam propagated to the photon shutter at the end of the FOE and successful completion of gas bremsstrahlung radiation surveys at a ring current of 85 mA, vacuum conditioning of the beamline was allowed to begin on July 15 during normal operations, at a ring current of 250 mA. On July 21, improved vacuum conditions allowed the IVU gap to be closed to 15 mm, and beam was propagated into endstation hutch 4-ID-C on the following day. Vacuum conditioning continues.

Figure 2. ISR: KB Mirrors' vacuum chamber undergoing a gentle (80˚C) bake in hutch 4-ID-D.

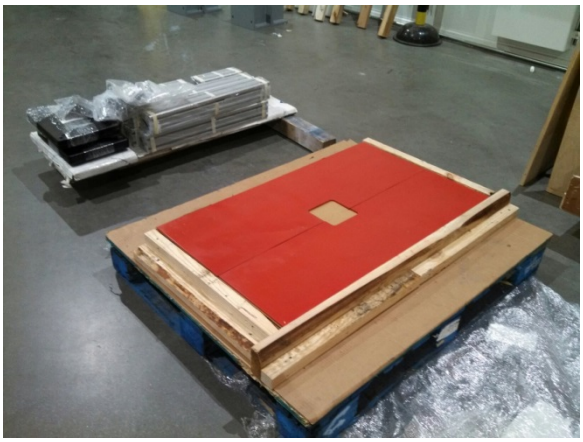


Figure 3. ISR: Lead sheets and stand components of the secondary bremsstrahlung shield.

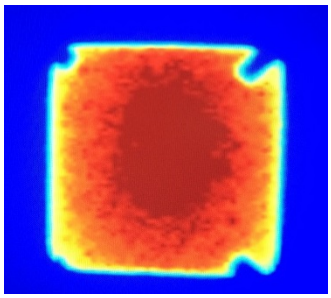


Figure 4. ISR: White beam on the first visual diagnostic. Notches in corners are due to shadows cast by the diamond blades of the first BPM.

ISS – INNER SHELL SPECTROSCOPY

With the objective flux KPP having been achieved for ISS in June, progress in July focused on further technical commissioning activities with beam, including preparations for science commissioning experiments in August (off NEXT project).

Fly scans with the coordinated motion of the mirror motors and high heat load monochromator have been realized (Figure 5). Fast detection with ion chambers has been demonstrated as well as data extraction methodology based on time stamps generated by analog and digital readout instruments developed under NEXT project (FPGA "pizza boxes"). Upcoming work will focus on integration of fluorescence detectors in the detection scheme.

Progress on remaining ISS contracts during July included receipt and installation by Square One of the ISS Sample Handling System. The only remaining ISS contract is the emission spectrometer package (PI), the schedule for which includes FAT in the first week of September followed by delivery and installation by the end of September.

All ISS scope within NEXT is expected to be completed by the end of September 2016.

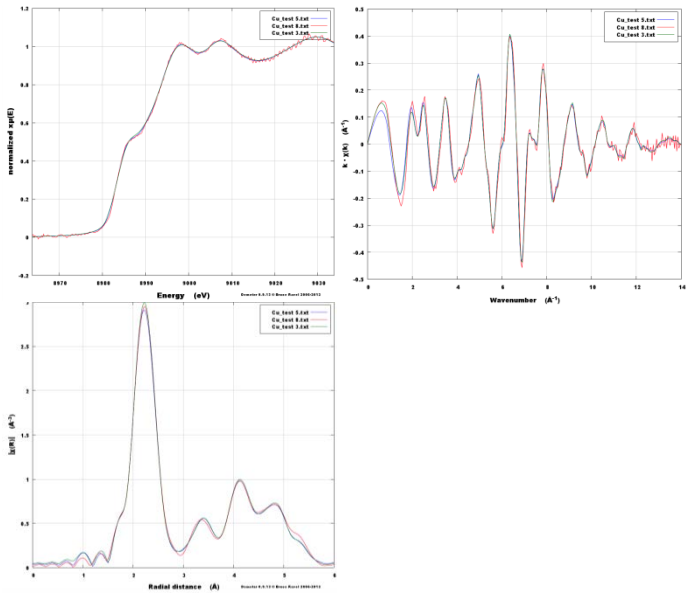


Figure 5. ISS: Results of the first speed test of the high heat load monochromator. Upper left panel: copper K-edge absorption spectra taken at three speeds: 2s (red), 20s (blue), and 200s (black). Corresponding EXAFS k·χ(k) (upper right panel) and χ(R) functions (lower panel).

SIX – SOFT INELASTIC X-RAY

All the beamline motion cables are now terminated on the rack side, and good progress has been made on the beamline component side as well. The terminated motor and encoder cables for the exit slit are shown in Figure 6. Terminations remain to be completed for the M3 and M4 mirror systems and some diagnostic components.

SmarAct addressed all findings that were issued during the FAT of the in-vacuum sample diffractometer, including the estimate of the circle of confusion of the polar rotation axis (<20 μm) and the vacuum performance of the device. This completes the FAT of the device, which will be shipped early August to BNL. Interferometry measurements of the vibrational properties of the device are being scheduled with Evgeny Nazaretski of the NSLS-II Optics and Metrology Group for September.

ColdEdge has completed the manufacturing and testing of the closed-circle pulse tube cryostat, which shipped at the end of the month. This cryostat will be used to cool samples

mounted on the SmarAct diffractometer via Cu braids. The open-circle cryostat will be ready for shipping in the first half of August. Sample pucks will be directly attached to the open-circle cryostat, resulting in a higher cooling efficiency, at the expense of fewer degrees of freedom for sample positioning.

Progress was made by Bestec during July in assembly of the sample chamber and spectrometer mechanical and electrical components. Photos of the spectrometer optics tank and M5 mirror assembly tripod are shown in Figure 7. The FAT for the SIX endstation contracts is scheduled for the end of September.

The removable panel in the SIX satellite building wall was taken down and a temporary wooden door fabricated and installed, as shown in Figure 8. This work was carried out by the NSLS-II carpenter in a timely fashion, as the granite blocks for the spectrometer tracks, which will be carried inside the building through this door, are expected to be delivered in early August. The temporary door will remain in place until the sample chamber and spectrometer components are delivered in October.

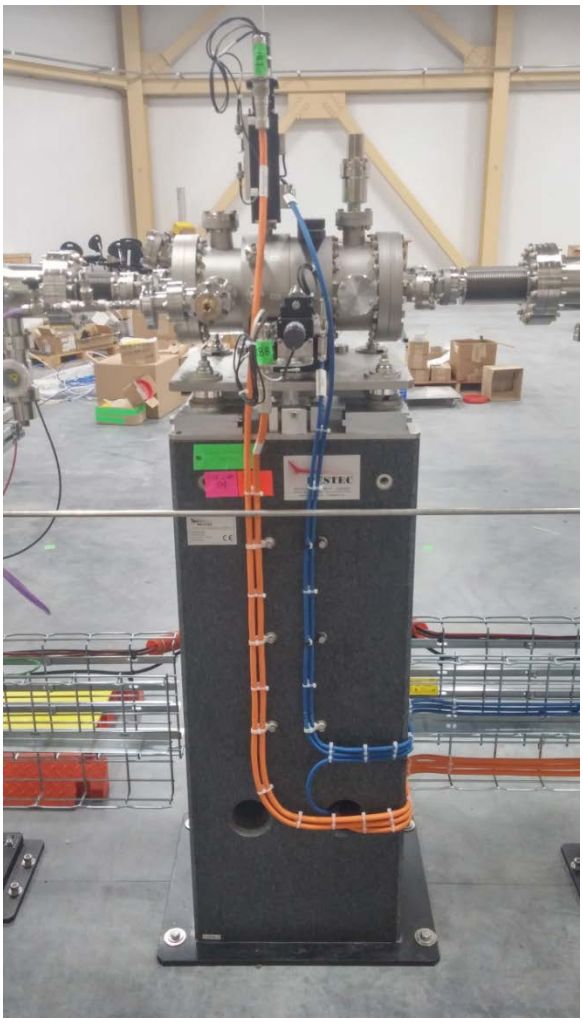


Figure 6. SIX: Terminated motor and encoder cables at the PGM exit slit.

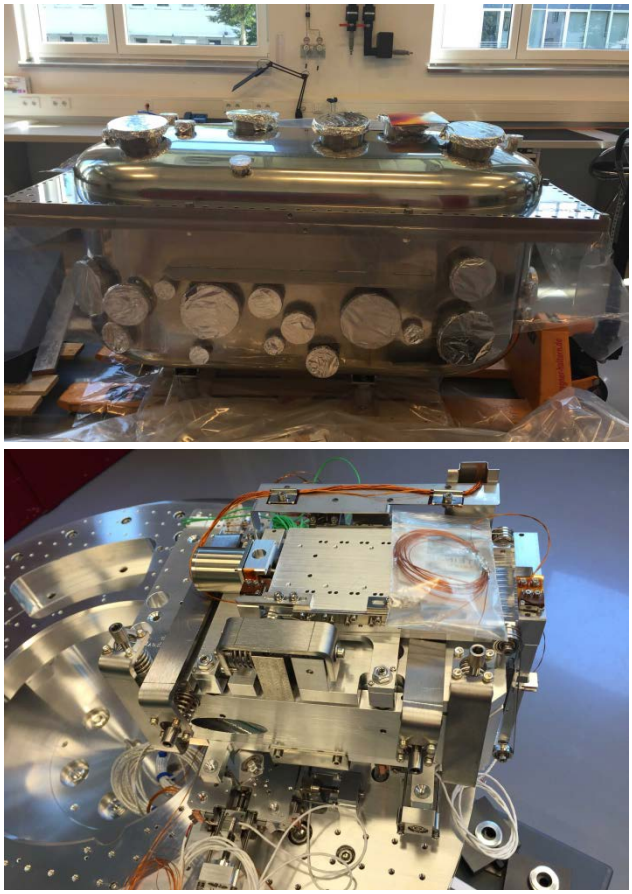


Figure 7. SIX: Spectrometer optics tank (top) and M5 tripod assembled on the sample chamber optics wheel (bottom) at Bestec.

Figure 8. SIX: Temporary wooden door in the satellite building, seen from inside (top) and outside (bottom).

SMI – SOFT MATTER INTERFACES

Progress was made during July on the final outstanding SAXS system shipments. The Pilatus 1M is a detector designed to be half-in vacuum, and to allow the detector to move within the SAXS Beam Chamber, a vacuum vessel was procured from Atlas Technologies. This vessel was received in July. Figure 9 shows the detector (left) inserted in the vessel (right), and SMI technical staff becoming familiar with the hoist to facilitate installation when the SAXS system becomes available. Also in July, contractor GNB completed the fabrication of the SAXS Beam Chamber. Figure 10 shows the fully assembled system at the factory. Factory acceptance test was scheduled for August 5, and as of this writing the tests have been approved and the equipment has been received at NSLS-II.

The only remaining components of the SMI SAXS system are in-house mechanics. This mechanics is divided into three activities: the Z translation running the length of the beam chamber, the X-Y mechanics that positions the detector in the beam, and the Cable Management assembly consisting of 3 detector motion axes, 6 beam stop motion axes, 3 beam stop signal channels, detector power, water, air, logic and data connections, and motor thermocouple channels. During July, the designs of the Z and X-Y mechanics were completed, including all small parts orders. Remaining work includes creation of fabrication drawings (design room) and fabrication (BNL Central Shops). The Cable Management design activity is 40% complete and is the sole remaining SMI activity where detail design and sourcing of small parts remains to be done.

Preparation for IRR of the SMI PDS continued during July. Fluka calculations required for Radiation Safety Review of SMI are well underway, with several informational meetings held during July to discuss preliminary results. The goal is to complete radiation safety documentation by mid-September.

SMI's two Photon Delivery System packages are tested and waiting for traveler execution. Progress was made this month on completion of the survey travelers.

Cable terminations for the two endstation detectors and associated positioning stages were nearly completed during July, with only 16 motor channels remaining.

SMI EPS work, which remains to be completed, awaits resources that were dedicated to non-NEXT beamlines during July. EPS crews are scheduled to complete tasks in the 12-ID-B and 12-ID-C hutches during the first week of September. PPS work has greatly accelerated at SMI during July, with the goal of certifying SMI PPS systems in October.

Figure 9. SMI: Pilatus 1M detector inserted into the vacuum vessel that separates its water and air supplies from the SAXS Beam Chamber vacuum. The detector sensors are seen at the left, behind a protective blue cover. Service feedthroughs will exit the chamber in the rear, at right.

Figure 10. SMI: SAXS Beam Chamber fully assembled on its astands at the site of contractor GNB.

INSERTION DEVICES

Magnetic field correction of the SIX EPU57 insertion device began in July. One iteration of virtual shimming (adjustment of the vertical position of magnet modules using thin non-magnetic shims) and two iterations of magic finger correction (addition of small cylindrical magnets at the ends of the device) were performed this month. This pace is slower than initially anticipated. Measurement of the magnetic field integral is rather slow, taking more than two hours to complete. In addition, machining work on the magic finger holder was also required, as the brass screws used to position the magic fingers into the threaded holes of the holder were damaging the threads. At the same time, more threaded holes were drilled into the magic finger holders to extend the horizontal range of magic finger correction to ±80mm.

The magnetic field integrals before any correction and after the July corrections are shown in Figure 11. The magnetic field integral is nearing specification at the end of July. A few more iterations will be completed in August in order for this insertion device to meet all the NSLS-II requirements.

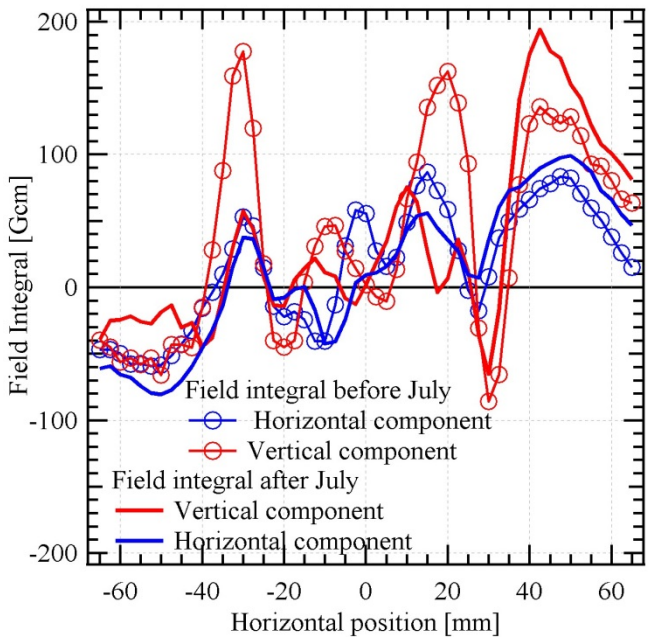


Figure 11. Insertion Devices: Comparison of SIX EPU57 magnetic field integrals before and after shimming and magic finger correction iterations performed during July.

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

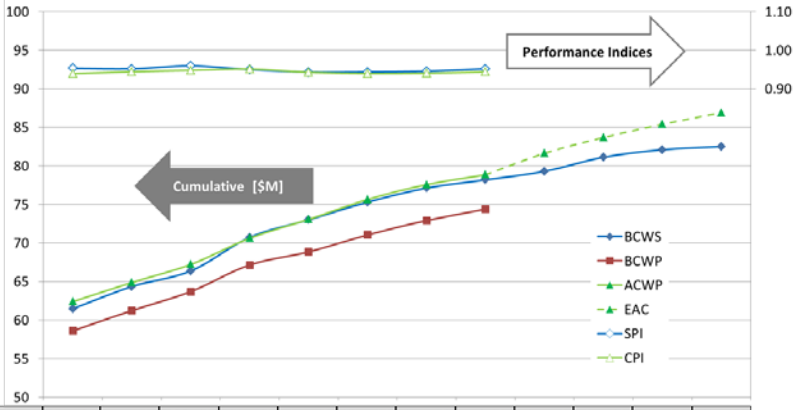
DOE OPA Status Review of NEXT	August 30-31, 2016
DOE OPA EVMS Review (BNL)	October 4-5, 2016

Acronyms and Abbreviations

AC	Alternating Current
ACWP	Actual Cost of Work Performed
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
BPM	Beam Position Monitor
BSA	Brookhaven Science Associates
CAM	Cost Account Manager
CD	Critical Decision
CPI	Cost Performance Index
CSS	Control System Studio
CV	Cost Variance
DCM	Double Crystal Monochromator
DOE	Department of Energy
DHRM	Double Harmonic Rejection Mirror
EAC	Estimate At Completion
EPICS	Experimental Physics and Industrial Control System
EPS	Equipment Protection System
EPU	Elliptically Polarizing Undulator
ES&H	Environment, Safety & Health
ESM	Electron Spectro-Microscopy beamline
ETC	Estimated Cost to Complete
EVMS	Earned Value Management System
FAT	Factory Acceptance Test
FDR	Final Design Review
FE	Front End
FEA	Finite Element Analysis
FOE	First Optics Enclosure
FPGA	Field-Programmable Gate Array
FTE	Full Time Equivalent
FWHM	Full Width at Half Maximum
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
GISAXS	Grazing Incidence SAXS
HFM	Horizontal Focusing Mirror
HVFM	Horizontal and Vertical Focusing Mirrors
ID	Insertion Device
IOC	Input / Output Controller
IRR	Instrument Readiness Review
ISR	Integrated In-Situ and Resonant X-ray Studies
ISS	Inner Shell Spectroscopy beamline
IVU	In-Vacuum Undulator
KB	Kirkpatrick Baez
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
SOE	Secondary Optics Enclosure
SPI	Schedule Performance Index
SSA	Secondary Source Aperture
SV	Schedule Variance
TEC	Total Estimated Cost
TPC	Total Project Cost
UB	Undistributed Budget
UHV	Ultra-High Vacuum
VAC	Variance At Completion
VDM	Vertical Deflection Mirror
VFM	Vertical Focusing Mirror
WAXS	Wide Angle X-ray Scattering
WBS	Work Breakdown Structure
WS	Working Schedule
XUV	Extreme UltraViolet
YAG	Yttrium Aluminum Garnet

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	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16
BCWS	61.5	64.3	66.4	70.7	73.0	75.3	77.1	78.2	79.3	81.1	82.1	82.5
BCWP	58.6	61.2	63.7	67.2	68.9	71.0	72.9	74.4				
ACWP	62.4	64.9	67.2	70.6	73.1	75.6	77.6	78.8				
SPI	0.95	0.95	0.96	0.95	0.94	0.94	0.95	0.95				
CPI	0.94	0.94	0.95	0.95	0.94	0.94	0.94	0.94				
ETC									8.6	5.8	3.8	2.1

NEXT as of 7/31/2016	Current Period	Cum-to-Date
Plan (BCWS) $k	1,063	78,179
Earned (BCWP) $k	1,488	74,393
Actual (ACWP) $k	1,282	78,840
SV $k	425	-3,786
CV $k	206	-4,446
SPI	1.40	0.95
CPI	1.16	0.94
Budget at Completion $k (PMB [UB])		82,970
Planned % Complete (BCWS/BAC)		94.2%
Earned % Complete (BCWP/BAC)		89.7%
Contingency $k		7,030
Contingency / (BAC – BCWP)		82.0%
EAC $k		87,452
Contingency / (EAC – BCWP)		53.8%
(Contingency + VAC) / (EAC – ACWP)		29.6%
TPC = PMB + Contingency		90,000

The NEXT project Schedule Variance (SV) for July 2016 is +$425k, with an associated monthly Schedule Performance Index (SPI) of 1.40 (red status). The largest contributors to the current month schedule variance are provided in the table below. The cumulative SPI is 0.95 (green status), the same as it was in June.

The NEXT project Cost Variance (CV) for July 2016 is +$206k, with an associated monthly Cost Performance Index (CPI) of 1.16 (yellow 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 June.

Leading Current Month Variances [$k], July 2016

WBS	Title	PV	EV	AC	Schedule		Cost	
					SV	Issues	CV	Issues
2.01	Project Support	169	169	172	0	--	-4	--
2.03	Common Systems	253	163	118	-90	Utilities (2.03.01): +$45k (performance of work scheduled earlier); PPS (2.03.02): -$92k (delays as PEMP notable & partner beamlines have taken priority); EPS (2.03.03): -$71k (priority issues as for 2.03.02, plus shortage of EPS engineers); Control Station (2.03.04): +$27k	45	Positive cost performance (savings) for equipment protection systems (EPS), mostly material
2.04	Controls	99	31	88	-68	Sum of scheduled activities earned earlier [ESM Integrated Testing (-$13k), ISR Integrated Testing (-$22k), ISS Integrated Testing (-$18k)] and scheduled activities not yet performed [net SIX activities (-$4k), net SMI activities (-$13k)]	-57	Labor charges for effort that was earned in previous months or will be earned in subsequent months
2.05	ESM Beamline	14	79	199	66	Completion of activities scheduled in earlier months: PDS gaskets & fittings (+$44k);endstation installation, testing, and finishing items (+$20k)	-119	Driven by accrual or payment on major contracts made this month for value earned last month, dominated by a payment to VG Scienta for the endstation electron energy analyzer contract

Leading Current Month Variances [$k], July 2016								
WBS	Title	PV	EV	AC	Schedule		Cost	
					SV	Issues	CV	Issues
2.07	ISR Beamline	146	191	153	45	Previously-scheduled activities performed this month: HFM (+$45k), burn-through device (+$21k); Scheduled activities to be performed later: DHRM (-$16k), KB (-$19k); IRR activities, some performed early, some late (+$14k)	38	Positive cost performance (savings) in ISR management (labor)
2.08	ISS Beamline	63	196	58	133	Earlier-scheduled activities performed this month: Sample Handling System activities, Focusing Mirror commissioning activities, Lens package fabrication activities, spectrometer activities, Sample Chamber activities, and testing activities.	138	Dominated by earned value on ISS contracts that will be accrued or paid next month
2.09	SIX Beamline	90	382	241	292	Sum of activities performed in July but scheduled earlier: pink beam mask receipt and acceptance (+$60k), approval of M1M3 and PGM commissioning reports (+$10k), receipt of piezo shutter (+$17k), receipt of sample chamber cameras (+$15k), grating bench test and acceptance (+$40k), cryostat delivery (+$102k), progress in spectrometer arm assembly and testing (+$22k), DAQ installation (+$27k)	141	Dominated by earned value on SIX contracts that will be accrued or paid next month
2.10	SMI Beamline	148	119	163	-28	PDS activities performed this month, scheduled earlier: PPS aperture (+$35k), vacuum interfaces (+$36k), test activities (+$8k); Activities scheduled this month, not yet performed: SAXS/WAXS systems (-$93k), bounce-down mirror (-$6k); DAQ activities (-$3k)	-44	Labor overage during heavy installation period
2.11	Insertion Devices	80	157	89	77	Earlier-scheduled activities performed this month: SIX EPU57 (+$83k), current strip power supplies (+$64k); Purchases (cabinets and connectors) performed earlier than planned (+$7k); Activities scheduled this month, to be performed in future months: ESM EPU105 assembly & shimming (-$77k)	68	Labor efficiencies on work performed this month (assembling, shimming, and power supply activities): $127k performed vs. $60k charged
	Total	**1063**	**1488**	**1282**	**425**	**Total**	**206**	

As of July 31, 2016, the project is 89.7% complete with 82.0% contingency ($7.0M) for $8.6M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through July 2016. The project EAC for July is reported at $87,452k 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 July 2016, the VAC (-$4,482k) is dominated by the cumulative cost variance (-$4,446k), which is in turn dominated by labor cost overage on work performed to date.

The July 2016 EAC ($87.45M) is $0.03M lower than the June value. As of the end of July, contingency on EAC is $2.55M, which represents 29.6% of $8.58M EAC work remaining. Outstanding commitments on fixed-price equipment contracts total $5.55M, so the $2.55M contingency on EAC represents 83.2% of $3.06M 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.

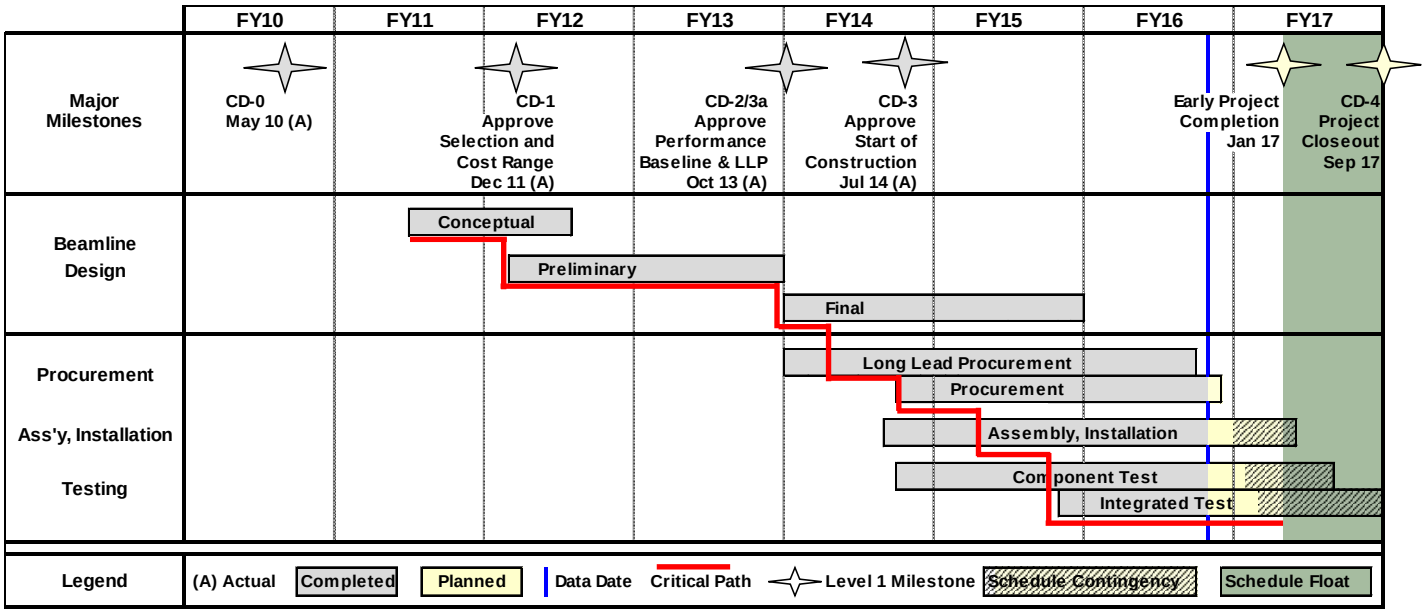
Three PCRs were approved and implemented in July.

PCR	PCR Level	Baseline Change [$]	Description
16-119	L3	74	Update Common System Baseline with Additional Support Identified in ETC
16-120	L3	162	ESM & SIX Contract Amendment Updates
16-121	L3	49	Incorporate EAC Changes in WBS 2.07 and 2.10 into Baseline

No PCRs are planned for August.

Milestones – Near Term		Planned	Actual
L3	SIX - Testing Monochromator and Slits complete	1-Mar-16	Expect August
L3	ISR - Installation of DCM Monochromator complete	15-Mar-16	24-Jun-16
L3	Common Beamline Systems: Electrical Utilities Installed	29-Apr-16	27-May-16
L3	ESM - Testing Monochromator and Slits complete	12-May-16	27-May-16
L2, L3	Common Beamline Systems: Mechanical Utilities Installed	31-May-16	Expect August
L3	ISR – Installation of Beamline Components Complete	29-Jun-16	Expect December
L2	Receive EPUs for ESM and SIX	12-Aug-16	1-Jun-16
L3	Insertion Devices - ESM EPU105 Received	12-Aug-16	1-Jun-16
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 July 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 7/31/2016	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	0.72	0.50	38.04	34.50
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	1.34	0.62	29.30	15.85
WBS 2.04 Control System	0.52	0.52	20.38	18.88
WBS 2.05 ESM Beamline	0.12	0.66	15.53	18.13
WBS 2.06 FXI Beamline	0.00	0.00	4.77	4.60
WBS 2.07 ISR Beamline	0.90	0.47	16.65	14.89
WBS 2.08 ISS Beamline	0.21	0.20	14.26	14.40
WBS 2.09 SIX Beamline	0.27	0.41	18.02	20.88
WBS 2.10 SMI Beamline	0.78	0.37	15.06	14.31
WBS 2.11 Insertion Devices	0.57	0.40	6.45	5.76
WBS 2.12 ID & FE Installation	0.00	0.00	3.88	7.97
Total	5.43	4.15	191.08	178.91

** 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 July 2016: 131

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 / 07 / 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 / 07 / 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	168,704	168,704	172,493	0	(3,789)	8,900,005	8,900,005	9,705,190	0	(805,184)	9,918,232	10,670,863	(752,631)
2.01.01 Project Management	72,023	72,023	55,502	0	16,521	4,154,737	4,154,737	3,855,992	0	298,745	4,598,029	4,337,030	260,998
2.01.02 Project Support	96,680	96,680	116,991	0	(20,310)	4,745,268	4,745,268	5,849,198	0	(1,103,930)	5,320,204	6,333,833	(1,013,629)
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	253,392	162,973	118,084	(90,418)	44,889	7,135,375	6,574,343	7,878,124	(561,032)	(1,303,781)	7,340,417	8,503,531	(1,163,114)
2.03.01 Utilities	0	45,183	36,518	45,183	8,665	4,209,423	4,100,702	4,345,518	(108,721)	(244,816)	4,210,031	4,347,019	(136,988)
2.03.02 Personnel Protection System (PPS)	116,919	24,807	52,575	(92,112)	(27,768)	1,485,177	1,093,172	1,939,900	(392,005)	(846,728)	1,620,824	2,424,530	(803,706)
2.03.03 Equipment Protection System (EPS)	122,841	52,173	11,595	(70,668)	40,577	653,807	619,350	842,717	(34,457)	(223,368)	680,294	912,191	(231,897)
2.03.04 Control Station	2,577	29,756	9,709	27,179	20,046	306,744	280,894	180,218	(25,850)	100,675	306,744	206,069	100,675
2.03.05 Common Beamline Systems Management	11,054	11,054	7,687	0	3,368	480,225	480,225	569,770	0	(89,545)	522,524	613,722	(91,198)
2.04 Control System	99,363	31,172	87,892	(68,190)	(56,720)	4,444,883	4,370,460	4,581,184	(74,423)	(210,725)	4,648,844	4,867,455	(218,612)
2.04.01 Control System Management	4,964	4,964	757	0	4,207	273,533	273,533	242,008	0	31,525	294,427	262,914	31,513
2.04.02 Control System Design & Implementation	94,399	24,544	84,717	(69,854)	(60,173)	2,821,127	2,745,040	3,037,115	(76,087)	(292,075)	2,929,314	3,229,264	(299,951)
2.04.03 Control System Equipment	0	1,664	2,418	1,664	(754)	1,350,223	1,351,887	1,302,062	1,664	49,826	1,425,103	1,375,278	49,826
2.05 ESM Beamline	13,770	79,404	198,863	65,635	(119,459)	9,301,025	9,157,774	9,883,059	(143,250)	(725,285)	9,422,464	10,148,967	(726,503)
2.05.01 ESM Management	13,770	9,960	6,743	(3,810)	3,217	565,539	569,351	473,058	3,812	96,293	610,744	516,373	94,372
2.05.02 ESM Beamline Systems	0	69,445	192,121	69,445	(122,676)	8,735,485	8,588,423	9,410,002	(147,063)	(821,579)	8,811,720	9,632,594	(820,874)
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	146,382	191,175	153,183	44,792	37,991	9,683,408	8,743,540	8,896,470	(939,868)	(152,930)	10,392,425	10,588,795	(196,370)
2.07.01 ISR Management	51,157	64,726	24,660	13,569	40,066	1,033,409	1,062,613	1,000,973	29,204	61,639	1,105,394	1,043,791	61,604
2.07.02 ISR Beamline Systems	95,225	126,449	128,523	31,224	(2,075)	8,649,999	7,680,927	7,895,496	(969,072)	(214,569)	9,287,031	9,545,004	(257,974)
2.08 ISS Beamline	63,230	196,167	58,312	132,936	137,854	10,294,415	10,056,902	10,727,476	(237,513)	(670,574)	10,472,212	11,187,817	(715,605)
2.08.01 ISS Management	12,928	12,928	17,645	0	(4,717)	674,706	802,114	662,843	127,408	139,271	838,199	672,147	166,052
2.08.02 ISS Beamline Systems	50,303	183,239	40,667	132,936	142,572	9,619,709	9,254,787	10,064,632	(364,922)	(809,845)	9,634,013	10,515,671	(881,657)
2.09 SIX Beamline	90,493	382,049	240,788	291,556	141,260	9,822,228	8,691,418	9,219,474	(1,130,810)	(528,056)	11,764,836	12,576,303	(811,467)
2.09.01 SIX Management	18,223	18,223	4,913	0	13,310	670,711	670,711	647,036	0	23,674	729,841	706,207	23,634
2.09.02 SIX Beamline Systems	72,270	363,825	235,875	291,556	127,950	9,151,517	8,020,707	8,572,437	(1,130,810)	(551,731)	11,034,995	11,870,096	(835,101)
2.10 SMI Beamline	147,688	119,489	163,414	(28,200)	(43,925)	8,894,016	8,308,551	8,586,108	(585,465)	(277,557)	9,126,837	9,274,762	(147,925)
2.10.01 SMI Management	11,253	11,253	5,929	0	5,325	705,873	705,873	625,410	0	80,463	805,656	724,762	80,894
2.10.02 SMI Beamline Systems	136,435	108,235	157,485	(28,200)	(49,250)	8,188,143	7,602,678	7,960,698	(585,465)	(358,020)	8,321,181	8,550,000	(228,819)
2.11 Insertion Devices	79,785	156,927	89,276	77,143	67,651	4,625,206	4,511,986	4,308,975	(113,220)	203,011	4,805,392	4,580,034	225,359
2.11.01 ESM EPU Insertion Device	77,207	154,350	87,153	77,143	67,197	4,421,514	4,308,294	4,156,169	(113,220)	152,125	4,587,795	4,413,317	174,478
2.11.02 SIX EPU Insertion Device	0	0	0	0	0	117,137	117,137	70,375	0	46,762	117,137	70,375	46,762
2.11.03 Insertion Devices Management	2,577	2,577	2,123	0	454	86,555	86,555	82,431	0	4,124	100,460	96,342	4,118
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	1,062,806	1,488,059	1,282,307	425,253	205,753	78,179,017	74,393,435	78,839,760	(3,785,582)	(4,446,325)	82,970,116	87,452,227	(4,482,111)
Management Reserve													
Undistributed Budget													
Performance Management Baseline (PMB)	1,062,806	1,488,059	1,282,307	425,253	205,753	78,179,017	74,393,435	78,839,760	(3,785,582)	(4,446,325)	82,970,116	87,452,227	(4,482,111)