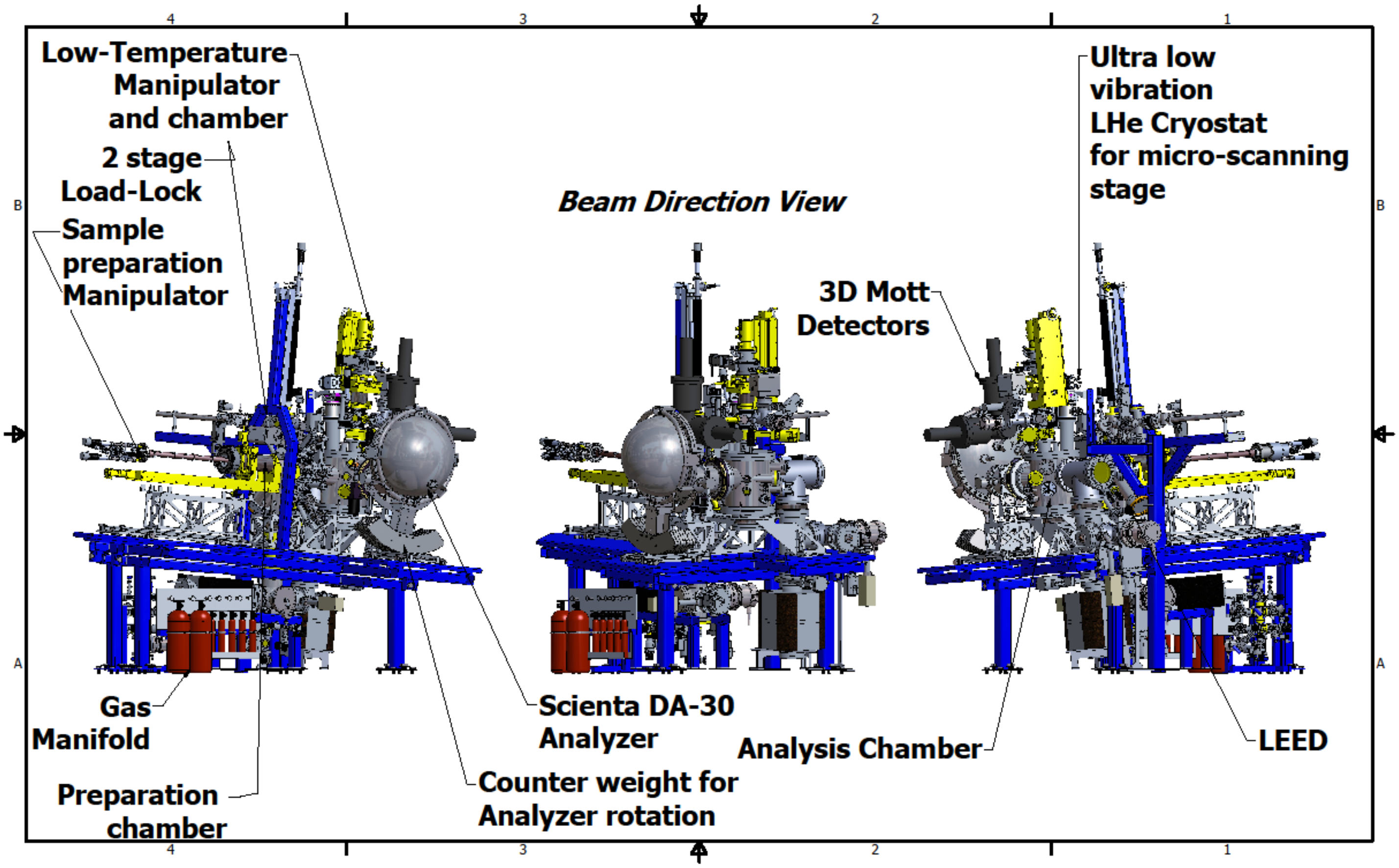
NSLS-II Experimental Tools (NEXT)

March 2015 Project Activity
Report due date: April 20, 2015



ESM µ-ARPES Endstation at 21-ID

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OVERALL ASSESSMENT

During March 2015, progress continued to be made on all phases of the project, including awarding major procurements, finalizing endstation designs, and installing utilities. In parallel, the website for the April 17 Mini-Review of NEXT was prepared.

Four major procurements were awarded during March: a contract for the ISS sample chamber assembly on March 18, purchase of non-optics components for the ESM and SIX beamlines on March 19, a contract for spectrometer grating rulings for SIX on March 26, and a contract for the ISR instrumented 6-circle diffractometer on March 27. Upcoming major procurements include the diamond window and diamond phase plates for ISR, the higher harmonic rejection mirror system for ISS, vacuum sample stages for SMI, and the x-ray emission spectrometer for ISS. As of the end of March, 96% of all major photon delivery system procurements and 81% (52 of 64) of all major procurements have been awarded.

Two PCRs were approved in March, both of which incorporated contract awards or amendments. PCR NEXT_15_081 (WBS 2.08.02, +$83K change to baseline) implemented amendments to the ISS Filter Box and ISS Gas Handling System contract and implemented the contract for the ISS Sample Chamber. PCR NEXT_15_078 (WBS 2.05.02 and 2.09.02, +$952K change to baseline) implemented multiple contract awards and amendments for ESM and SIX. The ESM budget increased by $190K ($148K M&S, $42K labor), consisting mostly of changes to many small endstation procurements and increased estimated labor needed to complete installation and testing of ESM endstation equipment. The SIX budget increased by $762K (all M&S) from changes to multiple major SIX endstation procurements, most significantly those for the 15m-radius emission spectrometer and its detector. The majority of the cost increase associated with these PCRs was previously captured in EAC.

BAC rose $1.04M in March, to $81.15M, more than 90% of which is associated with PCR NEXT_15_078, which implemented contract awards and amendments for ESM and SIX Beamline systems. EAC rose a modest $0.39M, to $82.0M. The largest contributors to the -$0.8M VAC at this point are expected overages in project support ($0.4M), common systems ($0.3M), and ISS beamline systems ($0.1M). Cost contingency is reported at $8.85M, which represents 18.8% of $47.1M BAC work remaining or 18.5% of $47.9M EAC work remaining. If all of estimated VAC were to materialize, the contingency would be reduced to $8.04M, which represents 16.8% of $47.9M EAC work remaining. Since outstanding commitments total $23.0M, the $8.04M contingency on EAC represents 31.4% of the $25.5M uncommitted EAC work to go.

The cumulative EVMS schedule index decreased 0.01 in March, to 0.96, resulting from relatively small (<$100K) schedule variances in five level 2 WBS elements. The cumulative EVMS cost index fell 0.01 to 1.01.

Acceptance testing of NEXT shielded enclosures (hutches) made further progress in March, with 80% of the tests completed by the end of the month.

One of the five integrally-cooled mirrors being manufactured for NEXT beamlines by InSync, Inc. has been delivered and the delivery schedule for the remaining four remained stable during March. NEXT and PPM staff continue to maintain frequent contact with this supplier, including receiving weekly status updates.

COMMON SYSTEMS

PCR-15-061, approved in January ($1.4M) consists mostly of labor additions based on estimates informed by experience on the NSLS-II Project beamline common systems.

Progress on design and installation of NEXT mechanical and electrical utility systems continued at an accelerated pace in March. Work accelerated because utilities work on the ABBIX project is complete, thereby freeing up additional resources to assign to NEXT installation. The accelerated pace is expected to continue until mechanical and electrical utilities installation for NEXT is complete.

ISR utilities are now completely installed, while SMI and ESM utilities installation are both approximately 90% complete. Utilities installation on the SIX and ISS beamlines also made good progress, with both beamlines approximately 75% installed. The working schedule shows completion of NEXT electrical and mechanical utilities installation in April.

The contract for NEXT liquid nitrogen distribution piping was awarded to Acme Cryogenics in December. The scope of this contract includes the design, fabrication, and installation of piping from the experimental floor mezzanine level to beamline cryo-coolers and to experimental hutches that require liquid nitrogen supply. Installation drawings were fully approved in March. Installation is scheduled to start on April 13. PPS design and development is well underway, with a focus on ESM and SMI. Some rework has been required at hutch interface points. PPS team recently met with hutch vendors to develop a plan to remediate these issues. The majority (90%) of Personnel Protection System (PPS) components have been received through March. PPS installation began at ESM in March, including the installation of PPS interlock conduit for the A and B chains. PPS installation work, while being part of one month behind schedule, is expected to accelerate in April as resources currently allocated to ABBIX become available.

The EPS team is continuing to receive EPS requirements for each beamline, and participates actively in design reviews with vendors so that interface points between EPS and photon delivery components can be understood early. The procurement of Equipment Protection System (EPS) components is approximately 70% complete through March, with components continuing to be received as system definition matures. Installation of EPS components expected to start in late FY2015.

Development of control stations at ESM, SMI, ISS, and SIX has been finalized and contract awards have been made.

Some furniture for ESM has been delivered. Upcoming furniture deliveries are anticipated in April and May. Installation of the furniture will occur later in FY2015 and early FY2016, after installation of Utilities and PPS is complete at each beamline.

BEAMLINE CONTROLS

In March, NEXT controls engineers continued to refine controls cable and rack layouts, mostly for endstations where designs are being finalized. Work on controls design documentation is also making progress. Based on lessons learned from NSLS-II Project beamlines, it has been decided that PLCs for NEXT EPS and industrial controls systems will be designed and assembled in house and shipped to the supplier for installation and testing prior to system delivery. This strategy will eliminate duplication of effort and ensure compatibility of EPS wiring with NSLS-II requirements. Controls engineers have begun collecting and documenting PLC requirements and specifications for each beamline and endstation.

Controls engineers participated in control system discussions at the Final Design Reviews (FDRs) of the DHRM and KB mirror optics packages for ISR. For the KB mirror support table, the subcontractor (Square One, Inc.) requires use of an enhanced Delta Tau motion controller that supports absolute encoders. As reported in January 2015, NEXT controls engineers have shown successful Delta Tau control of absolute encoders in connection with the mirror systems being developed for the ESM and SIX beamlines. An enhanced Delta Tau motion controller has been purchased for shipment to Square One.

One of the NEXT controls engineers is responsible for front end controls, for both the NSLS-II Project and NEXT Project. Recent operating experience with these systems at NSLS-II Project beamlines has revealed some issues with disabled motion when a software limit is hit. Experience gained in troubleshooting these systems and finding the eventual solution (with updated EPICS motor record and tpmac support) will be beneficial to the commissioning of NEXT beamlines.

To satisfy the data acquisition model at the ISS beamline, where it is intended to have motion positions captured with timing information during fly scans, the controls group has been working with ISS beamline staff to develop "Pizzabox" electronics based on the NSLS-II accelerator cell controller digital front end. The FPGA inside the “Pizzabox” has been programmed to capture multiple channels of encoder readings with time stamps at each capture and save in on-board memory. Controls engineers have recently developed a Python script to read the captured readings in order to demonstrate the position capture capabilities of the "Pizzabox" prototype.

ESM – ELECTRON SPECTRO-MICROSCOPY

Simulations of secondary gas bremsstrahlung scattering (SGB) have been conducted for the ESM beamline (Primary gas bremsstrahlung is fully stopped in FOE based on ray tracing). The aim is to assess the validity of the shielding scheme adopted on the basis of geometrical ray tracing. In particular, for the soft-X ray beamlines there is the concern of SGB propagating along the beamline up to the monochromator and therefore requiring a special radiation enclosure around the monochromator optics.

All SGB simulations have been performed by Dr. Amy Xia of the NSLS-II Radiation Safety and Radiation Physics group. The FLUKA calculations assume a GB source generated by a 3 GeV, 500 mA electron beam in a 15.5m-long straight section at 10^{-9} Torr.

The First Optical Enclosure (FOE) is the primary shield for the SGB radiation. The FOE structure is made of lead (Pb) with 18 mm thick outboard lateral panel, a 10 mm thick roof, and a 50 mm thick downstream wall. In this calculation the principal scatterer considered is the M1 mirror (60x70x605 mm long Si block),

The following lists the main shields:

1) the SGB shield #1: a 600 mm wide Pb wall (100 mm thickness) immediately following the mirror
2) the primary GB stop (a 200 mm long stack of Pb bricks following SGB shield #1)
3) the photon shutter (two W pieces , total 38 mm thick)
4) the guillotine (Pb, 100 mm thick)
5) the γ-stop, a W-block (75 mm diameter, 5 cm thick) at the downstream end of the monochromator

This shielding scheme is quite effective, as shown in Figure 1. The majority of the SGB is contained inside the FOE. One stream of SGB (~0.5 mrem/h maximum) unavoidably leaks down the beam pipe to the monochromator chamber, where it is sufficiently shielded by the W gamma stop. As shown in Figure 1, the dose rate inside the beam pipe downstream of the monochromator is reduced to ~0.05 mrem/h. Outside the vacuum transport pipe, the SGB dose rate is well below the limit required for shielding on the NSLS-II floor (0.05 mrem/h).

These results lead to the conclusion that no radiation safety enclosure zone will be required downstream of FOE. Of course, all shielding will be verified by radiation survey during commissioning and if a radiation leakage is observed during measurement, shielding shall be installed to mitigate the radiation level outside of the enclosure to an acceptable level.

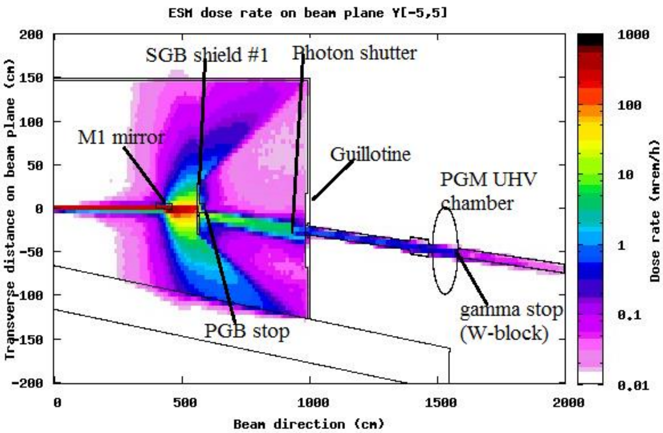


Figure 1: FLUKA calculation of the scattered bremsstrahlung dose rate from the white beam M1 mirror in the ESM FOE. All shields taken into consideration in the calculation are indicated.

FXI – FULL-FIELD X-RAY IMAGING

The FXI photon delivery system procurement contract was in preparation at the end of March. It is expected to be ready to award off project in April.

The FXI radiation enclosure (hutch) contract is proceeding on schedule, with final designs complete and fabrication continuing at Caratelli's site. Delivery and on-site construction is expected in September.

ISR – IN-SITU AND RESONANT HARD X-RAY

The final scoring meeting for best-value determination of bids received for the Instrumented Six-Circle Diffractometer procurement was held on March 2, and a contract for this system was awarded to Huber Diffraction, USA on March 27. The RFQ for high pressure, high temperature grown, type IIa, single crystal diamonds, which will be used as phase plates for polarization control in the 3.5-14 keV energy range, was posted on FedBizOpps on March 25, with a bid due date of April 6.

A drawing of egress aisles— inboard, outboard, and a duck-under downstream of the FOE— was released. This drawing will be used by the Survey Group to mark the experimental floor before the aisles are painted. An updated version of the Optics Package ICD that includes the Second Mask was also released during March.

The PDR for the Dual Phase Plate Assembly (DPP) contract was held at Huber on March 4-5. Two design changes that were requested during the kick-off meeting were implemented in the preliminary design: the entire length of the component was decreased by 200 mm, and the travel range of the Piezo Flipper was increased by 10 mm. The shorter flange-to-flange length for the DPP provides additional space for the upstream Pink Beam Stop, which Toyama has designed in a stand-alone chamber instead of being integrated with the DCM (see Figure 2). The larger travel range for the Piezo Flipper will be helpful operationally as more phase plates can be accommodated, thus avoiding the time consuming process of swapping out phase plates when working in different x-ray energy ranges. Another improvement in the preliminary design of the DPP was a new approach to providing pitch adjustment of the individual chi circles. This adjustment was envisioned by the ISR Team as being manual, and requiring the vacuum chamber to be vented for access. Huber has instead proposed a flexure stage design that has several advantages: motorized control, out-of-vacuum access, and improved stability due to a more compact design of the chi circle supports. The FDR for the DPP has been tentatively scheduled for May 15.

The FDR for the Mirrors Package, which includes the Double Harmonic Rejection Mirror (DHRM) and KB Mirror, was held at BNL on March 16-17 with representatives from Toyama and Square One, the subcontractor for the KB Mirror table. Two of the design changes to the DHRM that were requested during the PDR — the location of the ion pump and the addition of a granite support for the Secondary Source Aperture — were described, and the flexure stage for the second mirror was redesigned to achieve the ≤100 nrad resolution specification on pitch and roll. The remaining modifications to be made to the DHRM design will enable the use of direct beam when harmonic rejection is not necessary. For the KB Mirror, one significant change since the PDR was the addition of out-of-vacuum arcs for pitch (first, vertical, mirror) and yaw (second, horizontal, mirror). These additional stages add height to the individual mirror stacks, which requires a reduction in the thickness of the support plate to satisfy the overall height requirement of the system. These changes reduce the stability of the KB Mirror, as confirmed in vibrational FEA, and indicate the need for additional design refinement. The design of the table also needs to be finalized, in particular to satisfy the ≤ 1 μm resolution specification on the height of the first, vertical, mirror.

Discussions regarding the two additional ISR contracts with Toyama — the Optics Package and the Shielded Transport Pipes — were held on March 18. All of the Optics Package 2D drawings provided by Toyama were reviewed, and the subsequently updated 3D models are shown in Figure 2. The FDR for the Shielded Transport Pipes has been tentatively scheduled for May 20 or 21.

The PDR for the Gas Handling System was held at Applied Energy Systems on March 26. Much discussion concerned the safety components such as emergency stops, gas detection, exhaust system requirements, and light and audible alarms. The most significant remaining design hurdle for the system is related to space constraints in Hutch D, which cannot accommodate the proposed 70" wide by 19.5" deep vented enclosure. The ISR Team will work closely with Applied Energy Systems in the lead-up to the FDR in order to find a vented enclosure design that can be accommodated.

The FDR for the Gas Handling System has been tentatively scheduled for May 11.

Two RGA systems for the ISR beamline arrived and are undergoing acceptance testing.

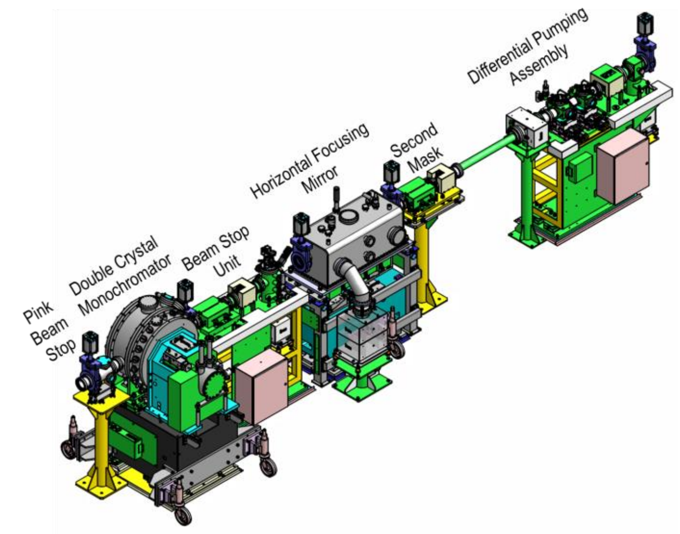


Figure 2: 3d models of the ISR FOE components from the Differential Pumping Assembly through the Pink Beam Stop, from Toyama.

ISS – INNER SHELL SPECTROSCOPY

The final package of the ISS photon delivery system, for the filter box, was awarded to Toyama. Installation of this component is planned in December 2015, together with installation of the collimation and focusing mirrors which are also being provided by Toyama. This approach optimizes logistics and provides significant cost and schedule benefits.

Proposals for the only optics package in the endstation enclosure, the higher harmonic rejection mirror package, were received and are currently being evaluated. The sample chamber package was awarded to Physikalische Instrumente GmBH, with the proposed design shown in Figure 3.

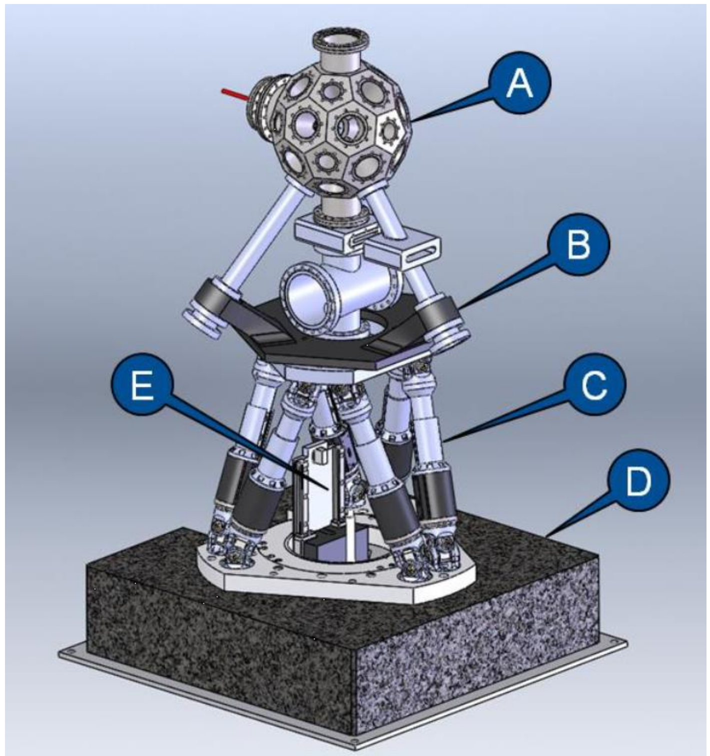
The addition of all controls aspects to the gas handling system contract reduces significantly the interface points between the NSLS-II controls group and the supplier; it not only minimizes the efforts to monitor the contract and manage the interfaces but also simplifies the safety and operations reviews of this system and therefore reduces schedule risk during the commissioning of the system.

The PDR report for the major components of the ISS beam transport system contract has been approved and the agreed design changes have been incorporated, permitting the FDR of the complete system to take place at the end of April.

The Mythen detection system from DECTRIS, a set of linear detector arrays with 50µm spatial resolution, was delivered in March. These detectors will be used for both the von Hamos and the spherical backscattering analyzers. Currently, the system contains five detector heads and detector electronics with 24 readout channels, allowing easy expansion for additional spectrometers.

A site visit to Toyama by the ISS team in March provided the opportunity to assess the manufacturing progress of the monochromator, collimation mirror, and focusing mirror contract. In addition to the mirrors and the Si crystal for the high heat load monochromator, all long lead items have been delivered to the Toyama site. All major component sub-assemblies for the high heat load monochromator and a prototype of the mirror bender which will be used in both mirror packages have been assembled. The ISS team was able to observe and undertake motion and stability tests of the monochromator motion system, the crystal cage of the second crystal, and the bender mechanism of the mirror systems. The results of the tests were discussed with the Toyama team. All tested monochromator parts are exceeding specifications. The mirror bender test showed good reproducibility of the mechanics but a large motion hysteresis and a longitudinal twist of the mirror surface proportional to the bending radius. Mitigation strategies were discussed and are being implemented in the design or assembly protocol.

Data storage servers, the major hardware component of the ISS data acquisition system, have been received.



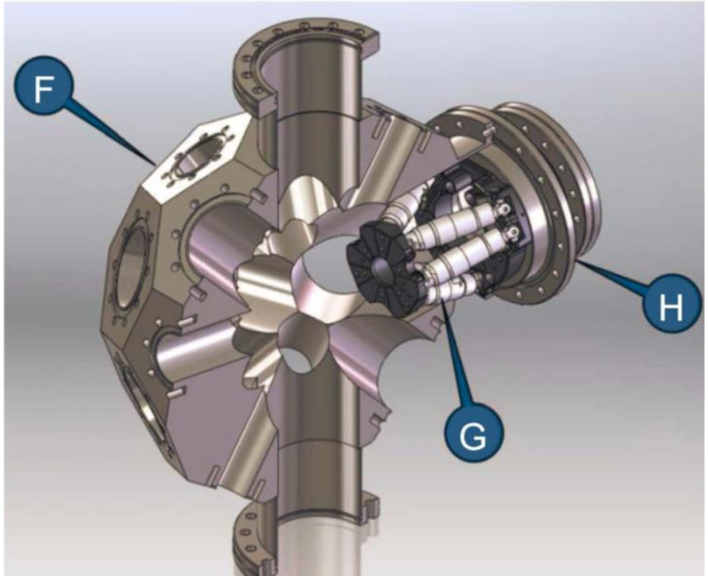


Figure 3: ISS sample chamber assembly. Top: Preliminary layout of the proposed ISS sample chamber assembly. The concept includes a monolithic vacuum chamber (A) with the Incident poly-capillary lens (PCL) hexapod inside, a support structure (B) connecting the chamber to the support hexapod (C), a granite support stand (D), and an additional elevation mechanism (E). Bottom: Cross-section view of the sample chamber (F) showing the hexapod (G) that will support the poly-capillary lens and the adapter flange (H).

SIX – SOFT INELASTIC X-RAY

One of the most challenging mechanical specifications for SIX is the vertical stability tolerance of the detector, ±400 nm, which needs to be achieved across the large detector vertical motion range, between ~1.4 m and ~4 m above floor height. Thanks to an alternative optical scheme suggested by the SIX optics scientist, this specification could become considerably easier to achieve. This scheme, illustrated in Figure 4 together with the current scheme, relies on the addition of a plane pre-mirror before the grating, and a Riemer-Torge mechanism for the motion of the pre-mirror/grating combination in a similar fashion to a PGM. The main advantage of this design is that the outgoing beam height can be fixed for all energies, implying that a significantly simplified and therefore more stable detector support stand could be designed. This new scheme will be reviewed by the soft x-ray optics experts of the SIX BAT next month, just prior to the PDR of the spectrometer arm with Bestec.

Photon delivery system packages with Bestec are currently all in production. The delivery of the PGM has been delayed by one month due to the extra time needed by Bestec to implement a recently developed active feedback compensation system that will further improve the stability of the grating pitch, which is the most critical specification of this unit. The new delivery schedule, early May, will not affect the installation schedule. The production of the M1, M3 and M4 mirror systems is on schedule.

The second set of two spectrometer grating substrates (50 nrad tangential slope error) from JTEC Corp. were shipped on March 27, two weeks after the contractual date. Production of the other optics, the elliptical mirror M3, the circular cylindrical mirror M6, and the ellipsoidal mirror M4, is on schedule. The polishing of the internally cooled PGM pre-mirror M2, specified to a tangential slope error of 100 nrad, is beyond the current capabilities of InSync, Inc., which produced the mirror. The solicitation for the polishing of M2 was posted on FBO as an RFQ, and awarded to JTEC on March 10. The unpolished M2 was received from InSync on March 25 and inspected on March 27. The shipping memo to ship the mirror to JTEC is currently being processed.

The preliminary mechanical design of the CCD detector for the emission spectrometer was received from XCAM on March 29. The need for better decoupling between the cryocooler head and the camera chamber, to minimize the propagation of vibrations to the camera sensors, was identified by SIX and has been communicated to XCAM. This iteration could cause a slight delay in the approval date of the preliminary design, currently scheduled for April 6, although this delay may be absorbed by the float built into XCAM's schedule.

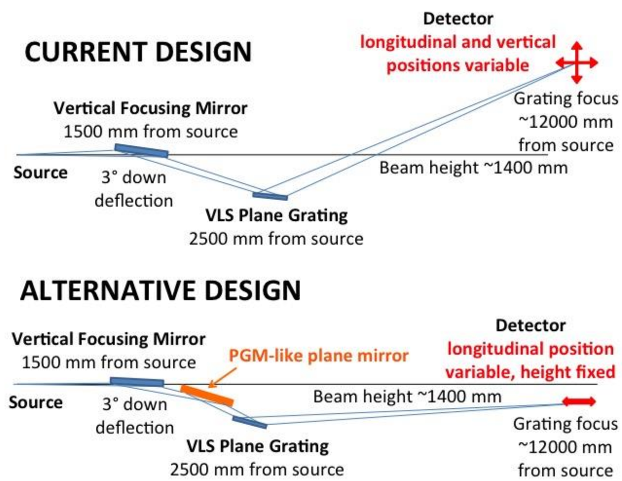


Figure 4: Sketch of the current and alternative optical schemes for the SIX spectrometer.

SMI – SOFT MATTER INTERFACES

Visible progress has been made on both of SMI's Photon Delivery System packages. IDT, supplier of the White Beam Components, sent a "Data Pack" at the beginning of March consisting of a number of End Item Documentation files, including wiring diagrams, draft safety plan items, and an updated Program Plan showing good progress, in detail, on all components including the Secondary Bremsstrahlung shields that were added just after the FDR meeting last fall. IDT have opted to procure two identical granite stands for the SMI DCM, shipping the first to their plant and the second to BNL, ahead of schedule. This allows them to assemble and test the

DCM at their facility, then disassemble and ship without also having to pack and ship the stand on SMI's schedule. IDT will use the spare granite for their future DCM orders worldwide.

Regarding the focusing mirrors and beam transport package, Cinel has also brought one component in ahead of schedule: the flat Vertical Deflection Mirror from subcontractor Zeiss. The optical metrology report for the bare Si optical surface shows that its figure exceeds specifications. During fabrication, one corner on the back of the mirror developed a crack (see Figure 5). Zeiss machined a smooth contour to prevent propagation of the damage. This imperfection will not affect the performance or mounting. The mirror remains with Cinel and will be coated and measured again before delivery to BNL.

Several endstation items are now under contract, to which SMI team members have been assigned principal responsibility for review meetings and travel. Assistant scientist Misha Zhernenkov has the responsibility for JJ X-ray's contract for the SMI CRL Transfocator. JJ X-ray provided a comprehensive PDR Report at the end of March, well in time for the meeting at their site. Misha, along with engineer Daniel Bacescu, will travel for that meeting in early April. GNB hosted their PDR meeting for the vacuum chamber on March 23. The most important item to resolve is the method to open the chamber's clam-shell lid using the hutch hoist. GNB will need to manufacture a custom spreader bar for the lift. Clearances are tight, as shown in Figure 6. There is precedent at BNL for custom rigging tools supplied by contractors. SMI has scheduled an internal review meeting with BNL Rigging subject matter experts, to take place prior to GNB's FDR meeting in mid-April. The review meetings, overseen by scientist Elaine DiMasi and engineer Scott Coburn, will take place in early April.

During March, bid proposals were received for the Vacuum Sample Stages and specification for the Double Crystal Deflector was completed. Regarding controls, SMI cable studies have been signed off as official drawings, the rack layouts have been shared with the Vacuum Group to plan for the first cable pulling activity, and DiMasi took advantage of a 32-hour Python programming course offered on site to prepare for upcoming Data Acquisition design activities.

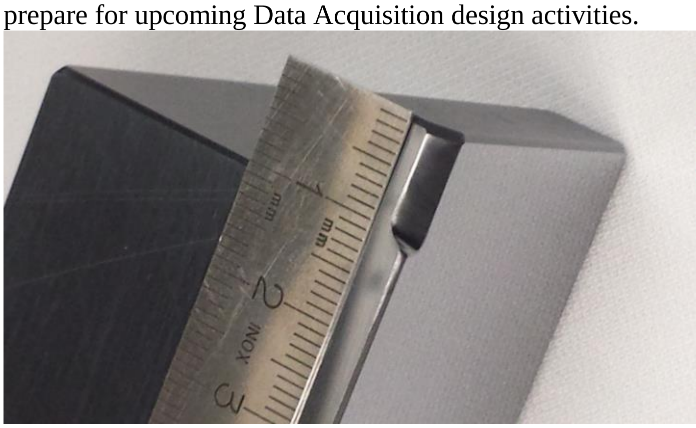


Figure 5. View of the back of the SMI flat Vertical Deflection Mirror, procured from Zeiss via Cinel. A small crack has been given a smooth contour to protect the optical surface, which has been measured and found to exceed figure specifications.

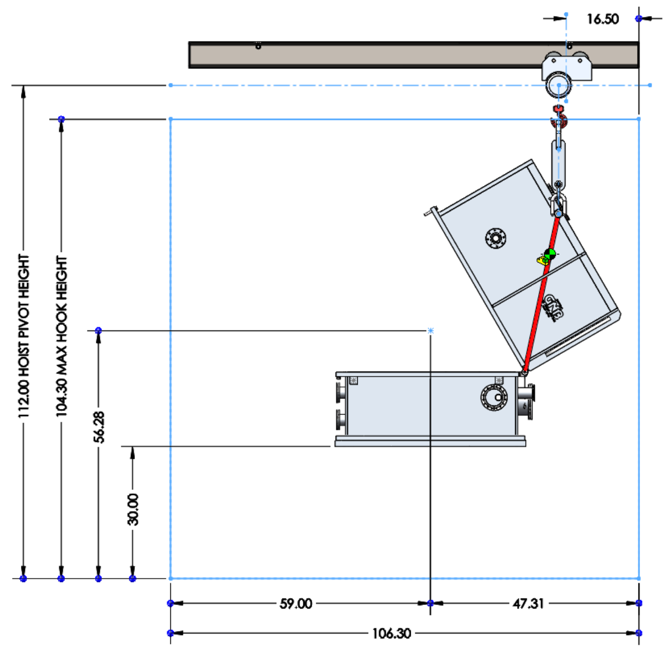


Figure 6. The SMI sample vacuum chamber, rendered by contractor GNB, is shown "floating" within its constraints: fixed positions from the floor (granite stand not shown) and the inboard hutch wall (blue box, bottom and right sides), and the rather low maximum hook height of the manual hoist. GNB will supply a custom spreader bar, as illustrated, to correctly lift the chamber lid at a point along the line joining the lid center of gravity to the hinge pin (red line, green marking).

INSERTION DEVICES

Important results regarding the dynamic aperture of the NSLS-II storage ring with NEXT EPUs installed have been achieved this month. Accelerator physics simulations carried out in February and March have demonstrated that successful correction of the deleterious effects of these insertion devices will be achieved with the following number of flat wires (current strips): 36 each for the 3.5m-long SIX EPU57 and the 2.8m-long ESM EPU105 devices and none for the 1.4m-long ESM EPU57. For consistency among devices and compatibility with the CSX EPUs, current strips containing 40 wires will be provided for each NEXT EPU. In the first days of NEXT EPU operation, current will be applied to 36 of the 40 wires for the long EPUs for optimal correction. Eventually, as needed, correction of the short ESM EPU57 can be provided as more EPUs are installed in the ring.

Two Preliminary Design Reviews and one Final Design Review were held in March. The controls FDR for the ESM EPU57 contract with Kyma was held early in the month. Controls will be ready for testing at the end of July 2015. Kyma will develop the low level controls (Delta Tau programming, tuning of the servo motors, etc.) while Cosylab is responsible for the EPICS layer, as a sub-contract. During the PDR for the two long EPUs held with Kyma in mid-March, FEA analyses of the main mechanical components were carefully reviewed. Results of magnetic field profile computations were also presented in order to complete the magnetic design.

The PDR for the NEXT EPU vacuum chamber contract was held with FMB Berlin in the last week of March. This contract includes the delivery of two NEG-coated narrow gap vacuum chambers, taper boxes, supports, and the flat wires (current strips). The PDR review focused mainly on the mechanical design, as some of the parts have a long fabrication time. The flat wires system will be carefully reviewed at the FDR scheduled for April.

PROJECT MILESTONES

Milestone	Planned	Actual
CD-0 (Mission Need):	May 27, 2010	May 27, 2010
CD-1 (Alternative Selection):	Dec. 19, 2011	Dec. 19, 2011
CD-2 (Performance Baseline):	Oct. 9, 2013	Oct. 9, 2013
CD-3A (Long Lead Procurement):	Oct. 9, 2013	Oct. 9, 2013
CD-3 (Start Construction):	Mar. 31, 2014	Jul. 7, 2014
Internal Early Project Completion – Beamlines	Sept. 30, 2016	
Early Project Completion:	Jan. 31, 2017	
CD-4 (Project Completion):	Sept. 29, 2017	

UPCOMING EVENTS

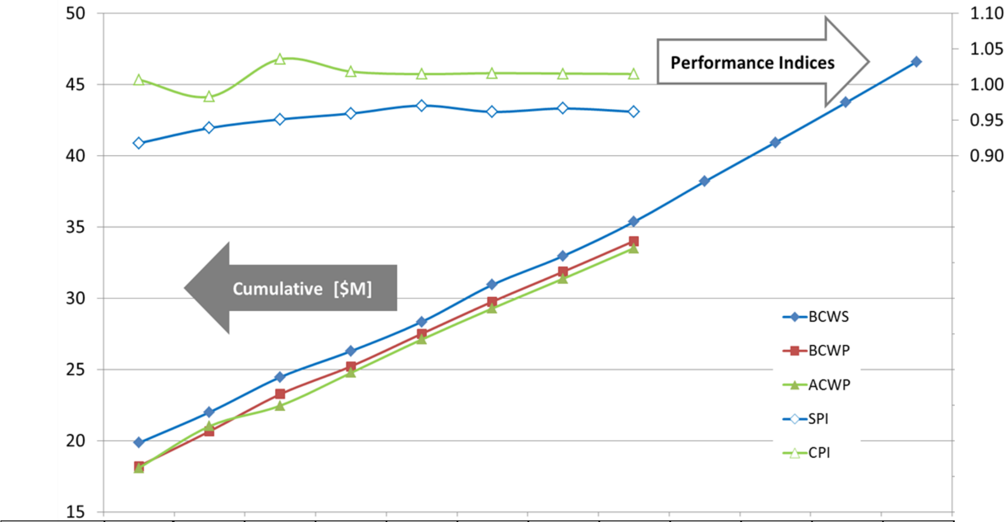
DOE/OPA Mini-Review	April 17, 2015
BNL EVMS surveillance review	June 29 – July 1, 2015

Acronyms and Abbreviations

ABBIX	Advanced Beamlines for Biological Investigations with X-rays
ACWP	Actual Cost of Work Performed
APP	Advanced Procurement Plan
ARPES	Angle-Resolved Photo-Electron Spectroscopy
BAC	Budget at Completion
BAT	Beamline Advisory Team
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BNL	Brookhaven National Laboratory
CAM	Cost Account Manager
CCD	Charge-Coupled Device
CD	Critical Decision
CPI	Cost Performance Index
CRL	Compound Refractive Lens
CSX	Coherent Soft X-ray
CV	Cost Variance
DCM	Double Crystal Monochromator
DHRM	Double Harmonic Rejection Mirror
DOE	Department of Energy
DPP	Dual Phase Plate
EAC	Estimate at Completion
EPS	Equipment Protection System
EPU	Elliptically Polarizing Undulator
ESM	Electron Spectro-Microscopy beamline
EVMS	Earned Value Management System
FBO	Federal Business Opportunities
FDR	Final Design Review
FE	Front Ends
FEA	Finite Element Analysis
FOE	First Optics Enclosure
FPGA	Field Programmable Gate Array
FTE	Full Time Equivalent
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
ID	Insertion Device
ISR	Integrated In-Situ and Resonant X-ray Studies
ISS	Inner Shell Spectroscopy beamline
KB	Kirkpatrick-Baez
M&S	Material & Supplies
NEXT	NSLS-II Experimental Tools project
NSLS-II	National Synchrotron Light Source ll
OPA	Office of Project Assessment
OPC	Other Project Costs
PCR	Project Change Request
PDR	Preliminary Design Report
PGM	Plane Grating Monochromator
PLCs	Programmable Logic Controllers
PMB	Performance Management Baseline
PPM	Procurement and Property Management
PPS	Personnel Protection System
RFQ	Request for Quote
RGA	Residual Gas Analyzer
SGB	Secondary Gas Bremsstrahlung
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
WBS	Work Breakdown Structure
XES	X-ray Emission Spectrometer

COST AND SCHEDULE STATUS

Cost and schedule progress is being tracked using an Earned Value Management System (EVMS) against the cost and schedule baseline established on October 1, 2013. All baseline changes are being controlled through the NEXT Change Control Board. Cost and schedule revisions are being managed using Project Change Control procedures.



Cum $M	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15
BCWS	19.9	22.0	24.5	26.3	28.4	31.0	33.0	35.4	38.2	40.9	43.7	46.6
BCWP	18.2	20.7	23.3	25.2	27.5	29.8	31.9	34.0				
ACWP	18.1	21.0	22.5	24.8	27.1	29.3	31.4	33.5				
SPI	0.92	0.94	0.95	0.96	0.97	0.96	0.97	0.96				
CPI	1.01	0.98	1.04	1.02	1.01	1.02	1.02	1.01				

The NEXT project Schedule Variance (SV) for March 2015 is -$244K, with an associated monthly Schedule Performance Index (SPI) of 0.90 (green status). The cumulative SPI is 0.96 (green status), 0.01 lower than in February 2015. The negative current month schedule variance is the net result of a number of contributors, both positive and negative: -$105K in WBS 2.03 (Common Systems) resulting from slower-than-planned progress installing conduit for PPS systems in March, -$68K in WBS 2.04 (Control Systems) resulting from delays in delivery of control system hardware, +$83K in WBS 2.08 (ISS Beamline) for greater-than-planned progress in photon delivery system fabrication and data acquisition system procurement, as well as smaller magnitude schedule variances in the other Level 2 WBS areas.

The NEXT project Cost Variance (CV) for March 2015 is +$11K, with an associated monthly Cost Performance Index (CPI) of 1.01 (green status). The current-period cost variances will vary from month to month depending on the number, magnitude, and timing of accruals and payments. The cumulative CPI is 1.01 (green status).

As of March 31 2015, the project is 41.9% complete with 18.8% contingency ($8.9M) for $47.1M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through March 2015.

The project EAC for March is reported at $81,961K against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $81,150K. The Variance At Completion (VAC = BAC - EAC) of -$811K represents the sum of contributors to EAC which have not been added to baseline via PCRs. The major contributors to VAC at the end of March include: -$0.4M in WBS 2.01.02 (Project Support) for estimated overruns in this account, -$0.3M in common systems for estimated overruns in WBS 2.03.01 (Utilities) and additional required EPS hardware in WBS 2.03.03, and -$0.1M in WBS 2.08 (ISS Beamline) for upcoming procurement awards.

The contingency ($8.9M) is 18.5% of $47.9M EAC work remaining.

2 PCRs were approved and implemented in March.

PCR	PCR Level	Baseline Change [$]	Description
PCR-15-081	L3	82,501	ISS: APP032 and APP 037 Contract Amendments, APP038 Award
PCR-15-078	L3	951,779	ESM/SIX APP Contract Awards

Forthcoming PCRs include:

A Level 3 PCR (NEXT_15_070) in WBS 2.03.04 (Common Systems Control Stations) for procurement refinements,

two Level 3 PCRs in WBS 2.03.01 (Common Systems Utilities), one for an amendment to the LN2 piping contract (NEXT_15_080) and the other for additional equipment racks for SIX (NEXT_15_083), and a Level 3 PCR (NEXT_15_082) in WBS 2.07.02 (ISR Beamline Systems) for award of the instrumented six-circle diffractometer.

NEXT as of 3/31/2015	Current Period	Cum-to-Date
Plan (BCWS) $K	2,395	35,369
Earned (BCWP) $K	2,151	34,022
Actual (ACWP) $K	2,140	33,521
SV $K	-244	-1,347
CV $K	11	501
SPI	0.90	0.96
CPI	1.01	1.01
Budget at Completion $K (PMB [UB])		81,150
Planned % Complete (BCWS/BAC)		43.6%
Earned % Complete (BCWP/BAC)		41.9%
Contingency $K		8,850
Contingency / (BAC – BCWP)		18.8%
EAC $K		81,961
Contingency / (EAC – BCWP)		18.5%
(Contingency + VAC) / (EAC – BCWP)		16.8%
TPC = PMB + Contingency		90,000

SPI Project to Date*:

0.96

CPI Project to Date*:

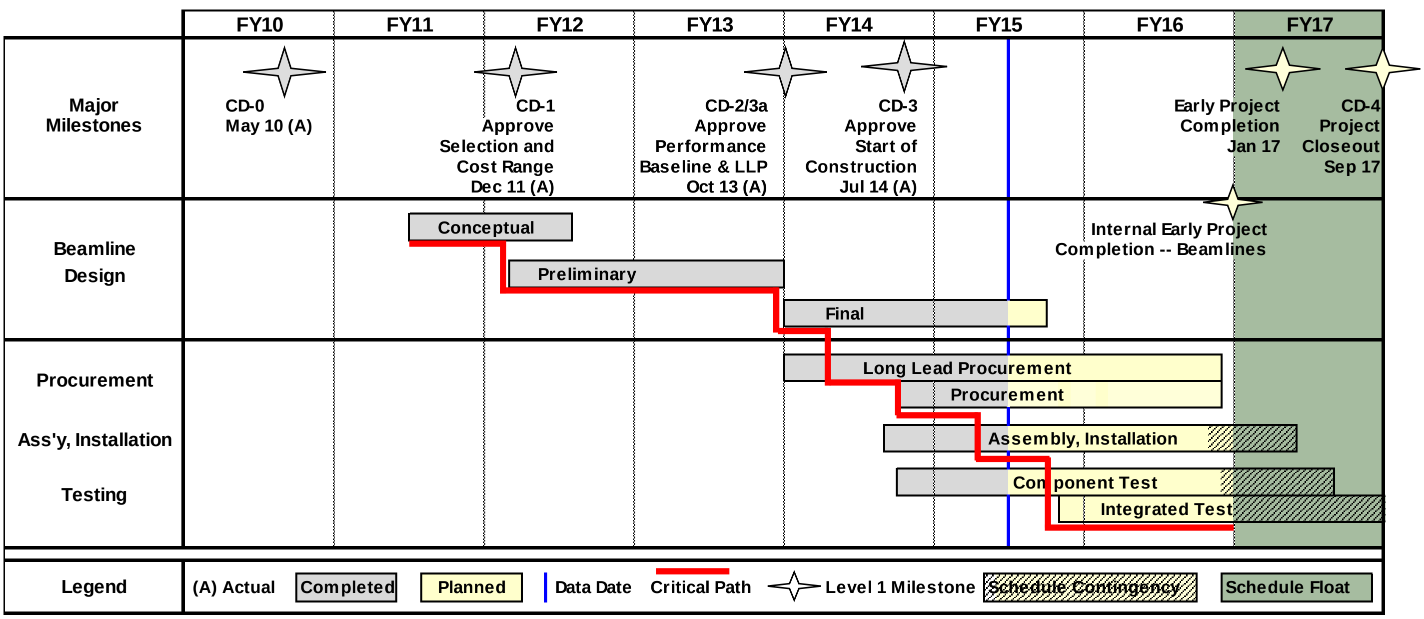
1.01

**Cause & Impact:* No reportable variance

Corrective Action: None required

Milestones – Near Term		Planned	Actual	Notes
L2,L3	Receive ISS Gas Handling System	17-Mar-15		Expect May
L3	SIX – Award Spectrometer Grating Chamber	17-Mar-15	4-Feb-15	
L3	ISS – Award XES Spectrometer	21-May-15		Expect May/June

PROJECT SCHEDULE



The project critical path runs through activities in WBS 2.10 (SMI beamline). As of March 2015, the active critical path activity is specification, procurement, design, fabrication, delivery, installation, and testing of the SMI Double Crystal Deflector MI, which delivers the SMI x-ray beam of varying energy to a fixed point on the surface of liquid samples in the liquids endstation (SMI ES1).

Staffing Report

Staffing as of 3/31/2015	Current Period		Cumulative-to-Date	
	Planned (FTE-yr)	Actual (FTE-yr)	Planned (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	0.77	0.90	23.57	24.31
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	1.35	0.57 *	11.88	3.48 *
WBS 2.04 Control System	0.68	0.50	9.95	7.88
WBS 2.05 ESM Beamline	0.41	0.38	7.91	8.19
WBS 2.06 FXI Beamline	0.06	0.03	4.61	4.27
WBS 2.07 ISR Beamline	0.26	0.31	7.89	8.00
WBS 2.08 ISS Beamline	0.28	0.37	7.66	8.17
WBS 2.09 SIX Beamline	0.34	0.38	11.98	12.14
WBS 2.10 SMI Beamline	0.21	0.28	7.76	7.92
WBS 2.11 Insertion Devices	0.12	0.12	2.18	1.49
WBS 2.12 ID & FE Installation	0.43	0.42	0.59	1.16
Total	**4.91**	**4.26**	**104.74**	**95.75**

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

Number of individuals who worked on NEXT during March 2015: 111

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

Thousands of $ | FORM APPROVED | OMB No. 0704-0188

1. CONTRACTOR	2. CONTRACT	3. PROGRAM	4. REPORT PERIOD
a. NAME Brookhaven National Laboratory	a. NAME	a. NAME March 2015 NEXT Project	a. FROM (YYYYMMDD) 2015 / 03 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER	b. PHASE	b. TO (YYYYMMDD) 2015 / 03 / 31
	c. TYPE / d. SHARE RATIO	c. EVMS ACCEPTANCE X YES	

WBS (2) Control Account ITEM (1)	CURRENT PERIOD Budgeted Cost Work Scheduled (2)	Budgeted Cost Work Performed (3)	Actual Cost Work Performed (4)	Variance Schedule (5)	Variance Cost (6)	CUMULATIVE TO DATE Budgeted Cost Work Scheduled (7)	Budgeted Cost Work Performed (8)	Actual Cost Work Performed (9)	Variance Schedule (10)	Variance Cost (11)	AT COMPLETION Budgeted (14)	Estimated (15)	Variance (16)
2.01 Project Management and Support	189,680	189,680	210,888	0	-21,209	5,989,599	5,989,599	6,338,419	0	-348,820	9,792,909	10,181,909	-389,000
2.01.01 Project Management	78,173	78,173	54,410	0	23,764	2,933,438	2,933,438	2,847,770	0	85,668	4,657,379	4,657,379	0
2.01.02 Project Support	111,506	111,506	156,479	0	-44,973	3,056,161	3,056,161	3,490,649	0	-434,488	5,135,530	5,524,530	-389,000
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	345,001	240,078	395,442	-104,923	-155,364	3,762,251	3,159,623	3,952,819	-602,628	-793,196	6,131,166	6,443,836	-312,669
2.03.01 Utilities	248,516	151,984	264,807	-96,532	-112,823	2,835,246	2,256,864	2,806,624	-578,382	-549,760	3,458,105	3,560,105	-102,000
2.03.02 Personnel Protection System (PPS)	34,939	65,316	93,743	30,377	-28,427	341,832	410,462	635,959	68,630	-225,498	1,323,218	1,364,818	-41,600
2.03.03 Equipment Protection System (EPS)	47,672	13,881	18,334	-33,791	-4,453	226,547	150,497	93,707	-76,049	56,790	594,451	747,251	-152,800
2.03.04 Control Station	4,977	0	641	-4,977	-641	16,827	0	16,587	-16,827	-16,587	278,704	294,973	-16,269
2.03.05 Common Beamline Systems Management	8,897	8,897	17,918	0	-9,021	341,800	341,800	399,941	0	-58,141	476,689	476,689	0
2.04 Control System	158,895	90,458	94,466	-68,437	-4,008	2,584,912	2,289,643	2,328,059	-295,269	-38,416	4,538,849	4,538,849	0
2.04.01 Control System Management	6,494	6,494	2,092	0	4,402	183,293	183,293	131,403	0	51,889	294,427	294,427	0
2.04.02 Control System Design & Implementation	101,509	83,964	92,374	-17,545	-8,410	1,469,171	1,216,690	1,368,293	-252,481	-151,603	2,912,234	2,912,234	0
2.04.03 Control System Equipment	50,893	0	0	-50,893	0	932,448	889,661	828,362	-42,787	61,298	1,332,188	1,332,188	0
2.05 ESM Beamline	296,223	255,234	209,182	-40,989	46,053	4,591,296	4,610,466	4,009,709	19,169	600,757	9,130,823	9,130,822	0
2.05.01 ESM Management	10,986	10,986	7,674	0	3,311	366,466	366,466	364,968	0	1,498	692,100	692,100	0
2.05.02 ESM Beamline Systems	285,237	244,249	201,507	-40,989	42,741	4,224,831	4,244,000	3,644,741	19,169	599,259	8,438,722	8,438,722	0
2.06 FXI Beamline	52,857	72,819	8,831	19,963	63,989	1,323,132	1,490,161	973,929	167,029	516,232	1,818,324	1,818,324	0
2.06.01 FXI Management	15,606	15,606	8,420	0	7,186	409,359	409,359	430,944	0	-21,584	409,359	409,359	0
2.06.02 FXI Beamline Systems	37,250	57,213	411	19,963	56,802	913,773	1,080,801	542,985	167,029	537,816	1,408,965	1,408,965	0
2.07 ISR Beamline	300,924	245,750	286,736	-55,174	-40,986	2,385,215	2,243,026	2,380,488	-142,189	-137,462	10,347,185	10,331,938	15,247
2.07.01 ISR Management	26,293	26,293	18,546	0	7,748	601,333	601,333	601,367	0	-34	1,076,573	1,076,573	0
2.07.02 ISR Beamline Systems	274,631	219,457	268,190	-55,174	-48,733	1,783,882	1,641,693	1,779,121	-142,189	-137,428	9,270,612	9,255,365	15,247
2.08 ISS Beamline	401,552	484,738	371,384	83,186	113,354	4,585,955	4,400,028	4,153,157	-185,927	246,871	9,824,531	9,945,382	-120,851
2.08.01 ISS Management	19,008	19,008	23,898	0	-4,890	426,823	426,823	425,848	0	975	838,199	838,199	0
2.08.02 ISS Beamline Systems	382,544	465,731	347,486	83,186	118,244	4,159,132	3,973,205	3,727,309	-185,927	245,896	8,986,332	9,107,183	-120,851
2.09 SIX Beamline	305,684	294,672	298,327	-11,011	-3,655	4,138,114	3,988,269	3,875,612	-149,844	112,657	12,231,759	12,231,758	0
2.09.01 SIX Management	17,991	17,991	19,701	0	-1,710	375,361	375,361	354,806	0	20,555	845,551	845,551	0
2.09.02 SIX Beamline Systems	287,693	276,682	278,626	-11,011	-1,944	3,762,753	3,612,908	3,520,806	-149,844	92,102	11,386,207	11,386,207	0
2.10 SMI Beamline	82,952	55,287	124,331	-27,665	-69,044	3,029,816	2,962,087	3,083,025	-67,729	-120,938	9,729,726	9,733,763	-4,038
2.10.01 SMI Management	23,516	23,516	10,988	0	12,528	447,273	447,273	408,697	0	38,576	918,583	918,583	0
2.10.02 SMI Beamline Systems	59,436	31,771	113,343	-27,665	-81,572	2,582,542	2,514,814	2,674,327	-67,729	-159,514	8,811,142	8,815,180	-4,038
2.11 Insertion Devices	192,643	170,157	19,996	-22,486	150,162	1,073,538	966,154	366,682	-107,384	599,472	4,779,614	4,779,613	0
2.11.01 ESM EPU Insertion Device	190,066	167,580	18,530	-22,486	149,050	911,820	804,436	272,113	-107,384	532,323	4,562,016	4,562,016	0
2.11.02 SIX EPU Insertion Device	0	0	0	0	0	117,137	117,137	70,375	0	46,762	117,137	117,137	0
2.11.03 Insertion Devices Management	2,577	2,577	1,466	0	1,112	44,581	44,581	24,195	0	20,387	100,460	100,460	0
2.12 ID & FE Installation & Testing	68,371	52,012	120,174	-16,359	-68,162	97,824	115,776	252,228	17,952	-136,452	1,017,782	1,017,781	0
2.12.01 ID & FE Installation & Testing Management	2,704	2,704	1,077	0	1,627	5,162	5,162	2,612	0	2,550	31,153	31,153	0
2.12.02 ID Installation & Testing	29,694	9,684	41,479	-20,010	-31,795	56,689	31,617	102,010	-25,072	-70,393	423,921	423,921	0
2.12.03 FE Installation & Testing	35,973	39,624	77,618	3,651	-37,994	35,973	78,996	147,606	43,023	-68,610	562,708	562,708	0
Total Project Baseline	2,394,782	2,150,887	2,139,757	-243,896	11,130	35,368,967	34,022,148	33,521,442	-1,346,820	500,705	81,149,982	81,961,293	-811,311
Undistributed Budget													
Management Reserve													
Performance Management Baseline - PMB	**2,394,782**	**2,150,887**	**2,139,757**	**-243,896**	**11,130**	**35,368,967**	**34,022,148**	**33,521,442**	**-1,346,820**	**500,705**	**81,149,982**	**81,961,293**	**-811,311**