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PROJECT EXECUTION PLAN
FOR THE
NSLS-II EXPERIMENTAL TOOLS (NEXT) PROJECT

April 2017

NSLSII-NX-PLN-003

Project # MIE-SC-12-NEXT

Brookhaven National Laboratory
Upton, N.Y.

Office of Basic Energy Sciences
Office of Science
U.S. Department of Energy

Administrative Update of August 2016 PEP
to reflect
NEXT Project Completion

PROJECT EXECUTION PLAN
FOR THE
NSLS-II EXPERIMENTAL TOOLS (NEXT) PROJECT

APRIL 2017

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5/9/2017

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5/9/2017

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By approving this plan I acknowledge the requirements set forth herein and agree with its implementation.

Project Execution Plan for the NSLS-II Experimental Tools (NEXT) Project at Brookhaven National Laboratory

Revision History Log

Revision	Date	Summary of Change
0	December 2011	Release of the document
1	June 2012	Preliminary PEP updated to PEP for CD-2 Review
2	June 2013	Final update for baseline scope and milestones
3	September 2013	Updated per CD-2 OPA review recommendations
4	March 2014	Updated per CD-3 OPA review recommendations
5	August 2016	Update to reflect changes since previous version. Document number and format changed to reflect NSLS-II naming standard NSLSII-DPT-PDN-001 (previously NX-C-PRJ-PLN-001)
6	April 2017	Administrative updates

NSLS-II EXPERIMENTAL TOOLS
PROJECT EXECUTION PLAN

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Signatures shown are for the March 2014 version of the PEP. Changes in 2016 and 2017 are administrative, so no further approvals were sought.

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ACRONYMS IN USE

AE	Acquisition Executive
ALD	Associate Laboratory Director
ANSI	American National Standards Institute
BCP	Baseline Change Proposal
BES	Basic Energy Sciences
BESAC	Basic Energy Sciences Advisory Committee
BHSO	Brookhaven Site Office
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CCB	Change Control Board
CD	Critical Decision
CR	Continuing Resolution
DOE	Department of Energy
DOE-HQ	DOE-Headquarters
EA	Environmental Assessment
EIS	Environmental Impact Statement
ES&H	Environment, Safety and Health
ESM	Electron SpectroMicroscopy
EVMS	Earned Value Management System
FONSI	Finding of No Significant Impact
FPD	Federal Project Director
FY	Fiscal Year
FXI	Full-field X-ray Imaging
IPR	Independent Project Review
IPT	Integrated Project Team
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
ISR	Integrated In-Situ and Resonant X-Ray Studies
ISS	Inner Shell Spectroscopy
IRR	Instrument Readiness Review
KPP	Key Performance Parameters
LCC	Lifecycle Costs
LEED	Leadership in Energy and Environmental Design
M&O	Management and Operating
MIE	Major Item of Equipment
NEPA	National Environmental Policy Act
NEXT	NSLS-II Experimental Tools
NSLS	National Synchrotron Light Source
NSLS-II	National Synchrotron Light Source II
OSHA	Occupational Safety and Health Administration
OPA	Office of Project Assessment
OPC	Other Project Costs
ORPS	Occurrence Reporting and Processing Systems
PARS II	Project Assessment and Reporting System II
PCR	Project Change Request
PEP	Project Execution Plan
PS	Photon Sciences
QA	Quality Assurance
SAC	Science Advisory Committee
SBMS	Standards-Based Management System
SC	Office of Science
SIX	Soft Inelastic X-ray Scattering
SMI	Soft Matter Interfaces
TEC	Total Estimated Cost
TPC	Total Project Cost
TXM	Transmission X-ray Microscope
VE	Value Engineering
VUV	Vacuum Ultraviolet
WBS	Work Breakdown Structure
XANES	X-ray Absorption Near Edge Spectroscopy
XAS	X-ray Absorption Spectroscopy
XES	X-ray Emission Spectroscopy

NSLS-II EXPERIMENTAL TOOLS PROJECT EXECUTION PLAN

1 INTRODUCTION

This Project Execution Plan (PEP) describes the management and project execution processes that were used to ensure that the NSLS-II Experimental Tools (NEXT) Project scope was completed on time and within budget. The PEP defines the project scope, describes the organizational framework and overall management systems for the project, and identifies roles and responsibilities of the project participants. It also describes the formal change control process by which the project scope, cost, and schedule may be revised.

Revisions to the PEP were processed and approved by the NEXT Federal Project Director in concurrence with the NEXT Program Manager. Administrative updates of this PEP to reflect actual budgets, approved baseline change proposals, and/or to incorporate other minor changes are included as required.

1.1 Project Background

The National Synchrotron Light Source II (NSLS-II) is a highly optimized, third-generation synchrotron facility that enables the study of material properties and functions, particularly materials at the nanoscale, at a level of detail and precision never before possible. The NSLS-II accelerator and its insertion devices provide world-leading brightness and flux as well as exceptional beam stability over a broad range of photon energies from infrared to hard x-rays. NSLS-II is designed to house at least 58 beamlines. These experimental facilities, once built-out and operational, will support a large user program that carries out research in such diverse fields as materials science, chemistry, environmental science, physics, biology, and medicine.

The NSLS-II project, which started construction in 2009 and was completed in 2015, provided design, construction, and installation of the accelerator hardware and civil construction of facilities including offices and laboratories required to produce a new synchrotron light source. It included a third generation storage ring, injector, experimental areas, and appropriate support equipment, all housed in a new building. The NSLS-II project scope also provided an initial suite of six “best-in-class” beamlines.

Beyond the initial suite of six NSLS-II project beamlines, the Department of Energy approved Critical Decision 0 (CD-0) *“Approve Mission Need”* for the NEXT project in May 2010. The project received CD-1 *“Approve Alternative Selection and Cost Range”* approval on December 19, 2011, CD-2/3a *“Approve Performance Baseline and Long Lead Procurement”* on October 9, 2013, and CD-3 “Approve Start of Construction” on July 7, 2014. The NEXT project has designed six and constructed five insertion device beamlines at NSLS-II by 2017.

1.2 Justification of Mission Need

The mission of the Department of Energy’s (DOE) Office of Science (SC) is “To advance basic research and the instruments of science that are the foundations for DOE’s applied missions, a base for U.S. technology innovation, and a source for remarkable insights into our physical and biological world, and the nature of matter and energy.” Within SC, the Office of Basic Energy Sciences (BES) program’s responsibilities include planning, constructing, and operating major scientific user facilities to serve researchers from universities, federal laboratories, and industry.

The mission of the Basic Energy Sciences (BES) program within the DOE Office of Science is to foster and support fundamental research to expand the scientific foundations for new and improved energy technologies, and for understanding and mitigating the environmental impacts of energy use. As part of this mission, the BES program plans, constructs, upgrades, and operates major scientific user facilities to serve researchers at universities, national laboratories, and industrial laboratories, a role formally recognized by Congress in the Energy Policy Act of 1992. Under BES leadership, these facilities have flourished and have become one of the great success stories in the Department of Energy over the past 20 years.

Over the past decade, BES research needs have been defined and documented by the scientific community in ten "*Basic Research Needs"* Workshop Reports in the areas of the hydrogen economy; solar energy utilization; superconductivity; solid state lighting; advanced nuclear energy systems; combustion of 21st century transportation fuels; electrical-energy storage; geosciences as it relates to the storage of energy wastes (the long-term storage of both nuclear waste and carbon dioxide); materials under extreme environments; and catalysis for energy applications. These were followed by several reports by the Basic Energy Sciences Advisory Committee (BESAC) on *"Directing Matter and Energy: Five Challenges for Science and the Imagination," "Science for Energy Technology: Strengthening the Link between Basic Research and Industry,"* and "*New Science for a Secure and Sustainable Energy Future,"* which summarized the magnitude of the challenges in the realm of energy and environment facing the U.S and emphasized the importance of fundamental science to finding transformational solutions. Collectively, these reports underscore the need to develop new tools that will allow the characterization of the atomic and electronic structure, the chemical composition, and the magnetic properties of materials with nanoscale resolution.

The objective of the NEXT project was to provide NSLS-II with five additional "best-in-class" beamlines, and the design and engineering for a sixth that will deliver advanced experimental capabilities complementary to those provided by the six NSLS-II Project beamlines. Developing these beamlines has enhanced the ability of the NSLS-II facility to enable scientific breakthroughs needed to achieve a secure and sustainable energy future. They support the urgent needs identified by the U.S. research community for responding to the DOE mission of achieving transformational energy solutions in the near-term while concurrently expanding our knowledge of fundamental energy science. The NEXT project will provide additional user capacity in the early years of NSLS-II operations supporting a wide range of research programs. The NEXT beamlines will support about 300 to 400 users per year.

2 PROJECT BASELINE

This section describes the project Performance Baseline, which consists of the scope, total project cost (TPC), schedule (CD-4 date), work breakdown structure, and funding profile.

2.1 Scope Baseline

The scope of the NEXT project was to develop and fabricate five insertion device beamlines for NSLS-II by carrying out the design, engineering, fabrication/procurement, assembly, and installation of the beamlines onto the NSLS-II experimental floor, followed by standalone integrated testing of installed hardware and equipment. The project scope also includes the design and engineering of the FXI, Full-field X-ray Imaging beamline.

The baseline plan assumes the funding profile shown in Table 2.8.

The beamlines contained in the NEXT Major Item of Equipment (MIE) project and their capabilities are described briefly below. Refer to the NEXT Beamline Design Parameters and Scope table in Appendix C

for a listing of calculated design values for the energy range, energy resolution, spot size, and flux for the NEXT beamlines, branches, and endstations.

ESM, Electron SpectroMicroscopy, is an elliptically polarized undulator-based high-resolution, high-flux, wide-energy range, micro-focused VUV/soft x-ray beamline designed to provide high-quality monochromatic radiation to two electron microscopes for 1) in-situ growth and structural, electronic, and chemical characterization of material surfaces at the nanometer scale (XPEEM) and 2) ultra-high energy- and angle-resolved photoemission studies of materials in ultra-high vacuum conditions (μ-ARPES). The combination of full field (XPEEM) and scanning (μ-ARPES) microscopies is a unique feature of ESM that will advance our understanding of material properties, both physical and chemical, to unprecedented levels. The ESM scientific program directly addresses three of the five DOE BES Grand Scientific Challenges: 1) controlling material processes at the electronic level; 2) designing synthesis of revolutionary new materials with tailored properties; and 3) understanding and controlling the emerging phenomena and the non-equilibrium processes and mastering energy and information on the nanoscale. Additionally ESM can be expected to play a pivotal role in meeting the specific Grand Challenges in Science and Energy set by BES for Next Generation Photon Sources.

The threshold scope configuration of ESM consists of the Wide Energy Line photon delivery system branch (15–2000 eV energy range, $\geq 10^{-5}$ calculated energy resolution) and the μ-ARPES endstation (1×1 μm^2 calculated minimum spot size, $\geq 1\times10^{10}$ photons/sec measured flux).

ISR, Integrated In-Situ and Resonant X-Ray Studies, is an in-vacuum undulator-based x-ray scattering beamline covering the 2.4–23 keV energy range that enables the *in-situ* study of materials in a flexible range of environment chambers. Specialized optics provide polarization control and microfocusing with a greater than 1 meter working distance from the focusing optic. The broad range of capabilities address DOE BES mission priorities by enabling fundamental research in materials synthesis and processing, structure-property relationships in complex materials, and materials response to external stimuli such as high magnetic field.

The threshold scope configuration of ISR consists of the inboard photon delivery system branch (2.4–23 keV energy range, 1.3×10^{-4} calculated energy resolution) and the Magnet/6-circle endstation (variable calculated spot size down to 50×300 μm^2 (V × H) spot size, $>2\times10^{11}$ photons/sec measured flux at 10 keV).

ISS, Inner Shell Spectroscopy, is a damping-wiggler-based, hard x-ray beamline devoted to inner-shell spectroscopy and serving a very broad user community, including energy science, life and environmental science, materials science, industrial applications, and more. The exceptional flux provided by an NSLS-II damping wiggler enables science which greatly expands the capabilities at existing spectroscopy beamlines. This includes 1) measurement of X-ray Absorption Spectroscopy (XAS) at ultra-low absorber concentration or sample volume, including systems of environmental, technological, or other relevance, 2) high-resolution fluorescence detection for all XANES measurements, and 3) X-ray Emission Spectroscopy (XES). All ISS detectors and spectrometers were designed to accommodate various in-situ sample environments, thus allowing for real measurements of real materials under real conditions. Taken together, this suite of spectroscopies will be able to provide a complete picture of inner-shell electronic structure and apply them to a broad, cross-disciplinary scientific mission, thereby supporting the DOE mission to enable transformative science and technology solutions in the energy and environmental area.

The threshold scope configuration of ISS consists of its photon delivery system (4.9–36 keV energy range, 1.3×10^{-4} calculated energy resolution) and endstation (calculated spot size down to 25×25 μm^2 (V × H), $>2\times10^{12}$ photons/sec measured flux over the 4.9–25 keV energy range).

SIX, Soft Inelastic X-ray Scattering, is an elliptically polarized undulator-based inelastic scattering beamline that provides world-leading energy and wavevector (**q**) resolution for research addressing key energy related challenges and fundamental condensed matter physics. The beamline delivers high brightness polarized photons to an endstation located on a long beamline equipped with an ultrahigh resolution spectrometer (10 meV design resolution) and continuously variable momentum transfer. This energy resolution better than anything in operation today in the soft x-ray energy range, covering important elemental absorption edges that are particularly sensitive to magnetic and orbital excitations. It can potentially revolutionize studies in condensed matter excitations including correlated electron materials and superconductors, energy storage, environmental science, and catalysis at ambient pressures. This offers the prospect of major steps forward in addressing forefront energy-related questions pertaining to the DOE Mission Need. Specifically, the SIX beamline scientific program addresses questions related to technological improvements in energy sources (clean, renewable) and usage (storage, transmission), as well as in nuclear safety. In order for the emission spectrometer optics to achieve this ultimate resolution, the ultrahigh resolution endstation and its very large emission spectrometer are located in a satellite building outside the NSLS-II experimental hall.

The threshold scope configuration of SIX consists of its photon delivery system (165–2300 eV energy range, $\geq 10^{-5}$ calculated energy resolution) and the soft RIXS endstation, featuring a high-resolution 15m-radius emission spectrometer ($0.3 \times 2.5\ \mu m^2$ calculated spot size, $\geq 1.5\times 10^{10}$ photons/sec measured flux).

SMI, Soft Matter Interfaces, is an in-vacuum undulator based x-ray scattering beamline operating from 2.05–24 keV, dedicated to structural studies of interfaces in soft and bio materials. It provides micron-sized beams to address solid-vapor, solid-liquid, liquid-liquid, and liquid-vapor interfaces, using small- and wide-angle scattering and reflectivity geometries, to probe molecular self-assembly and shed new light on structure-function relationships from sub-nanometer to micron length scales. The beamline's world-class capabilities for fast reflectivity and time resolved scattering, mapping, and visualization can shed new light on the behaviors of polymers, gels, liquid crystals, granular materials, biomolecular materials, and micro/nano-fluidics systems. These capabilities are fundamental to the DOE/BES mission to design, model, assemble, and characterize new organic devices, biomimetic materials, and nanoscale composites, for applications in energy transfer and other functional materials.

The threshold scope configuration of SMI consists of the inboard photon delivery system branch (2.05–24 keV energy range, 1.3×10^{-4} calculated energy resolution) and the GISAXS endstation (variable calculated spot size from $90 \times 200\ \mu m^2$ down to $1 \times 5\ \mu m^2$ (V × H), $\geq 10^{12}$ photons/sec measured flux).

Insertion Devices: The project scope includes fabrication (procurement), assembly, and testing of three insertion devices that match the source needs of the ESM and SIX beamlines. All are elliptically polarized undulators (EPUs) of the Apple-II type, with period lengths (105 mm and 57 mm for ESM and 57 mm for SIX) selected to match the photon energy ranges covered by these beamlines.

The project scope also includes the design and engineering of the following beamline:

FXI, Full-field X-ray Imaging, a damping wiggler-based hard x-ray microscopy beamline that will provide a state-of-the-art implementation of a 30 nanometer resolution, high speed transmission x-ray microscope (TXM) for samples demanding the highest resolution. The TXM, purposely designed for X-ray Absorption Near Edge Spectroscopy (XANES) imaging, features a precise metrology system for automated tomography. This will allow nondestructive tracking of 3D morphological and chemical state changes in a broad range of DOE/BES mission disciplines including energy, materials science, and the environment. For example, FXI will enable the tracking of changes in: a) energy storage devices in-operando; b) materials under different environments *in-situ*, and c) flow of fluids through porous media such as rocks.

The threshold scope activities for the FXI beamline consist of the design (conceptual, preliminary, and final) of the photon delivery system (5–11 keV energy range, 1.3×10^{-4} calculated energy resolution) and the TXM endstation (40 μm field of view, 30 nm calculated spatial resolution, and 5×10^{13} photons/sec calculated flux at 10 keV).

The activities associated with fabrication/procurement, assembly, and installation of the FXI beamline were performed by the project to the extent that it experienced favorable cost performance for the baseline scope activities. Construction of the two FXI hutches (18-ID-A and 18-ID-B) was performed by the NEXT Project.

The project scope is defined in the Work Breakdown Structure (WBS) described in section 2.4, Table 2.6. As each beamline listed in the WBS Dictionary was completed and passed the Instrument Readiness Review (IRR), it was transferred over to the NSLS-II Facility Operations organization for acceptance testing and measurement of flux to verify meeting the threshold Key Performance Parameters (KPPs). When the project has delivered, to the NSLS-II Facility Operations organization, sufficient scope to meet the Threshold KPP's as shown in Table 2.1, the project will request approval of CD-4, Approve Project Completion.

Table 2.1 – Key Performance Parameters at Project Completion

Performance Measure	Threshold KPP	Objective KPP
Number of beamlines designed	6	6
Number of beamlines installed and ready for commissioning with x-ray beam	5	6
Number of photon delivery system branches installed and accepted by NSLS-II facility operations	5	6
Number of endstations installed and accepted by NSLS-II facility operations	5	7
Synchrotron flux value measured at an endstation position of ESM*	10^{10} photons/s	10^{11} photons/s
Synchrotron flux value measured at an endstation position of ISR*	2×10^{11} photons/s	2×10^{12} photons/s
Synchrotron flux value measured at an endstation position of ISS*	2×10^{12} photons/s	2×10^{13} photons/s
Synchrotron flux value measured at an endstation position of SIX*	1.5×10^{10} photons/s	1.5×10^{11} photons/s
Synchrotron flux value measured at an endstation position of SMI*	10^{12} photons/s	10^{13} photons/s
On-axis spectral angular intensity** capability at 1 keV for a delivered EPU insertion device	2×10^{17}	8×10^{17}

* Prerequisites for measurement of synchrotron flux: operation of the NSLS-II storage ring at a current > 25 mA with beamline shutter enabled, insertion device and front end installed and operational, with all required safety systems approved and operating. Flux values correspond to NSLS-II ring operation at 500 mA and will be scaled linearly to the actual current value at the time of measurement.

** On-axis spectral angular intensity: photons/sec/0.1% bw/mrad^2 at 500 mA ring current and other ring design parameters, calculated using the measured magnetic field profile of the insertion device.

The Threshold KPPs are the minimum parameters against which the project's performance is measured when complete. At CD-2, the Threshold KPPs comprise the official Project Performance Baseline. The Objective KPPs describe the maximum scope that the project could deliver given favorable cost performance. If the Project maintains excellent performance, with adequate contingency to address remaining risks, the Project may request that contingent scope activities be added to the project baseline consistent with the objective KPPs.

The achievement of the Threshold KPPs is a prerequisite for approval of CD-4, Project Completion. After installation, the Project conducted equipment testing, at the component and system levels, required to confirm that the hardware design performance specifications had been achieved. Successful completion of an Instrument Readiness Review (IRR), conducted jointly by NSLS-II Facility Operations and the NEXT Project, was required for each beamline, after which the beamline was transferred to operations for acceptance testing. Operations oversaw, and funded, the first measurement of synchrotron flux at each beamline. This measurement verified achievement of the associated KPP, for that beamline, and led to formal acceptance of that beamline for operation by the NSLS-II facility. Final project completion (CD-4) will occur when the complete project scope has been formally accepted by and transferred to the NSLS-II facility.

2.2 Cost Baseline

The Total Project Cost (TPC) for the NEXT project is $90.0M. This TPC is shown broken down by Level 2 of the Work Breakdown Structure (WBS) elements in Table 2.2 below.

The cost estimate was prepared by the NEXT project staff based on engineering estimates of similar beamlines being built as a part of the NSLS-II Project as well as actual vendor quotes. Greater than 60% of the material estimate is supported by either vendor catalog prices or quotes. The TPC includes contingency to cover known anticipated risks as well as uncertainties such as refinements in design concepts, improvements in technology, escalation rates, currency exchange rates, market conditions, changes in commodity prices, and other currently unknown or unexpected risks in the overall project.

The confidence in the TPC exists because the NEXT project beamlines costs were developed using a similar method as the six beamlines built as a part of NSLS-II project. In addition to vendor quotes/estimates and bottom-up labor estimates developed by the NEXT project, actual beamline component and system procurement award prices and labor experience from the NSLS-II Project were used to formulate the NEXT project cost estimate.

Table 2.2 – Project Cost Summary: Baseline (CD-2) and Actual (through 31-Mar-2017)

WBS #	WBS Title	Baseline Cost Total $K	Actual Cost Total $K
2.01	Project Management and Support	8,025	9,829
2.03	Common Beamline Systems	4,315	8,520
2.04	Control System	4,450	4,968
2.05	ESM Beamline	7,656	10,184
2.06	FXI Beamline	938	1,793
2.07	ISR Beamline	7,362	10,528
2.08	ISS Beamline	8,789	11,236
2.09	SIX Beamline	11,090	13,711
2.10	SMI Beamline	7,349	9,546
2.11	Insertion Devices	5,117	4,566
2.12	ID & FE Installation & Testing	0	1,453

	Direct TEC	65,092	86,333
	TEC Contingency	21,908	667
	Subtotal TEC	**87,000**	**87,000**
2.01	Project Management and Support	1,177	1,177
2.02	Conceptual Design	1,807	1,807
2.04	Control System	16	16
	Direct OPC	3,000	3,000
	Subtotal OPC	**3,000**	**3,000**
	Total Project Cost (TPC)	**90,000**	**90,000**

NEXT project risks were identified and assessed at the lowest WBS level and at the project level. Experience from the NSLS-II project beamlines was integrated into the risk profile. The mitigation costs for these risks were estimated as a percentage of the WBS element cost. The total value of assessed risk for the NEXT project at baseline, as an element of project contingency, was $21.8M. All contingency is assigned to the project and held by the FPD.

2.3 Schedule Baseline

Project CD-4 date is 4QFY17, which provided approximately 12 months of schedule contingency at baseline. The following Tables list the key schedule milestones.

Table 2.3 – NEXT Project Critical Decision Dates

Critical Decision Dates (Level 1 Milestones)	Schedule
CD-0, Approve Mission Need	5/27/2010 (actual)
CD-1, Approve Alternative Selection and Cost Range	12/19/2011 (actual)
CD-2, Approve Performance Baseline	10/9/2013 (actual)
CD-3a, Approve Long Lead Procurement	10/9/2013 (actual)
CD-3, Start of Construction	7/7/2014 (actual)
CD-4, Approve Project Completion	4QFY17

Table 2.4 – Baseline Level 2 Milestones for the NEXT Project

Level 2 Milestones	Schedule
Start Conceptual Design	4/1/2011 (actual)
Start Preliminary Design	12/19/2011 (actual)
Conceptual Design Complete	9/28/2012 (actual)
Hold 1st Photon Delivery System Design Review	10/21/2013 (actual)
Award 1st EPU Insertion Device Procurement Contract	6/9/2014 (actual)
Hold Final Design Review of SIX Beamline	10/28/2014 (actual)
1st Shielded Enclosure Acceptance Test Completed	10/30/2014 (actual)

Receive ISS Gas Handling System	7/22/2015 (actual)
Receive 1st Soft X-ray Grating	9/16/2015 (actual)
Receive 1st Double Crystal X-ray Monochromator	9/30/2015 (actual)
Complete Installation of 1st Beamline Components	3/30/2016 (actual)
1st Beamline Available for Acceptance Test	4/13/2016 (actual)
Receive EPUs for ESM and SIX	6/15/2016 (actual)
Common Beamline Systems: Mechanical Utilities Installation Complete	8/29/2016 (actual)
Complete Installation of Common Beamline Systems PPS	1/6/2017 (actual)
Early Project Completion – including IRR	4Q FY17

Table 2.5 –Level 3 Milestones for the NEXT Project

Level 3 Milestones	Schedule
Start Beamline Hutch Specifications and SOWs	1/11/2013 (actual)
Approve Initial Long Lead Procurements	4/30/2013 (actual)
Common Beamline Systems: Mechanical Utilities Installed	8/29/2016 (actual)
Common Beamline Systems: Electrical Utilities Installed	3/31/2017 (actual)
Common Beamline Systems: PPS Installed	1/6/2017 (actual)
Common Beamline Systems: EPS Installed	11/30/2016 (actual)
Beamline Control Systems Complete	3/15/2017 (actual)
ESM – Complete Specifications of Shielded Enclosures	2/13/2013 (actual)
ESM – Hold Beamline Final Design Review	10/22/2013 (actual)
ESM – Award Monochromator and Slits Package	4/22/2014 (actual)
ESM – Beamline Control System Design Complete	7/21/2014 (actual)
ESM – Testing Monochromator and Slits complete	4/29/2016 (actual)
ESM – Photon Delivery System Ready for Integration	6/26/2016 (actual)
ESM – Installation of Beamline Components Complete	12/30/2016 (actual)
FXI – Hold Beamline Final Design Review	11/5/2013 (actual)
FXI – Beamline Control System Design Complete	7/23/2014 (actual)
ISR – Complete Specifications of Shielded Enclosures	3/11/2013 (actual)
ISR – Hold Beamline Final Design Review	11/8/2013 (actual)
ISR – Award DCM Monochromator Package	5/9/2014 (actual)
ISR – Beamline Control System Design Complete	9/26/2014 (actual)
ISR – Bench test of Dual Phase Plate Assembly complete	3/4/2016 (actual)
ISR – Installation of DCM Monochromator complete	5/2/2016 (actual)
ISR – Installation of Beamline Components Complete	2/14/2017 (actual)
ISS – Complete Specifications of Shielded Enclosures	2/8/2013 (actual)
ISS – Hold Beamline Final Design Review	11/15/2013 (actual)
ISS – Beamline Control System Design Complete	7/21/2014 (actual)
ISS – Award XES Spectrometer	6/5/2015 (actual)

(Continues…)

Table 2.5 –Level 3 Milestones for the NEXT Project *(concluded)*

ISS – Receive Gas Handling System	7/9/2015 (actual)
ISS – Testing High Heatload Monochromator complete	11/23/2015 (actual)
ISS – Testing Collimating Mirror Pair complete	2/26/2016 (actual)
ISS -- Installation of Beamline Components Complete	3/30/2016 (actual)
SIX – Complete Specifications of Shielded Enclosures	3/11/2013 (actual)
SIX – Award Monochromator and Slits Package	3/21/2014 (actual)
SIX – Beamline Control System Design Complete	7/23/2014 (actual)
SIX – Hold Beamline Final Design Review	7/24/2014 (actual)
SIX – Award Spectrometer Grating Chamber	7/3/2015 (actual)
SIX – Testing of Spectrometer Detector Complete	9/9/2016 (actual)
SIX – Testing Monochromator and Slits complete	10/21/2016 (actual)
SIX – Installation of Beamline Components Complete	5/4/2017
SMI – Complete Specifications of Shielded Enclosures	3/11/2013 (actual)
SMI – Hold Beamline Final Design Review	10/21/2013 (actual)
SMI – Award DCM Monochromator Package	3/13/2014 (actual)
SMI – Beamline Control System Design Complete	7/23/2014 (actual)
SMI – Bench Test of DCM Monochromator Complete	11/30/2015 (actual)
SMI – Installation of CRL Focusing Optics Complete	3/24/2016 (actual)
SMI – Installation of Beamline Components Complete	4/28/2017 (actual)
Insertion Devices – SIX EPU Received	3/2/2016 (actual)
Insertion Devices – ESM EPU Received	6/15/2016 (actual)

2.4 Work Breakdown Structure (WBS)

The Work Breakdown Structure for the NEXT project is shown below (Table 2.6). This WBS contains a complete definition of the project scope and is the basis for planning, executing, and controlling project activities. WBS elements define discrete increments of project scope and the deliverables associated with that scope.

Table 2.6 – NEXT Project WBS Level 1, 2, and 3 Elements

2.01 Project Management and Support	2.01.01 Project Management
	2.01.02 Project Support
2.02 Conceptual Design and Advanced Conceptual Design	2.02.01 Intentionally left blank
	2.02.02 Conceptual Design & Analysis of Photon Delivery Systems
	2.02.03 Conceptual Design of User Instruments
	2.02.04 ESM Advanced Conceptual Design
	2.02.05 FXI Advanced Conceptual Design
	2.02.06 ISR Advanced Conceptual Design
	2.02.07 ISS Advanced Conceptual Design
	2.02.08 SIX Advanced Conceptual Design
	2.02.09 SMI Advanced Conceptual Design
2.03 Common Beamline Systems	2.03.01 Utilities
	2.03.02 Personnel Protection System (PPS)
	2.03.03 Equipment Protection System (EPS)
	2.03.04 Control Station
	2.03.05 Common Beamline Systems Management
2.04 Control System	2.04.01 Control System Management
	2.04.02 Control System Design & Implementation
	2.04.03 Control System Equipment
2.05 ESM Beamline	2.05.01 ESM Management
	2.05.02 ESM Beamline Systems
2.06 FXI Beamline	2.06.01 FXI Management
	2.06.02 FXI Beamline Systems
2.07 ISR Beamline	2.07.01 ISR Management
	2.07.02 ISR Beamline Systems
2.08 ISS Beamline	2.08.01 ISS Management
	2.08.02 ISS Beamline Systems
2.09 SIX Beamline	2.09.01 SIX Management
	2.09.02 SIX Beamline Systems
2.10 SMI Beamline	2.10.01 SMI Management
	2.10.02 SMI Beamline Systems
2.11 Insertion Devices	2.11.01 ESM EPU Insertion Device
	2.11.02 SIX EPU Insertion Device
	2.11.03 Insertion Device Management

2.12 ID & FE Installation & Testing *	2.12.01 ID & FE Installation & Testing Management
	2.12.02 ID Installation & Testing
	2.12.03 FE Installation & Testing

Descriptions of the WBS at Level 2 are given in Table 2.7.
* All scope for WBS 2.12 was removed from NEXT effective Nov. 1, 2015.

Table 2.7 – WBS Description

WBS #	WBS Title	WBS Description
2.01	Project Management Support	Performance of Project Management activities, including labor, materials, travel, and fixed costs associated with the operations of the Project Office, including the offices of the Project Manager; the project support functions; environment, safety, and health activities; quality assurance; configuration management; and document control.
2.02	Conceptual Design & Advanced Conceptual Design	Performance of conceptual design and advanced conceptual design activities to support the delivery of NEXT Project objectives, and management of these activities. The NEXT project will benefit from some of the designs already accomplished as part of the NSLS-II project and other modern SR facilities.
2.03	Common Beamline Systems	Performance of preliminary design, final design, specification, and procurement activities to support the delivery of common beamline components and systems for the NEXT Project beamlines, and management of these activities.
2.04	Control System	Engineering, design, procurement/fabrication, assembly, installation, and testing of beamline and endstation control systems for all NEXT project beamlines. These activities are separated into (i) beamline and endstation control system design and implementation and (ii) beamline and endstation control system equipment.
2.05	ESM Beamline	Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the ESM beamline.
2.06	FXI Beamline	Preliminary and final design of the "Full Field X-ray Imaging with Transmission X-Ray Microscope" (FXI) beamline.
2.07	ISR Beamline	Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the ISR beamline.
2.08	ISS Beamline	Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the ISS beamline.
2.09	SIX Beamline	Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the SIX beamline.
2.10	SMI Beamline	Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (subsystem and integrated) of the SMI beamline.
2.11	Insertion Devices	Fabrication of the EPU insertion devices and ID vacuum chambers for ESM and SIX. Includes effort for procurement oversight and contract management.
2.12	ID/FE Installation	Begin the installation of the front ends & insertion devices for ESM, SIX, ISR, and SMI, and installation of the front end for ISS (the insertion devices for ISS were installed as part of NSLS-II). The completion of the installation after 1-Nov-15 is not be a part of the NEXT project.

2.5 Funding Profile

Table 2.8 shows the funding profile for the NEXT project based on the TPC of $90.0 million.

Table 2.8 – Projected Funding Profile for the NEXT Project

	FY11	FY12	FY13	FY14	FY15	FY16	FY17	Total ($M)
OPC	$3							$3
TEC – Design		$3	$2					$5
TEC – Fabrication		$9	$10	$25.0	$22.5	$15.5	$0	$82
Total Project Cost ($M)	**$3**	**$12**	**$12**	**$25.0**	**$22.5**	**$15.5**	**$0**	**$90**

3 LIFE CYCLE COST

The operational service lifetime of the NEXT beamlines instruments is assumed to be about 15 years in average, and each beamline will cost approximately $2 million[1] annually to operate and maintain. Decommissioning costs are anticipated to be modest (<$1 million per beamline), and will take into account salvage and recycling of components wherever feasible and proper disposal of any contaminated components as waste. Conservatively, the total life cycle cost for the six NEXT beamlines would amount to approximately $313 million, which assumes 3% annual escalation and includes the NEXT Project TPC of $90.0 million.

4 ACQUISITION APPROACH

Acquisition strategies were chosen to obtain the best value based on the assessment of technical and costs risks on a case-by-case basis. For standard, build-to-print fabrications and the purchase of off-the-shelf equipment for routine applications, available purchasing techniques include price competition among technically qualified suppliers and use of competitively awarded blanket purchase agreements. The acquisition approach is described in detail in the NEXT Acquisition Strategy.

5 TAILORING STRATEGY

Because this was a non-complex MIE project similar to the six beamlines being built as a part of the NSLS-II Project, tailoring principles will be applied. The application of the following tailoring approaches should accelerate the project completion and reduce costs. This project plans to use the following tailoring principles:

- A limited number of scope items totaling ~$12.8M have been identified as long-lead procurement items which could be procured before CD-3 to mitigate schedule risk. These items include high heat load optical components ($6.4M), soft x-ray diffraction gratings and monochromators ($2.4M), and EPU insertion devices ($4M), all of which have long delivery times owing to their technical complexity. Early procurement of these items (and others that may be identified later) will mitigate schedule risk associated with long delivery times. The project will request CD-3a approval for these scope items, plus ~15% contingency, prior to or concurrent with CD-2 approval.

[1] This estimate is not a commitment to fund operations of these beamlines at this level.

- In addition to the LLP items above, a limited amount ($1.2M) of "initial" LLP was authorized prior to CD-3a to take advantage of common beamline systems procurements being made by NSLS-II. The project was able to save costs through the joint procurement and, by having these items available for early assembly and installation, has mitigated some schedule risk.
- After component and system testing for each beamline (described in Section 2.1, Scope Baseline) was completed, an Instrument Readiness Review was conducted for that beamline. Following the successful IRR, the beamline was transferred to NSLS-II facility operations for acceptance testing. Operations staffed and funded the first measurements of synchrotron flux at each beamline. This measurement verified the achievement of the associated KPP, for that beamline, and led to formal acceptance of that beamline for operation by the NSLS-II facility. Once accepted by the NSLS-II facility, the beamline is complete with respect to the project. Final project completion (CD-4) occurs when the complete project scope has been formally accepted and transferred to the NSLS-II facility.

6 BASELINE CHANGE CONTROL

As part of CD-0 approval, the Associate Director of Science for Basic Energy Sciences was delegated as the AE responsible for all subsequent CD approvals for the project.

6.1 Approval Levels for Change Control

Change approval Levels 0, 1, 2, and 3 listed in Table 6.1 control the project baseline. Project Change Requests (PCRs) will be approved as necessary to modify the baseline. Any Level 0, 1 and 2 PCRs will be reviewed by the project's Change Control Board (CCB) prior to submittal to DOE for approval. The CCB membership includes the NEXT Project Manager, NEXT Deputy Project Manager, NEXT Configuration & QA Manager, NEXT ES&H Manager, NEXT Project Controls Specialist, and NEXT Senior Business Operations Manager. It also includes the following ex officio members: NSLS-II Deputy Director for Construction, NSLS-II Photon Science Division Director, NSLS-II Director, and the NEXT Federal Project Director.

Level 4 project changes, defined in the NEXT Configuration Management Plan, are of an administrative type.

Table 6.1 Change Approval Levels

	Performance Baseline Deviation	Routine Project Changes		
	Level 0	Level 1	Level 2	Level 3
	Deputy Director for Science	Acquisition Executive (AD for BES)	DOE Federal Project Director*	NEXT Project Manager
Scope	Any change in scope and/or performance that affects the ability to satisfy the mission need or is not in conformance with the current Congressional budget request.	Any change affecting the NEXT project KPPs as defined in PEP Section 2.1.	Major changes affecting the NEXT project technology or approach to Level 2 WBS components as shown in Table 2.6.	Major changes to WBS below Level 2.
Cost	Any increase in the TPC as shown in Table 2.2.	Any increase in the baseline TEC or OPC as shown in Table 2.2.	Cumulative change of ≥ $5M in the performance measurement baseline.**	Cumulative change of ≥ $200K but < $5M in the performance measurement baseline.**
Schedule	Any delay in the original CD-4 date.	Any delay in Level 1 schedule milestone (with the exception of CD-4) > 1 quarter as shown in Table 2.3.	Delay in a Level 2 schedule milestone > 1 quarter as shown in Table 2.4.	Delay in a Level 3 schedule milestone > 1 quarter as shown in Table 2.5.
Funding	Any change to funding profile as shown in Section 2.5 that negatively impacts the performance measurement baseline	.		

* Any contingency usage will require the approval by the FPD or Federal personnel.

** After the cumulative threshold has been reached and the next higher change authority has been notified and has approved the changes, the cumulative cost thresholds will reset.

6.2 Contingency Management

Contingency has been estimated at the lowest WBS level but was held and managed at the project level. Contingency may be allocated to cover the estimated costs associated with identified technical, schedule, and costs risks to the project, as described in Section 8.1 of this document, or to add scope to the project baseline. The use of contingency funds was managed by the NEXT Federal Project Director (FPD). Formal baseline changes were made through the baseline change control process.

The NEXT FPD, with the concurrence of the Associate Director of Science for Basic Energy Sciences, may assign a portion of the contingency to the NEXT Project Manager for use as management reserve. Management reserve may also be generated via cost savings from approved baseline change proposals. The use of Management Reserve is approved by the NEXT Project Manager via the baseline change control process.

The distribution of the project contingency and management reserve, if established, was controlled in accordance with the baseline change control process. Formal baseline changes were normally made following a project-wide estimate at completion process or on individual elements when the existing

baseline no longer provided a reasonable basis for performance measurement.

Management of cost, schedule, and technical risks is integral to contingency management. The NEXT Project management team evaluates project risk on a continuing basis during project execution. DOE will review contingency usage on at least an annual basis as part of the Office of Science reviews.

7 MANAGEMENT STRUCTURE and INTEGRATED PROJECT TEAM

The Office of Science provides overall program policy and guidance, technical oversight, and budgets for implementing its assigned role. Specific responsibility for design, fabrication, and operation of NEXT is assigned to SC's BES. SC-BES provides funding for the NEXT Project directly to BNL via approved financial plans. Day-to-day oversight is provided by SC's Brookhaven Site Office (BHSO). As the Management and Operating (M&O) contractor for BNL, Brookhaven Science Associates (BSA) will be accountable to DOE for carrying out the NEXT Project.

BNL is organized into four science directorates. Among them, the Energy and Photon Sciences Directorate is responsible for operating NSLS-II and carrying out the NEXT Project. The NSLS-II Director, who appoints the NEXT Project Manager, reports to the Energy and Photon Sciences Associate Laboratory Director (ALD), who in turn reports to the Brookhaven Laboratory Director.

An Integrated Project Team (IPT) comprised of DOE and BNL personnel has been established to accomplish this project. The BNL NEXT Project Management Team will be responsible for project execution and day-to-day management of the project. This section outlines the project's organization and management approach. A schematic representation of the management arrangement is shown in Figure 7.1. The BNL NEXT Project Management Team consists of the Project Manager, Deputy Project Manager, ES&H Manager, QA Manager, Project Controls Manager, and CAMs assigned to each WBS level 2 element. The roles and responsibilities of project participants are summarized in the following subsections.

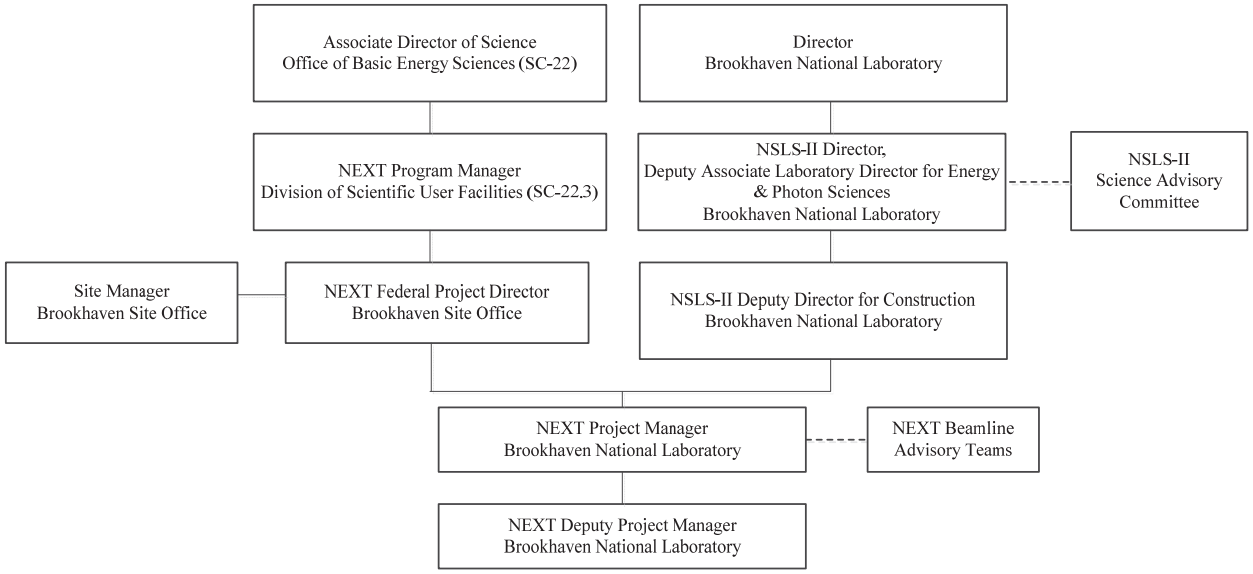

Figure 7.1 NEXT Project Management Relationships

7.1 Roles and Responsibilities of Project Participants

Acquisition Executive

The Associate Director of Basic Energy Sciences (SC-22) within the Office of Science serves as the Acquisition Executive for this project. As such, the AE has full responsibility for ensuring adequate project planning and execution, and for establishing broad policies and requirements for achieving project goals. Specific responsibilities for the NEXT project include:

- approves Critical Decisions;
- ensures the FPD appointed to a project is qualified and has appropriate communication and leadership skills prior to designation;
- approves the Acquisition Strategy and PEP, including IPT Charter;
- conducts monthly or quarterly project reporting/meetings;
- delegates approval authority for baseline changes;
- initiates definition of mission need and objectives of the project;
- approves Level 1 baseline changes;
- initiates formal periodic reviews of the project;
- provide HQ technical guidance and resources to the FPD and Program Manager; and
- provides funding for the project.

NEXT Program Manager

Specific responsibility for design, construction, and operation of NEXT is assigned to SC's Office of Basic Energy Sciences (SC-22), with day-to-day program management performed by the NEXT Program Manager in the Scientific User Facilities Division (SC-22.3). The specific roles and responsibilities of the NEXT Program Manager include:

- functions as DOE-Headquarters (DOE-HQ) point-of-contact for Project matters;
- serves as the representative in communicating the interests of the SC program;
- coordinates with FPD, IPT, other SC Staff offices, and DOE-HQ program offices, as needed, to execute the project;
- assists with budget formulation;
- reviews and provides recommendations to senior management on Levels 0 and 1 baseline changes;
- serves on the IPT;
- reviews documents (Mission Need Statement, Acquisition Strategy, PEPs, IPT Charter, etc.) and recommends approval;
- reviews project progress reports and deliverables;
- supports formal periodic reviews of the Project including DOE Office of Project Assessment (OPA) Reviews and tracks issues to resolution; and
- provides monthly reporting status in Project Assessment and Reporting System II (PARS II).

BHSO Site Manager

The DOE Headquarters NEXT Program Manager implements the NEXT Project through the field

organization at the Brookhaven Site Office. The BHSO Site Manager has been delegated responsibility and authority for carrying out the NEXT Project in a manner consistent with the PEP. Specific responsibilities of the BHSO Site Manager for the NEXT Project include:

- provides required Federal personnel resources at the site as necessary; and
- approves safety and security documents and environmental permits.

NEXT Federal Project Director

The NEXT Federal Project Director oversees execution of the NEXT Project. Support for the NEXT Federal Project Director will be provided by the BHSO Matrix organizations at the level required for project success. Specific roles and responsibilities include:

- serves as the single point of contact between federal and contractor staff for all matters relating to a project and its performance;
- prepares and maintains the IPT Charter and operating guidance with IPT support and ensures IPT is properly staffed;
- leads the IPT and delegates appropriate decision-making authority to the IPT members;
- serves as the Contracting Officer's Representative, as determined by the Contracting Officer;
- ensures development and implementation of key project documentation;
- monitors, reviews, evaluates, and reports on the performance of the project against the established technical, cost, and schedule performance baseline;
- prepares for and observes project reviews conducted by the NEXT Project and by DOE HQ;
- ensures design, fabrication, environmental, safety, security, health and quality efforts performed comply with the contract, public law, regulations and Executive Orders;
- ensures timely, reliable, and accurate integration of contractor performance data into the project's scheduling, accounting, and performance measurement systems, to include PARS II;
- provides monthly assessment in PARS II reporting;
- evaluates and verifies reported progress; makes projections of progress and identifies trends;
- authorizes use of project contingency in accordance with the levels described in this PEP;
- oversees development and submittal of key project documents to SC for concurrence/approval; and
- controls changes (within established authority) to the project baseline and seeks HQ approval for changes beyond the Federal Project Director’s authority.

Brookhaven Laboratory Director

The NSLS-II Federal Project Director implements the NEXT Project through the M&O contractor for BNL, Brookhaven Science Associates, which is responsible for overall project coordination, execution, and eventual operation. The Laboratory Director has overall responsibility for all projects, programs, operations, and facilities at Brookhaven National Laboratory. The Laboratory Director has established an Energy and Photon Sciences Directorate, led by an Associate Laboratory Director for Energy and Photon Sciences, to carry out all Photon Science activities at BNL, including the construction and operation of NSLS-II, execution of the NEXT Project, and other activities. Specific responsibility of the Laboratory Director for the NEXT Project includes:

- provides access to the laboratory personnel, resources, systems, and capabilities that are required to support execution of the NEXT project.

NSLS-II Director

The NSLS-II Director is responsible and accountable to the Associate Laboratory Director for Energy and Photon Sciences, to the Brookhaven Laboratory Director, and to DOE for ensuring that NSLS-II, NEXT, and related photon science activities at BNL achieve all mission requirements and are operated and/or executed within scope, cost, and schedule in a safe, cost efficient, and environmentally responsible manner. In order to carry out the NEXT Project, the NSLS-II Director has established a NEXT Project team within NSLS-II and the Energy and Photon Sciences Directorate, led by the NEXT Project Manager. Specific responsibilities of the NSLS-II Director for the NEXT Project include:

- ensures that the NSLS-II Project and the NEXT Project are fully integrated so as to maximize the scientific capabilities of the overall NSLS-II user facility and to minimize potential conflicts between the successful execution of the two projects;
- provides access to the resources, systems, and capabilities of the Energy and Photon Sciences Directorate that are required to support execution of the NEXT Project;
- conducts internal and external peer reviews of the NEXT Project;
- concurs on Level 0, 1, 2, and 3 NEXT Project Change Requests; and
- assigns responsibilities to the NSLS-II Deputy Director for Construction

NSLS-II Deputy Director for Construction

The NSLS-II Deputy Director for Construction reports to the NSLS-II Director and is assigned the following responsibilities for the NEXT project:

- day-to-day oversight and management support of the NEXT project;
- evaluation and trending of NEXT project performance;
- oversight of incorporation by the NEXT Project of lessons learned from other projects:
- organizing internal and external peer reviews of the NEXT project; and
- coordination of resources within NSLS-II to support execution of the NEXT project.

NEXT Project Manager

The NEXT Project Manager has been tasked by the NSLS-II Director with management responsibility and authority for the overall successful execution of the NEXT Project in a manner consistent with this PEP. Specific responsibilities of the NEXT Project Manager include:

- manages overall execution of the project to ensure that the project is completed within approved cost, schedule, and technical scope;
- ensures that project activities are conducted in a safe and environmentally sound manner;
- ensures ES&H responsibilities and requirements are integrated into the project;
- ensures that effective project management systems, cost controls, and milestone schedules are developed, documented, and implemented to assess project performance;
- oversees design, fabrication, installation, and commissioning;
- manages the interface and coordination of requirements with other projects and activities;
- oversees management of project risk activities, including oversight of the risk management team;
- chairs the project Change Control Board (CCB);

- prepares and provides recommendations to the Federal Project Director for Level 0, 1, and 2 change control proposals;
- represents the project in interactions with DOE, participates in management meetings with DOE, and communicates project status and issues;
- requests and coordinates internal and external peer reviews of the project;
- assists the FPD with project progress reporting and approves EV reporting data uploaded to DOE PARS II;
- serves as the primary point of contact with the Federal Project Director; and
- assigns responsibilities to the NEXT Deputy Project Manager

NEXT Deputy Project Manager

The NEXT Deputy Project Manager is responsible and accountable to the NEXT Project Manager for assigned NEXT project management functions. Specific responsibilities include:

- assists the NEXT Project Manager to manage execution of the project, to ensure that the project is completed within approved cost, schedule, and technical scope;
- ensures that project activities are conducted in a safe and environmentally sound manner;
- undertakes assigned project management activities and implements assigned actions; manages assigned project design, procurement, fabrication, installation, and testing activities;
- manages project cost and schedule activities, including the collection and tracking of cost and schedule performance data and variances;
- serves on the project Change Control Board (CCB);
- manages ongoing periodic assessment and documentation of project risk. Includes drafting of risk registry updates, chairing risk management team meetings, and development and oversight of risk mitigation activities; in case of unavailability of the NEXT Project Manager, represents the project in interactions with DOE, participates in management meetings with DOE, and communicates project status and issues; and
- serves as the secondary point of contact with the Federal Project Director.

NEXT Environment, Safety, and Health (ES&H) Manager

The NEXT ES&H Manager is responsible and accountable to the NEXT Project Manager for guiding the organizational elements in their respective safety efforts. Specific responsibilities include:

- provides overall policy and guidance on ES&H issues;
- works with the line organizations to make available necessary input from ES&H professionals and other support;
- ensures integration of ES&H factors into design, installation, commissioning, and operations;
- regularly assesses the effectiveness with which ISMS is being applied;
- coordinates the ES&H assessments conducted by others;
- assures compliance with BNL and OSHA regulations;
- after an event, oversees and coordinates adherence to required procedures in reporting abnormal events or conditions following the BNL Standards-Based Management System (SBMS) Subject Area: Occurrence Reporting and Processing Systems (ORPS); and
- generates and obtains appropriate approvals for safety documentation.

NEXT Quality Assurance (QA) Manager

The NEXT Quality Assurance Manager is responsible and accountable to the NEXT Project Manager for providing support to the NEXT Project in the area of quality assurance. Specific responsibilities include:

- plans, generates, and obtains approval for QA requirements and documentation;
- provides consultation to system managers to implement QA-related activities;
- provides project-specific QA training to system managers on this QA Plan and other topics that may be of interest to the project personnel;
- reviews completion of QA-related milestones as provided in project schedules, and report results to project management;
- performs QA surveillance and/or audits;
- works with the NEXT Project Manager to prevent situations where completion of critical planned QA activities are compromised due to cost, schedule, or other constraints;
- makes recommendations to the Project Manager when work should be stopped based on an investigation indicating that quality is inadequate as defined in the QA Plan; and
- participates individually or as part of a team in vendor surveys, vendor qualifications, and source inspections.

NEXT Project Controls Manager

The NEXT Project Controls Manager is responsible and accountable to the NEXT Project Manager for project control functions. Specific responsibilities include:

- develops cost and schedule data;
- implements and maintains the Performance Baseline and Earned Value Management System (EVMS);
- coordinates, reviews, and maintains the baseline change control process, and project progress reporting; and
- uploads earned value data reporting in to PARS II.

NEXT Beamline Level 2 Managers

The NEXT Beamline Level 2 Managers are responsible and accountable to the NEXT Project Manager for NEXT beamline development functions. Specific responsibilities include:

- interacts with the user community, including the beamline advisory team, for the beamline of responsibility;
- develops and establishes a scientific user program at the beamline of responsibility;
- manages assigned resources to deliver design and construction of the beamlines and instruments in accord with specifications and requirements, including cost, technical, schedule, quality, and safety objectives;
- coordinates work plans and verifies progress of the tasks which are assigned to the group; and
- organizes and prioritizes the work load and task assignments among the group staff members in order to meet the objectives of the cost plan and the schedule of the project.

NEXT Level 2 Manager for Common Beamline Systems

The NEXT Beamline Level 2 Manager for Common Beamline Systems is responsible and accountable to the NEXT Project Manager for NEXT common systems. Specific responsibilities include:

- manages group members to deliver design and construction of the beamlines common systems (Utilities, Personnel & Equipment Protection Systems, Control Stations) in accordance with specifications and requirements, including cost, technical, schedule, quality, and safety objectives;
- coordinates work plans and verifying progress of the tasks which are assigned to the group;
- organizes and prioritizes the work load and task assignments among the group staff members in order to meet the objectives of the cost plan and the schedule of the project;
- supervises group staff members;
- interacts and coordinates interface issues with the overall NSLS-II facility utilities systems by representing the NEXT Project;
- identifies and resolves interface issues within the NEXT Project; and
- develops and updates relevant project-wide interface documents.

NEXT Level 2 Manager for Beamline Control Systems

The NEXT Level 2 Manager for beamline control systems is responsible and accountable to the NEXT Project Manager for NEXT beamline control systems. Specific responsibilities include:

- manages group members to deliver design and construction of the beamlines control systems in accord with specifications and requirements, including cost, technical, schedule, quality, and safety objectives;
- coordinates work plans and verifying progress of the tasks which are assigned to the group;
- organizes and prioritizes the work load and task assignments among the group staff members in order to meet the objectives of the cost plan and the schedule of the project;
- supervises group staff members;
- interacts and coordinates interface issues with the overall NSLS-II facility control systems by representing the NEXT Project;
- identifies and resolves interface issues within the NEXT Project; and
- develops and updates relevant project-wide interface documents.

7.2 Integrated Project Team

The purpose of the Integrated Project Team is to support the Federal Project Director during the acquisition process. The IPT Charter, as stated in Appendix A, identifies the team members and their roles and responsibilities for the oversight and management of the NEXT project. The team size and membership will change as a project progresses from CD-0 to CD-4. The responsibilities of the IPT members include:

- supports the Federal Project Director;
- develops and/or participates in project planning, baseline development, and contracting;

- ensures all project interfaces are identified, completely defined, and managed to completion;
- identifies and defines appropriate and adequate scope, schedule, and cost parameters;
- supports the preparation, review, and approval of project documentation including Critical Decision packages;
- reviews and assesses project performance and status against established performance parameters, the baseline, milestones, and deliverables;
- identifies and resolves issues;
- plans and participates in project reviews, assessments, and appraisals as necessary;
- reviews and evaluates baseline and funding change requests and support the Change Control Boards as requested;
- plans and participates in operational readiness assessments; and
- supports the preparation, review, and approval of project completion and closeout documentation.

Additional information on the organization of the project personnel and their specific roles can be found in the IPT Charter.

7.3 Advisory Committees

Two advisory committees are represented in Figure 7.1. The roles of these committees are as follows:

Science Advisory Committee (SAC) – The Science Advisory Committee (SAC) reports to the NSLS-II Director and is charged to provide recommendations on issues related to the scientific utilization of NSLS-II facilities and on developments required to achieve and maintain the highest possible scientific productivity. The SAC reviews and provides advice on scientific output and utilization of NSLS-II facilities; long-term scientific directions; planning, development, and operation of NSLS-II facilities; and policies and procedures relevant to user access and utilization of scientific facilities.

Beamline Advisory Teams (BAT) – These teams report to the NEXT Project Manager and are charged to provide advice on the scientific mission and technical requirements for each beamline within the NEXT Project. They represent a particular user community and possess extensive scientific and technical expertise in designing, constructing, and operating synchrotron beamlines and/or instrumentation and conducting experiments.

8 PROJECT MANAGEMENT/OVERSIGHT

8.1 Risk Management

Risk assessments are conducted throughout the project lifecycle and the identified risks will be monitored, assessed, and retired during the project. A detailed Risk Management Plan describing the project's risk identification and management approach and associated risk register has been developed. The project risk registry will be reviewed monthly and updated approximately quarterly.

NEXT beamline and endstation instrumentation is based on components which are identical, similar, or incrementally evolved relative to those in other recently-developed beamlines worldwide and has a large degree of overlap with components of the NSLS-II Project beamlines. Therefore, the NEXT Project is considered to have relatively low technical and cost risks since the required components are within the currently available or achievable state-of-the-art. Long lead procurements will significantly mitigate potential schedule risks.

Risk management will be based on a graded approach in which levels of risk are assessed for project activities and elements. The assessment is based upon the potential consequences of activity or element failure, as well as the probability of occurrence. Risk minimization is implemented by conducting development activities, prototyping components, long lead procurements, and planning alternatives.

8.2 Interfaces and Interdependences

The following relationships between the NEXT and NSLS-II Projects exist and affect NEXT Project scope:

1) The elliptically polarized undulator (EPU) insertion devices and ID vacuum chambers for the ESM and SIX beamlines were designed by the NSLS-II Project and will be procured and tested by the NEXT Project. Installation and commissioning of these insertion devices and chambers will be undertaken by NSLS-II Facility Operations.

2) The NEXT Project capitalized on the following investments made by the NSLS-II Project for future beamline build-outs:

i. Second Satellite Building, for the SIX endstation and soft x-ray emission spectrometer
ii. Damping Wigglers, In-Vacuum Undulators, and Front Ends
iii. Shielded Enclosures
iv. Beamline Photon Shutters
v. Water-cooled electronics racks

8.3 Project Reporting and Communication Management Plan

The project reports in DOE PARS II. The NEXT Project Manager provides to the FPD a monthly project progress report. After CD-2, this monthly report will be consistent with requirements in the EVMS description document.

These reports will be supplemented with periodic teleconferences with BES to provide updates on the project progress and to discuss and resolve issues. Other organizations or personnel who may also participate in these calls include the AE, HQ personnel, OPA, and others as necessary.

8.4 Earned Value Management System

The Brookhaven National Laboratory has a certified EVMS that complies with the ANSI/EIA-748 Standard. The project EVMS implemented prior to CD-2 approval is consistent with the site EVMS description document and will provide an objective measure of actual costs and schedule performance against the Performance Measurement Baseline.

8.5 Project Reviews

Independent Project Reviews of the project status and management were conducted by SC Office of Project Assessment prior to each CD after the CD-0 approval and at least annually after CD-2.

The project also performed Conceptual, Preliminary, and Final Design reviews by external teams that were appointed and charged by the NSLS-II Director. Additional external and independent technical reviews, as applicable, were performed.

8.6 Engineering and Technology Readiness

All of the beamlines in the NEXT project are being developed in ways that are very similar to others recently built worldwide, including the initial six beamlines that are a part of the NSLS-II Project scope. Although refinement in design concepts and technological advances throughout the life of the project will be explored in order to provide the best state-of-the-art beamlines, the threshold parameter requirements

for the NEXT project were achievable with current technical capabilities. The project assessed engineering and technology readiness through design reviews, independent project reviews (IPRs), and other independent technical reviews.

8.7 Alternatives Analysis and Selection

An alternatives analysis was performed as part of the Acquisition Strategy development process. The alternative selected is to build best-in-class beamlines at the NSLS-II facility. See the Acquisition Strategy for the alternative analysis and selection details.

8.8 Environment, Safety and Health (ES&H)

The ES&H manager for the NEXT project is assigned to ensure that the project complies with all applicable ES&H requirements. An Environmental Management System to develop, implement, achieve, and maintain a successful ES&H policy is in place and expectations for ES&H performance have been established in the NEXT ES&H Plan.

A National Environmental Protection Act (NEPA) review of the NEXT project concluded that the project falls within the existing NSLS-II 2006 Environmental Assessment (EA) and no other NEPA documentation is required. The BHSO Site Manager approved a Finding of No Significant Impact (FONSI) that includes all potential environmental impacts of the NEXT project. Design, procurement, installation, and testing of the beamlines will be covered under the BNL's existing Integrated Safety Management (ISM) program and no additional ISM policies or procedures needs to be developed.

A Preliminary Hazard Analysis Report was prepared for the project. The report finds that all hazards identified are similar in nature and magnitude to those already found in the NSLS-II project. The impact of any hazard will be minor onsite and negligible off-site. The Hazard Analysis Report was prepared for CD-2 approval and will be updated as the project continues to mature. The project is not required to comply with sustainability and LEED goals since the project is an MIE.

8.9 Safeguards and Security

A security and vulnerability risk review was performed and the conclusion was that the safeguards and security issues for the NEXT project are considered small and manageable with standard practices. The project does not require a Security Vulnerability Assessment Report (SVAR) or additional security requirements that are not already addressed by current BNL policies and procedures. The project will use the existing BNL program and policy that is already approved by DOE.

8.10 Systems Engineering

The project used a systems engineering approach to execute and manage the project including performing value management analysis and value engineering studies; specification and design development, verification, and reviews; risk analysis and management; and coordination of fabrication and installation of equipment and systems, and other interface management activities.

8.11 Value Management

The project has been and will continue to perform a value management assessment as part of the design process to include making a determination of whether a value engineering study is required as described in the Value Management Plan for the NEXT Project. If value engineering is determined to be required, a Value Engineering (VE) study will be performed.

8.12 Value Engineering

When it is determined by a value management assessment process that a Value Engineering (VE) study is required for a scope of work, a VE study has been and will continue to be conducted. This process was carried out throughout the preliminary design phase of the project, and continued during the final design and construction phases of the project.

8.13 Configuration Management/Document Control

Configuration of the NEXT project baseline and associated documents was maintained using the formal change control processes described in the Configuration Management Plan for the NEXT Project. Baseline documents for the project consist of the following:

- NEXT Project Execution Plan
- NEXT Environmental, Safety, & Health Plan
- NEXT Preliminary and Final Hazard Analysis
- NEXT Quality Assurance Plan
- NEXT Risk Management Plan
- NEXT Configuration Management Plan
- BNL Project Controls Manual
- WBS
- WBS Dictionary
- Requirements, Specifications and Interface Documents
- Drawings and Specifications
- Approved Project Change Requests (PCRs) and Baseline Change Proposals (BCPs)

8.14 Quality Assurance and Testing and Evaluation

Quality Assurance is an integral part of effective project management and is employed throughout the design, procurement, and construction of the project as described in the Quality Assurance Plan for the NEXT Project. The project has a documented quality management program addressing the DOE adopted QA Criteria. In addition, national codes and standards are followed throughout. For essential components, the quality requirements are required for purchases, construction, lab fabrication, and for all sub-contractors performing work for the project. Refer to the design and procurement documents for specific QA, testing and evaluation, and acceptance requirements.

The resource-loaded schedule includes major QA and Testing and Evaluation activities as well as the durations and responsible resources.

8.15 Transition to Operations

Transition to Operations was accomplished in phases and started approximately 12 months prior to CD-4. At the completion of each beamline installation, the Project conducted equipment testing to confirm that the design performance specifications had been achieved. Upon successful completion of an Instrument Readiness Review (IRR), the beamline was transferred to the NSLS-II Facility Operations organization. Operations staffed and funded the first measurements of x-ray flux at each beamline. These measurements verified achievement of the associated KPP, for that beamline, and led to formal acceptance of that beamline for operation by the NSLS-II facility. Final project completion (CD-4) occurs when the complete project scope has been formally accepted and transferred to the NSLS-II facility.

8.16 Project Closeout

A project close-out plan has been developed and implemented. The following activities are discussed in the close-out plan:

- Project Completion Report, which describes how all contract obligations, products, services, and deliverables have been completed and accepted by the client.

- Project lessons learned
- How excess equipment and associated components will be properly dispositioned
- How project team members will be informed that the work is complete and that they are no longer authorized to charge to project charge codes
- How subcontractors/vendors are notified of the close out and how a formal request is submitted to the BNL Business Services Division, via the NSLS-II Business Operations Manager, to de-obligate balances and/or accrue outstanding costs and resolve/de-obligate outstanding balances. De-obligation and contract close out requires formal concurrence of vendors.
- How costs associated with closed charge codes must be cleared

A Draft Project Closeout Report has been developed prior to CD-4 approval. A Closeout report will be submitted to the program 90 days after CD-4 is approved and the Final Project Closeout Report will be submitted after all issues have been closed. The completion report will contain the final cost of the project, project lessons learned, and performance achieved at project completion.

As part of project closeout, the project will finalize PARS II reporting.

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Appendix A – Integrated Project Team (IPT) Charter

A.1 Purpose

This IPT Charter identifies the team members and their roles and responsibilities for the oversight and management of the NEXT Project. This Charter constitutes the agreement among the IPT members as to how the project baseline will be managed; the coordination and cooperation that will be afforded all team members and the dedication of each team member to achieve successful completion of the project. The charter embodies the three basic tenets of an IPT: the Federal Project Director is in charge of the project; the IPT is advisory and an implementing body to the FPD; and direct communication is expected as a means of exchanging information and building trust. The charter will be in effect until officially rescinded and will be updated as needed to reflect any changes.

A.2 Roles

The Integrated Project Team, organized and led by the Federal Project Director, is an essential element in DOE's acquisition process and is used during all phases of a project's life cycle. This team consists of professionals representing diverse disciplines with the specific knowledge, skills, and abilities to support the Federal Project Director in successfully executing the project. The IPT for the NEXT Project consists of members from both DOE and the contractor, BSA. The team membership will change as a project progresses from initiation to closeout to ensure the necessary skills are always represented to meet project needs. The IPT:

- supports the Federal Project Director;
- develops and/or participates in project planning, baseline development and contracting;
- ensures all project interfaces are identified, completely defined, and managed to completion;
- identifies and defines appropriate and adequate scope, schedule and cost parameters;
- supports the preparation, review, and approval of project documentation including Critical Decision packages;
- reviews and assesses project performance and status against established performance parameters, the baseline, milestones and deliverables;
- identifies and resolves issues;
- plans and participates in project reviews, assessments, and appraisals as necessary;
- reviews and evaluates baseline and funding change requests and support the Change Control Boards as requested;
- plans and participates in operational readiness assessments; and
- supports the preparation, review, and approval of project completion and closeout documentation.

A.3 Membership

The IPT is grouped into three areas (i.e., Executive, Core, and Support) with specific expectations on their responsibilities. Each member is responsible for supporting project performance, scope, schedule, cost, safety, and quality objectives; for identifying and meeting project and contract commitments; and for maintaining communication with other IPT members.

Core Members

The Core Team provides the day-to-day leadership for the NEXT Project and consists of the NEXT Program Manager, the NEXT Federal Project Director, the BNL NEXT Project Manager, and the BNL NEXT Deputy Project Manager.

The NEXT Federal Project Director, located at BHSO, serves as the Team Leader. The NEXT Federal Project Director's responsibilities involve:

- leading the Integrated Project Team, providing broad program guidance, and delegating appropriate decision-making authority to the IPT members:
- preparing and maintaining the Integrated Project Team Charter and operating guidance with IPT support;
- keeping the IPT and upper management informed;
- scheduling and holding regular meetings;
- initiating the development and implementation of key project documentation (e.g., Project Execution Plan);
- serving as the single point of contact between federal and contractor staff for all matters relating to the project and its performance;
- serving as the contracting officer's representative for the NEXT Project as determined by the contracting officer;
- defining the project cost, schedule, performance, and scope baseline;
- requesting and allocating budget;
- assuring that design, construction, environmental, safety, security, health, and quality efforts performed comply with the contract, public law, regulations, and Executive Orders;
- reporting and verifying timely, reliable, and accurate performance data;
- evaluating and verifying reported progress;
- making projections of progress and identifying trends; and
- approving changes in compliance with the approved change control process documented in the Project Execution Plan.

The NEXT Program Manager, located in the SC Office of Basic Energy Sciences, plays a key role in providing programmatic guidance to the NEXT Federal Project Director and the IPT. The NEXT Program Manager's responsibilities involve:

- overseeing development of project definition, technical scope, and budget to support mission need;
- developing project performance measures, and monitoring and evaluating project performance throughout the project's life cycle;
- providing direction to the NEXT Project regarding BES budgets;

- coordinating with BES program elements as needed to facilitate project performance; and
- overseeing the DOE project line-management organization and ensuring the line project teams have the necessary experience, expertise, and training in design engineering, safety and security analysis, construction, and testing.

The BNL NEXT Project Manager is responsible and accountable for overall successful execution of the project scope of work, including overall project management and ensuring that the project's objectives in terms of technical parameters, cost, and schedule are achieved in a safe and environmentally compliant manner. The BNL NEXT Project Manager responsibilities involve:

- supporting the NEXT Federal Project Director in implementing DOE project management processes;
- providing input on project documentation (e.g., Project Execution Plan) and developing and maintaining contractor project documentation;
- defining and leading the BNL NEXT Project Team;
- implementing a performance measurement system;
- monitoring the technical design;
- proactively identifying and ensuring timely resolution of critical issues within the contractor's control which impact project performance;
- communicating accurate and reliable project status and performance issues to DOE;
- ensuring that the Project's ES&H and QA goals are achieved;
- identifying and managing project risks; and
- managing the contractor's management reserve funds.

The NEXT Deputy Project Manager assists the NEXT Project Manager in successful execution of the project scope of work. The Deputy Project Manager will act in place of the Project Manager when the Project Manager is not in place.

Executive Members

The Executive members provide executive leadership to the NEXT Project and champion its success in their respective organizations. The Executive Members of the IPT consist of the Manager of BHSO, the NSLS-II Director, the NSLS-II Deputy Director for Construction, and the NSLS-II Photon Division Director. These members are responsible for ensuring that the necessary resources and support are provided and that needed approvals are provided in a timely manner.

Support Members

The Support Members are involved in the daily activities of the NEXT Project and have functions in project management, project controls, contracting, field execution, safety oversight, and/or business operations that are integral to the NEXT Project.

Because of the progressive and dynamic nature of a project, the personnel skill and knowledge mix will change throughout the project's lifecycle. Unexpected events and requirements may arise that require resources beyond that of the core IPT. As such, the type and amount of personnel support will vary and the IPT membership may change to incorporate the necessary skills and expertise. This flexibility allows the Federal Project Director to adapt the team to meet specific needs. The Federal Project Director and Core Members will identify those resource gaps and determine the timing and level of support needed.

A.4 IPT Scope of Effort and Limits of Authority

The IPT members assisted the NEXT Federal Project Director with preparing this Charter. The NEXT Federal Project Director, in coordination with the NEXT Program Manager, maintains authority for final decision making and communicates to the team the decision making strategy to be used for specific issues.

A.5 Communications

Communications Internal to IPT and Meetings

The NEXT Federal Project Director will communicate to the team the goals and purpose of the team; each team member's expected level of contribution to meeting goals and expectations; and all issues related to successful team performance. The NEXT Federal Project Director will ensure that summaries and appropriate meeting documentation are created, maintained, and distributed. Any IPT member is authorized to communicate with any other IPT member, or support staff, as necessary to accomplish and fulfill his or her roles and responsibilities.

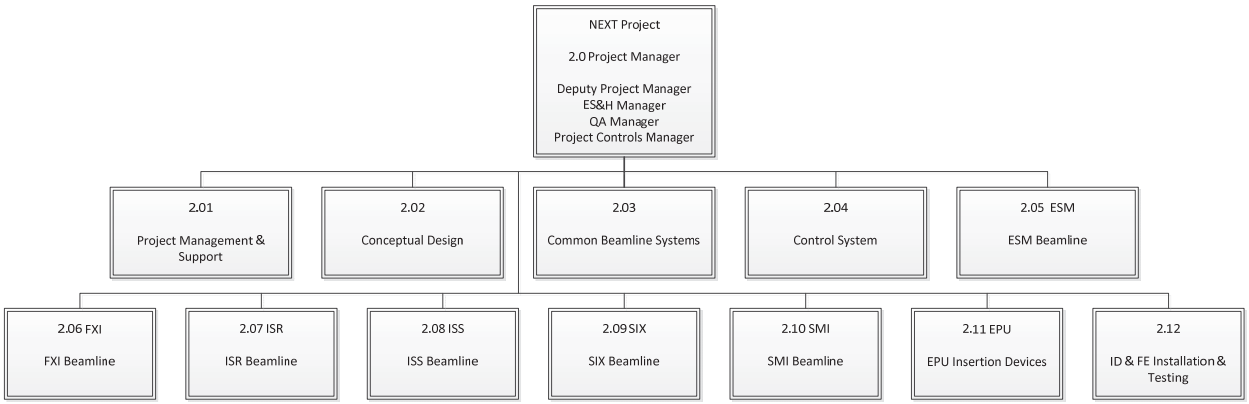
The IPT will participate in the Monthly Performance Review meeting. This meeting will be chaired by the NEXT Federal Project Director and will focus on scope, cost and schedule performance to aid the Federal Project Director in his/her project monitoring and reporting duties. The basis for the meeting will be the Monthly Project Report submitted by the NEXT Project Manager.

Communications External to IPT

Communications external to the IPT are the responsibility of the Core Members. The NEXT Federal Project Director will ensure that adequate and frequent communication regarding DOE policy and its impacts on site projects is delivered to the contractor in a timely manner.

Appendix B – NEXT Project Work Breakdown Structure

B.1 Work Breakdown Chart to Level 2



B.2 Work Breakdown Structure Dictionary

The NEXT Work Breakdown Structure (WBS) Dictionary shown below is current as of March 2017. The WBS Dictionary is maintained by BNL Project Controls, subject to NEXT Project Change Control.

2 NSLS-II Experimental Tools (NEXT) Project

The goal of the NSLS-II Experimental Tools (NEXT) MIE Project is to design and build a suite of additional beamlines with new and advanced experimental techniques that will extend the insertion device based science programs beyond that provided by the six initial NSLS-II project beamlines, in a timely manner. The NEXT project will provide a significant capacity at the early years of NSLS-II operations to allow the exploration of the unique scientific opportunities offered by the new facility, as well as support the wide-ranging research programs of the existing NSLS user community.

2.01 Project Management & Support

Performance of Project Management activities, including labor, materials, travel, and fixed costs associated with the operations of the Project Office, including the offices of the Project Manager; the project support functions; environment, safety, and health activities; quality assurance; configuration management; and document control.

2.01.01 Project Management

Perform project management activities and provide project support functions associated with the operations of the NEXT Project, including effort required to conduct project close-out activities. The Project Manager has line management responsibility and authority for carrying out the NEXT Project. Additionally, miscellaneous materials, appropriate conference expenses, and appropriate travel costs are included.

2.01.02 Project Support

Provide functions including project support, financial, administrative, procurement, human resources, and other support functions for all areas of the Project. Level of Effort labor, materials, travel, building maintenance, project close-out activities and utilities costs for the Project office and laboratory space are included in this area.

2.02 Conceptual Design & Advanced Conceptual Design

Performance of conceptual design and advanced conceptual design activities to support the delivery of NEXT Project objectives, and management of these activities. The NEXT project will benefit from some of the designs already accomplished as part of the NSLS-II project and other modern SR facilities.

2.02.01 Intentionally Left Blank

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2.02.02 Conceptual Design and Analysis of Photon Delivery Systems

Conceptual design and analysis of the optical systems delivering the required photon parameters to the experimental stations. These components include optical components such as mirrors, monochromators, and slits.

2.02.03 Conceptual Design of User Instruments

Conceptual design and analysis of the instruments required to carry out the user science experiments planned for the NEXT Project beamlines.

2.02.04 ESM Advanced Conceptual Design

Advanced conceptual design of the photon delivery system and user instruments for the ESM beamline. Performance of activities to support delivery of these objectives, including advanced optical design, advanced analysis, and advanced design of user instruments.

2.02.05 FXI Advanced Conceptual Design

Advanced conceptual design of the photon delivery system and user instruments for the FXI beamline. Performance of activities to support delivery of these objectives, including advanced optical design, advanced analysis, and advanced design of user instruments.

2.02.06 ISR Advanced Conceptual Design

Advanced conceptual design of the photon delivery system and user instruments for the ISR beamline. Performance of activities to support delivery of these objectives, including advanced optical design, advanced analysis, and advanced design of user instruments.

2.02.07 ISS Advanced Conceptual Design

Advanced conceptual design of the photon delivery system and user instruments for the ISS beamline. Performance of activities to support delivery of these objectives, including advanced optical design, advanced analysis, and advanced design of user instruments.

2.02.08 SIX Advanced Conceptual Design

Advanced conceptual design of the photon delivery system and user instruments for the SIX beamline. Performance of activities to support delivery of these objectives, including advanced optical design, advanced analysis, and advanced design of user instruments.

2.02.09 SMI Advanced Conceptual Design

Advanced conceptual design of the photon delivery system and user instruments for the SMI beamline. Performance of activities to support delivery of these objectives, including advanced optical design, advanced analysis, and advanced design of user instruments.

2.03 Common Beamline Systems

Performance of preliminary design, final design, specification, and procurement and installation activities to support the delivery of common beamline components and systems for the NEXT Project beamlines, and management of these activities.

2.03.01 Utilities

Preliminary design, final design, project management, and purchase contract for the beamline basic utilities pack to include chilled and process water, electricity, LN2, GN2, gas extraction system, and oxygen deficiency sensors, etc. In-house labor for utilities design and installation is included.

2.03.02 Personnel Protection System (PPS)

Preliminary design, final design, project management, and construction of the Personnel Protection System (PPS) for the NEXT Project beamlines. To include PLC, switches, locks, and Human Machine Interface (HMI) panel.

2.03.03 Equipment Protection System (EPS)

Preliminary design, final design, project management and construction of the Equipment Protection System (EPS) for the NEXT project beamlines. To include PLC, wiring, and custom sensors.

2.03.04 Control Station

Design and procurement of all beamline furniture including chairs, desks, conference tables, bookshelves, filing cabinets, partitions and mains wiring/ethernet connections mounted on this equipment, and procurement of standard computer workstations and associated computer hardware such as printers and displays.

2.03.05 Common Beamline Systems Management

The scope of Common Beamline Systems Management is to oversee the design, procurement, fabrication and installation of the Common Beamline Systems for ESM, ISR, ISS, SIX, and SMI and the design for the FXI Beamline. The Common Beamline systems include Electrical and Mechanical Utilities, the Personal Protection System and the Equipment Protection System for the NEXT Beamlines. The scope includes computers and software for the manager and support staff, as well as LOE effort for project close-out activities.

2.04 Control System

Engineering, design, procurement/fabrication, assembly, installation, and testing of beamline and endstation control systems for all NEXT project beamlines. These activities are separated into (i) beamline and endstation control system design and implementation and (ii) beamline and endstation control system equipment. The control system WBS includes labor to design and prototype (as needed) the control system for all beamline and endstation equipment. It also includes labor to implement, integrate, test, and commission this equipment through successful completion of each beamline's IRR and taking of first light. Funding for the development of tools to manage the data centrally, analyze the data, or visualize the data collected is not in this project, it is expected to be funded in operations. The material costs in this WBS include all of the instrumentation to control the beam line and the end station including operator consoles, network hardware, and disk storage for all of the instrumentation, serial to Ethernet connections, motor controllers, and camera controllers. It includes all of the motor cables, Ethernet cables, and serial cables. It includes a VME crate, controller, and timing to locally distribute the machine timing to the experiment. It includes all I/O controllers needed to integrate the instrumentation in the beam line and the end station. The funding for the computers and disks to store experimental data is in each of the experimental beam lines (WBS 2.[05-10].02.04). The PLCs for Personnel Protection and Equipment Protection are provided by the Common Systems WBS. In each beam line budget is the funding for all motors, detectors, instruments and any additional I/O modules such as PLCs or Multi-channel analyzers.

2.04.01 Control System Management

This WBS includes test equipment required to prototype beam line control components, control design and implementation travel, and the manager's effort, including efforts required for project close-out

activities. It also includes equipment needed by the engineers to perform their job. It does not include time or travel needed by the employees for training.

2.04.02 Control System Design & Implementation

Effort required for preliminary design, final design, development of prototype systems, implementation, and commissioning of the controls, both hardware and software, for all NEXT project beamlines. These controls include motion control, vacuum control, and diagnostics. This WBS includes point to point tests required for installation and integration. It does not include machine protection for the experimental beam line. It does not include data acquisition or data analysis. It does not include control of the front end or insertion device. It does not include implementation labor for each beamline following successful completion of its IRR and taking of first light.

2.04.02.01 ESM Control System Design & Implementation

Effort required for preliminary design, final design, development of prototype systems, implementation, and commissioning of the controls, both hardware and software, for the ESM beamline. These controls include motion control, vacuum control, and diagnostics. This WBS includes point to point tests required for installation and integration. It does not include machine protection for the experimental beam line. It does not include data acquisition or data analysis. It does not include control of the front end or insertion device. It does not include implementation labor following successful completion of IRR and taking of first light.

2.04.02.02 FXI Control System Design

Effort required for preliminary and final design of the controls, both hardware and software, for the FXI beamline. These controls include motion control, vacuum control, beam control, and cooling, from the ratchet wall to the detector. This WBS does not include machine protection for the experimental beam line. It does not include data acquisition or data analysis. It does not include control of the front end or insertion device.

2.04.02.03 ISR Control System Design & Implementation

Effort required for preliminary design, final design, development of prototype systems, implementation, and commissioning of the controls, both hardware and software, for the ISR beamline. These controls include motion control, vacuum control, and diagnostics. This WBS includes point to point tests required for installation and integration. It does not include machine protection for the experimental beam line. It does not include data acquisition or data analysis. It does not include control of the front end or insertion device. It does not include implementation labor following successful completion of IRR and taking of first light.

2.04.02.04 ISS Control System Design & Implementation

Effort required for preliminary design, final design, development of prototype systems, implementation, and commissioning of the controls, both hardware and software, for the ISS beamline. These controls include motion control, vacuum control, and diagnostics. This WBS includes point to point tests required for installation and integration. It does not include machine protection for the experimental beam line. It does not include data acquisition or data analysis. It does not include control of the front end or insertion device. It does not include implementation labor following successful completion of IRR and taking of first light.

2.04.02.05 SIX Control System Design & Implementation

Effort required for preliminary design, final design, development of prototype systems, implementation, and commissioning of the controls, both hardware and software, for the SIX beamline. These controls include motion control, vacuum control, and diagnostics. This WBS includes point to point tests required for installation and integration. It does not include machine protection for the experimental beam line. It does not include data acquisition or data analysis. It does not include control of the front end or insertion

device. It does not include implementation labor following successful completion of IRR and taking of first light.

2.04.02.06 SMI Control System Design & Implementation

Effort required for preliminary design, final design, development of prototype systems, implementation, and commissioning of the controls, both hardware and software, for the SMI beamline. These controls include motion control, vacuum control, and diagnostics. This WBS includes point to point tests required for installation and integration. It does not include machine protection for the experimental beam line. It does not include data acquisition or data analysis. It does not include control of the front end or insertion device. It does not include implementation labor following successful completion of IRR and taking of first light.

2.04.03 Control System Equipment

Control Equipment needed for the NEXT Project beamlines including: two operator consoles for control and archive of control equipment, network routers, gateway to the machine control system, timing IOC to synchronize to the machine timing, motor controllers, serial to ethernet hubs, and a soft IOC for controlling all Ethernet based motors, serial devices, and PLCs. It also includes all Ethernet and timing cables. This does not include: cables from these controllers to the instruments, the required PLCs for machine protection and equipment control, the serial cables to the vacuum gauges nor the vacuum controllers, the detector control, the data acquisition computer, nor the data analysis equipment.

2.05 ESM Beamline

Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the ESM beamline.

2.05.01 ESM Management

Perform Project Management activities specific to the ESM beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.05.01.01 ESM Beamline Management

Perform Project Management activities specific to the ESM beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.05.02 ESM Beamline Systems

Preliminary design, final design, specification, procurement, fabrication, assembly, installation, and testing of sub-system and integrated systems of all ESM beamline components from the shield wall to and including the endstation. These components include optical components such as mirrors, monochromators, beam diagnostic systems, shielded enclosures, endstation apparatus, sample changing equipment, detectors, and the hardware and software of data acquisition systems.

2.05.02.01 Photon Delivery System

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all beamline components from the shield wall to the endstation(s). These components include optical components such as mirrors, monochromators (containing crystals, gratings, lenses, and filters) and the systems that house, cool, and manipulate them; diagnostic systems that measure beam properties such as position, size, flux, and polarization; slits, shutters; collimators; masks; and beam stops.

2.05.02.02 ESM Shielded Enclosures

Preliminary design, final design, specification, assembly and installation, and test of optic enclosures (first, second, third, ...) and experimental endstation enclosures (EESEs). Scope to include all labyrinths, doors, windows, fans, and lights, but not the wiring to these devices. Hutch fabrication and installation contract scope is excluded.

2.05.02.03 ESM Endstation Equipment

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all experimental endstation equipment.

2.05.02.04 ESM Data Acquisition

Hardware and software to acquire and store experimental data from the ESM beamline. This includes data produced by beamline and endstation diagnostic monitors and by experimental endstation detectors. Includes software to serve the user database and some aspects of data analysis.

2.06 FXI Beamline

Preliminary and final design of the "Full Field X-ray Imaging with Transmission X-Ray Microscope" (FXI) beamline. Construction of FXI shielded enclosures.

2.06.01 FXI Management

Perform Project Management activities specific to the FXI beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.06.01.01 FXI Beamline Management.

Perform Project Management activities specific to the FXI beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.06.02 FXI Beamline Systems

Preliminary and final design of all FXI beamline components from the shield wall to and including the endstation. These components include optical components such as mirrors, monochromators, beam diagnostic systems, shielded enclosures, endstation apparatus, sample changing equipment, detectors, and the hardware and software of data acquisition systems.

2.06.02.01 FXI Photon Delivery System

Preliminary and final design of all beamline components from the shield wall to the endstation(s). These components include optical components such as mirrors, monochromators (containing crystals, gratings, lenses, and filters) and the systems that house, cool, and manipulate them; diagnostic systems that measure beam properties such as position, size, flux, and polarization; shutters; masks; and slits.

2.06.02.02 FXI Shielded Enclosures

Preliminary design, final design, specification, assembly and installation, and test of optics enclosure and experimental endstation enclosure. Scope to include design of all labyrinths, doors, windows, fans, and lights, but not the wiring to these devices. Hutch fabrication and installation contract scope is included.

2.06.02.03 FXI Endstation Equipment

Preliminary and final design of all experimental endstation equipment.

2.06.02.04 FXI Data Acquisition

Preliminary and final design of hardware and software to acquire and store experimental data from the FXI beamline. This includes data produced by beamline and endstation diagnostic monitors and by experimental endstation detectors. Includes software to serve the user database and some aspects of data analysis.

2.07 ISR Beamline

Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the ISR beamline.

2.07.01 ISR Management

Perform Project Management activities specific to the ISR beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group, including costs associated with ISR Beamline Advisory Team; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.07.01.01 ISR Beamline Management

Perform Project Management activities specific to the ISR beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group, including costs associated with ISR Beamline Advisory Team; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.07.02 ISR Beamline Systems

Preliminary design, final design, specification, procurement, fabrication, assembly, installation, and testing of sub-system and integrated systems of all ISR beamline components from the shield wall to and including the endstations. These components include optical components such as mirrors, a monochromator, phase plates, beam diagnostic systems, shielded enclosures, endstation apparatus, and the hardware and software of data acquisition systems.

2.07.02.01 ISR Photon Delivery System

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all beamline components from the shield wall to the endstations. These components include optical components such as mirrors, a crystal monochromator, phase plates, and the systems that house, cool, manipulate, and pump them; diagnostic systems that measure beam properties such as position, size, flux, and polarization; slits, shutters; collimators; masks; and beam stops.

2.07.02.02 ISR Shielded Enclosures

Preliminary design, final design, specification, assembly and installation, and test of optics enclosures (first and second) and experimental endstation enclosures (EESEs). Scope to include all labyrinths, doors, windows, fans, and lights, but not the wiring to these devices. Hutch fabrication and installation contract scope is excluded.

2.07.02.03 ISR Endstation Equipment

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all experimental endstation equipment.

2.07.02.04 ISR Data Acquisition

Hardware and software to acquire and store experimental data from the ISR beamline. This includes data produced by beamline and endstation diagnostic monitors and by experimental endstation detectors. Includes software to serve the user database and some aspects of data analysis.

2.08 ISS Beamline

Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the ISS beamline and the endstation.

2.08.01 ISS Management

Perform Project Management activities specific to the ISS beamline. Includes labor, materials, travel, and fixed costs associated with management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.08.01.01 ISS Beamline Management

Perform Project Management activities specific to the ISS beamline. Includes labor, materials, travel, and fixed costs associated with management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.08.02 ISS Beamline Systems

Preliminary design, final design, specification, procurement, fabrication, assembly, installation, and testing of sub-system and integrated systems of all ISS beamline components from the shield wall to and including the endstation. These components include optical components such as mirrors, monochromators, beam diagnostic systems, shielded enclosures, endstation apparatus, sample changing equipment, detectors, and the hardware and software of data acquisition systems.

2.08.02.01 ISS Photon Delivery System

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all beamline components from the shield wall to the endstation(s). These components include optical components such as mirrors, monochromators (containing crystals, gratings, lenses, and filters) and the systems that house, cool, and manipulate them; diagnostic systems that measure beam properties such as position, size, flux, and polarization; slits, shutters; collimators; masks; and beam stops.

2.08.02.02 ISS Shielded Enclosures

Preliminary design, final design, specification, assembly and installation, and test of optics enclosures (first, second, third, …) and experimental endstation enclosures (EESEs). Scope to include all labyrinths, doors, windows, fans, and lights, but not the wiring to these devices. Hutch fabrication and installation contract scope is excluded.

2.08.02.03 ISS Endstation Equipment

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all experimental endstation equipment. Prototyping activities are included as appropriate.

2.08.02.04 ISS Data Acquisition

Hardware and software to acquire and store experimental data from the ISS beamline. This includes data produced by beamline and endstation diagnostic monitors and by experimental endstation detectors. Includes software to serve the user database and some aspects of data analysis.

2.09 SIX Beamline

Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the SIX beamline.

2.09.01 SIX Management

Perform Project Management activities specific to the SIX beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.09.01.01 SIX Beamline Management

Perform Project Management activities specific to the SIX beamline. Includes labor, materials, travel, and fixed costs associated with management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.09.02 SIX Beamline Systems

Preliminary design, final design, specification, procurement, fabrication, assembly, installation, and testing of sub-system and integrated systems of all SIX beamline components from the shield wall to and including the endstation. These components include optical components such as mirrors,

monochromators, beam diagnostic systems, shielded enclosures, endstation apparatus, sample changing equipment, detectors, and the hardware and software of data acquisition systems.

2.09.02.01 SIX Photon Delivery System

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all beamline components from the shield wall to the endstation(s). These components include optical components such as mirrors, monochromators (containing crystals, gratings, lenses, and filters) and the systems that house, cool, and manipulate them; diagnostic systems that measure beam properties such as position, size, flux, and polarization; slits, shutters; collimators; masks; and beam stops.

2.09.02.02 SIX Shielded Enclosures

Preliminary design, final design, specification, assembly and installation, and test of optics enclosures (first, second, third, …) and experimental endstation enclosures (EESEs). Scope to include all labyrinths, doors, windows, fans, and lights, but not the wiring to these devices. This scope also includes the generation of the Requirements, Specifications and Interfaces (RSI) for the Satellite Building. Hutch fabrication and installation contract scope is excluded.

2.09.02.03 SIX Endstation Equipment

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all experimental endstation equipment. Installation and commissioning activities associated with the Sample Chamber Triple Rotating Flange are excluded.

2.09.02.04 SIX Data Acquisition

Hardware and software to acquire and store experimental data from the SIX beamline. This data includes that produced by beamline and endstation diagnostic monitors and by experimental endstation detectors. Includes software to serve the user database and some aspects of data analysis.

2.10 SMI Beamline

Preliminary design, final design, specification and procurement and/or fabrication, assembly and installation, and test (sub-system and integrated) of the SMI beamline.

2.10.01 SMI Management

Perform Project Management activities specific to the SMI beamline. Includes labor, materials, travel, and fixed costs associated with the management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.10.01.01 SMI Beamline Management

Perform Project Management activities specific to the SMI beamline. Includes labor, materials, travel, and fixed costs associated with management of the beamline group; project support functions specific to this beamline; beamline-specific environment, safety, and health activities; beamline-specific quality assurance; beamline configuration management; and beamline document control. Includes effort required to conduct project close-out activities. Scientific program development: Organize and participate in scientific and advisory team meetings, perform proof of principle experiments, and keep abreast of research fields related to beamline program.

2.10.02 SMI Beamline Systems

Preliminary design, final design, specification, procurement, fabrication, assembly, installation, and testing of sub-system and integrated systems of all SMI beamline components from the shield wall to and including the endstation. These components include optical components such as mirrors, monochromators, beam diagnostic systems, shielded enclosures, endstation apparatus, sample changing equipment, detectors, and the hardware and software of data acquisition systems.

2.10.02.01 SMI Photon Delivery System

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all beamline components from the shield wall to the endstation(s). These components include optical components such as mirrors, monochromators (containing crystals, gratings, lenses, and filters) and the systems that house, cool, and manipulate them; diagnostic systems that measure beam properties such as position, size, flux, and polarization; slits, shutters; collimators; masks; and beam stops.

2.10.02.02 SMI Shielded Enclosures

Preliminary design, final design, specification, assembly and installation, and test of optics enclosures (first, second, third, …) and experimental endstation enclosures (EESEs). Scope to include all labyrinths, doors, windows, fans, and lights, but not the wiring to these devices. Hutch fabrication and installation contract scope is excluded.

2.10.02.03 SMI Endstation Equipment

Preliminary design, final design, specification and procurement and/or fabrication (including tooling if manufactured in house), assembly and installation, and test (sub-system and integrated) of all experimental endstation equipment.

2.10.02.04 SMI Data Acquisition

Hardware and software to acquire and store experimental data from the SMI beamline. This includes data produced by beamline and endstation diagnostic monitors and by experimental endstation detectors. Includes software to serve the user database and some aspects of data analysis.

2.11 Insertion Devices

Fabrication of the EPU insertion devices and ID vacuum chambers for ESM and SIX. Includes effort for procurement oversight and contract management.

2.11.01 ESM EPU Insertion Device

Fabrication of the EPU insertion devices and ID vacuum chambers for ESM and SIX, including current strips & power supplies. Effort for procurement oversight and contract management is also included.

2.11.02 SIX EPU Insertion Device

Procurement Initiation for the EPU insertion device and ID vacuum chamber for SIX, including effort for procurement oversight and contract management.

2.11.03 Insertion Device Management

Management of the EPU insertion devices and ID vacuum chambers for ESM and SIX. Includes effort for procurement oversight and contract management.

2.12 ID & FE Installation & Testing

Begin the installation of the front ends & insertion devices for ESM, SIX, ISR, and SMI, and installation of the front end for ISS (the insertion devices for ISS were installed as part of NSLS-II). The completion of the installation after 1-Nov-15 will not be a part of the NEXT project.

2.12.01 ID & FE Installation & Testing Management

Oversight of the initial installation of the front ends & insertion devices for the ESM, SIX, ISR, SMI & ISS Beamlines. Includes the scheduling activities and coordination with the groups performing the installation work and also with operations. Any oversight of the installation activities after 1-Nov-15 will not be a part of the NEXT project.

2.12.02 ID Installation & Testing

Begin magnetic measurement, installation, survey, bakeout and integrated testing of two EPUs for ESM beamline, one EPU for SIX beamline, one IVU for ISR beamline and one IVU for SMI beamline into the NSLS-II storage ring. Installation of the insertion devices includes preparation of the storage ring floor and positioning and grouting of all insertion device floor plates and required stands. Begin installation of canting magnets for ISR and SMI. Begin installation of vacuum chambers and transition pieces. Begin surveying all insertion devices and straight section components into position. Begin installation of insertion device power supplies, controls, vacuum equipment and associated electronics into racks on the storage ring mezzanine. Begin running all insertion device cabling and making connections. Begin installing water feed and return lines to each insertion device from the water headers. Begin pump down and bakeout of insertion device and straight section. Begin testing insertion devices controls and functionality. Completion of magnetic measurements and installation of ISR IVU and magnetic measurements for SMI IVU. The completion of the ID installation and testing after 1-Nov-15 will not be a part of the NEXT project.

2.12.03 ID Installation & Testing

Begin installation, survey, bakeout, and integrated testing of five front ends for the ESM, SIX, ISR, SMI and ISS beamlines in the NSLS-II storage ring tunnel. Installation of the front ends includes preparation of the storage ring floor and positioning and grouting of all front end stands. Begin installation of the ratchet wall collimators and X-ray (beam alignment) flags. Begin surveying all front end components into position and securing hardware with safety wire. Begin installation of ion pump power supplies, TSP power supplies, gauge controllers and other miscellaneous electrical components in racks above the storage ring. Begin running all front end cabling to the individual components and making connections. Begin installing water feed and return lines to each front end components from the water headers. Begin installing pneumatic lines to each front end components from the pneumatic header. Begin pump down and bakeout of full front end assembly. Begin testing of all front end switches and actuators, and interfacing to EPS system. Completion of the installation of front ends for ISR and ISS. The completion of the FE installation and testing after 1-Nov-15 will not be a part of the NEXT project.

Appendix C – NEXT Beamline Design Parameters and Scope

C.1 NEXT Beamline Design Parameter and Scope Table

The table below lists design parameters for the NEXT beamlines, branches, and endstations. Throughout the life of the project, the values of these parameters will be based on calculated and modeled quantities.

Beamlines can contain one or more photon delivery system branches, and each photon delivery system branch can contain one or more endstations. Energy range is determined by the monochromator geometry (e.g., included angle) and angular scanning ranges. Energy resolution is determined by the diffraction properties of the dispersing element, e.g., d-spacing of diffracting crystals and line spacing of diffraction gratings. Spot size and flux on sample are calculated, using ray tracing, from the source properties and the optical transfer function (magnification and demagnification) of the photon delivery system, which includes the effects of optical surface imperfections (figure and finish), filters, and limiting apertures. The table indicates which beamlines, branches, and endstations are in the NEXT threshold scope.

	Endstation	Energy Range (keV) Energy Resolution	Spot Size (VxH μm^2), mode	Flux (photons/s)	Threshold Scope
ESM	WEL Branch				Y
	μ-ARPES	0.015–1.5, $\geq 10^{-5}$	1 × 1	$\geq 1\times10^{10}$	Y
	AC-XPEEM	0.015–1.5, $\geq 10^{-5}$	36 × 6	$\geq 1\times10^{11}$	N*
FXI	Main Branch				N*
	TXM	5-11, 1.3×10^{-4}	40 μm FOV, 30 nm res.	5×10^{13} @ 10 keV	N
ISR	Inboard Branch				Y
	6-circle Diffractometer	6–23, 2.4–23, 1.3×10^{-4}	Variable to 40 × 200	$\geq 2\times10^{12}$ @ 10 keV	Y
	Base Diffractometer #1	6–23, 2.4–23, 1.3×10^{-4}	Variable to 40 × 200	$\geq 2\times10^{12}$ @ 10 keV	Y
	Base Diffractometer #2	2.4–23, 1.3×10^{-4}	Variable to 4 × 20	$\geq 2\times10^{12}$@ 10 keV	N*
	Outboard Branch (design only)				N
	4-circle	~15, 1.3×10^{-4}	10's × 10's	10^{12}	N
ISS	Main Branch				Y
	X-ray Emission, X-ray Absorption	4.9–36 1.3×10^{-4} (Si(111) DCM), 2.7×10^{-5} (high res mono)	25 × 25 (spectrometer), 1000 × 1000 (standard), 3mm×60mm (unfocused)	$\geq 2\times10^{13}$ (4.9-25 keV)	Y
SIX	Main Branch				Y
	Inelastic Soft X-ray Scattering	0.165–2.3, $\geq 10^{-5}$	0.3 × 2.5	$\geq 1.5\times10^{11}$ @ 10^{-5} res'n, $\geq 8\times10^{12}$ @ 10^{-4} res'n	Y
SMI	Inboard Branch				Y
	GISAXS	2.05–24 keV 1.3×10^{-4} (Si(111) DCM)	Ranges: 2.5×30 to 26×215	$\geq 10^{13}$	Y
	Liquid Surface Scattering	6.5–24 keV 1.3×10^{-4} (Si(111) DCM)	17×148	$\geq 8\times10^{12}$	N*
	Outboard Branch (design only)				N
	Liquid Surface Scattering	6.5–24 keV 1.3×10^{-4} (Si(111) DCM)	17×148	$\geq 10^{12}$	N

* Infrastructure for these endstations included in NEXT baseline scope.