

Unreviewed Safety Issue (USI) Evaluation Form

USI Evaluation No.: NSLS-II-EVAL-2015-003, Rev. 1

Title of USI Evaluation and Sponsor or Condition Owner:

Installation and Operation of ABBIX Beamlines

Steven Moss, PS Authorization Basis Manager

I. Description of Proposed Activity or Discovered Condition

See “Attachment for ABBIX – Beamlines 16 & 17 Installation USI Evaluation”, which includes Description and Safety Analysis.

REFERENCES

- 1) *Unreviewed Safety Issue Determination Procedure*, PS-C-ESH-PRC-002, Ver. 4, June 27, 2014.
- 2) *Safety Assessment Document for the National Synchrotron Light Source II*, PS-C-ESH-RPT-001, Ver. 3, May 2015, including Amendment No. 1, incorporating USI Evaluation No. NSLS-II-EVAL-2015-004, Rev. 1 dated 11/16/15.
- 3) *Accelerator Safety Envelope (ASE) NSLS-II*, PS-C-ESH-ROASE-001, Ver. 3, November 2015.
- 4) BNL SBMS Subject Area, *Accelerator Safety*, Section 8, “Unreviewed Safety Issue (USI) Process”.
- 5) *NSLS-II Process Description: Review Process for Facility Additions and Modifications*, PS-C-CMD-PLN-001, Ver. 4, September 4, 2014.
- 6) *NSLS-II Beamline Radiation Safety Commissioning Plan*, PS-C-XFD-PRC-004, Ver. 3, December 12, 2014.
- 7) *Final Design Report (FDR) for the ABBIX Project (Advanced Beamlines for Biological Investigations with X-rays) at the National Synchrotron Light Source II*, Ver. 1, November 2013.
- 8) USI Evaluation No. NSLS-II-EVAL-2014-015, “*Confirmation of Shielding Adequacy for EPU49, IVU21 and 22 Insertion Devices*”, Negative Determination, August 8, 2014.
- 9) *NSLS-II Technical Note No. 176, “16-ID LIX Beamline Radiation Shielding Analysis”*, June 16, 2015.
- 10) *NSLS-II Technical Note No. 189, Revised, “17-ID AMX/FMX Beamline Radiation Shielding Analysis”*, February 17, 2016.

11) *Final Design Report (FDR) for the ABBIX Project (Advanced Beamlines for Biological Investigations with X-rays) at the National Synchrotron Light Source II, Ver. 1 dated November 2013.*

12) *Hazard Analysis Report for the NSLSII Experimental Tools (NEXT) Beamlines and Advanced Beamlines for Biological Investigations with X-rays (ABBIX), LT-C-ESH-RPT-001, Ver. 4 December 2013.*

II. Does the proposed activity or discovered condition affect information presented in the Safety Assessment Document (SAD) (e.g., regarding equipment, administrative controls, or safety analyses)?

NO – Within the Safety Assessment Document for the National Synchrotron Light Source II [PS-C-ESH-RPT-001, Ver. 3 dated May 2015] Ref. 2, the following sections were reviewed without any impact:

Section 3.12 – Beamline Installation and Operations, including all subsections.

Section 3.9 – Radiation Protection System; Subsection 3.9.4 – Personnel Protection System - Beamlines

Section 4.15 – Ionizing Radiation Hazards during Routine Operations; Subsection 4.15.4 – Beamlines and Beamline Front Ends; Subsection 4.15.5 – Shielding for the FOE; Subsection 4.15.6 – Shielding Guidelines for the Experimental Enclosures; Subsection 4.15.7 – Shielding guidelines for the Experimental Beam Transport; Subsection 4.15.9 – Abnormal Beamline Operating Conditions, Including Maximum Credible Incident Vacuum Surges

Section 5.2 – Bases for Credited Controls for Operations at the NSLS-II Facility; Subsection 5.2.4 – Credited Controls for Radiation Hazards; Subsection 5.2.6 – Credited Control Supports for Radiation Hazards; Subsection 5.2.7 – Calibration, Testing, Maintenance and Inspection that maintain Credited Controls.

III. Does the proposed activity or discovered condition affect any of the requirements of the Accelerator Safety Envelope (ASE)?

NO – The proposed beamlines will conform to the requirements specified in the ASE. Within the DOE-approved NSLS II ASE [PS-C-ESH-ROASE-001, Ver. 3 dated November 2015] Ref. 3; the following sections were reviewed for impact on requirements, without any impact found:

Section 2.2 – Credited Controls for Radiation Hazard; Criterion 2.2.1 – Each accelerator and beamline when operational must have its Personnel Protection System (PPS) and associated barriers, including gates, fencing, and berms, and the area radiation monitoring system operational and certified in compliance with the approved procedure. The relevant PPS must be operational during testing of the RF cavities; Criterion 2.2.2 – All required radiological shielding for an area must be in place and certified in compliance with the approved inspection procedure during operation of that area with the radiation hazard; Criterion 2.2.3 – All required burn-through devices must be in place and certified in compliance with an approved inspection procedure during operation of a front-end with the radiation hazard.

Section 3 – Credited Control Supports; Criterion 3.1 – All required shielding and burn-through devices specified for the start-up of each accelerator or beamline shall be maintained in its approved configuration during operation and properly restored after maintenance periods; Criterion 3.2 – The accelerators and beamline PPS and associated barriers shall be maintained in its approved configuration; Criterion 3.3 – The area radiation monitoring system interfaced with the PPS for an area that is operational with beam shall be maintained in its approved configuration (Beam requirement only).

Section 4 – Calibration, Testing, Maintenance and Inspection That Maintain Credited Controls; Criterion 4.1 – All PPS must be functionally tested and revalidated at intervals consistent with the BNL Radiological Control Manual (Appendix 3A); Criterion 4.2 – Area radiation monitors must undergo annual calibration. The time between annual calibrations shall not exceed 15 months; Criterion 4.3 – Following all major shutdowns (> 15 days), radiological shielding and barriers (berms, shield blocks and fencing) must undergo visual inspection prior to operations to ensure that all required elements are in place and functional.

IV. USI Evaluation Criteria

1. Could the change or discovered condition significantly increase the probability of occurrence of an accident previously evaluated in the SAD?

Y or N

Justification: The design, installation and operation of a new beamline in accordance with the pre-planned methodology outlined in the SAD and adhering to the key procedures and processes spelled out in References 5 and 6 above assures that the design is well analyzed before it is built; to confirm its fitting within the established safety envelope for beamlines at NSLS-II. The successful completion of the project's

PDR itself establishes that the design was determined to be in accordance with the guidelines and limits of the SAD. The beamline commissioning process is already established to confirm that the completed beamline performs within the same safety boundaries before being authorized to operate. See the “Attachment for ABBIX – Beamlines 16 & 17 Installation/Operation USI Evaluation” for additional details on beamline design and safety analysis. That said, the installation and operation of ABBIX Beamlines as currently planned does NOT significantly increase the probability of occurrence of an accident previously evaluated in the SAD.

2. Could the change or discovered condition significantly increase the consequences of an accident previously evaluated in the SAD?

Y or N

Justification: The design, installation and operation of a new beamline in accordance with the pre-planned methodology outlined in the SAD and adhering to the key procedures and processes spelled out in References 5 and 6 above assures that the design is well analyzed before it is built; to confirm its fitting within the established safety envelope for beamlines at NSLS-II. The successful completion of the project’s PDR itself establishes that the design was determined to be in accordance with the guidelines and limits of the SAD. The beamline commissioning process is already established to confirm that the completed beamline performs within the same safety boundaries before being authorized to operate. See the “Attachment for ABBIX – Beamlines 16 & 17 Installation/Operation USI Evaluation” for additional details on beamline design and safety analysis. That said, the installation and operation of ABBIX Beamlines as currently planned does NOT significantly increase the consequences of an accident previously evaluated in the SAD.

3. Could the change or discovered condition significantly increase the probability of occurrence of a malfunction of equipment important to safety (e.g., engineered credited controls) previously evaluated in the SAD?

Y or N

Justification: For the reasons previously discussed in response to Questions 1 and 2 above and amplified by the “Attachment for ABBIX – Beamlines 16 & 17 Installation/Operation USI Evaluation” with its links; the installation and operation of ABBIX Beamlines as currently planned does NOT increase the probability of occurrence of a malfunction of equipment important to safety (e.g., engineered credited controls) previously evaluated in the SAD.

4. Could the change or discovered condition significantly increase the consequences of a malfunction of equipment important to safety (e.g., engineered credited controls) previously evaluated in the SAD?

Y or N

Justification: For the reasons previously discussed in response to Questions 1 and 2 above and amplified by the “Attachment for ABBIX – Beamlines 16 & 17 Installation/Operation USI Evaluation” with its links; the installation and operation of ABBIX Beamlines as currently planned does NOT significantly increase the consequences of a malfunction of equipment important to safety (e.g., engineered credited controls) previously evaluated in the SAD.

5. Could the change or discovered condition create the possibility of a different type of accident than any previously evaluated in the SAD that would have potentially significant safety consequences?

Y or N

Justification: For the reasons previously discussed in response to Questions 1 and 2 above and amplified by the “Attachment for ABBIX – Beamlines 16 & 17 Installation/Operation USI Evaluation” with its links; the installation and operation of ABBIX Beamlines as currently planned could NOT create the possibility of a different type of accident than previously evaluated in the SAD that would have potentially significant safety consequences.

6. Could the change increase the possibility of a different type of malfunction of equipment important to safety (e.g., engineered credited controls) than any previously evaluated in the SAD?

Y or N

Justification: For the reasons previously discussed in response to Questions 1 and 2 above and amplified by the “Attachment for ABBIX – Beamlines 16 & 17 Installation/Operation USI Evaluation” with its links; the installation and operation of ABBIX Beamlines as currently planned does NOT increase the possibility of a different type of malfunction of equipment important to safety (e.g., engineered credited controls) than any previously evaluated in the SAD.

V. USI Determination

A USI is determined to exist if the answer to any of the 6 questions above (in Section V) is "Yes." If the answers to all 6 questions are "No," then no USI exists.*

Does the proposed activity (or discovered condition) constitute a USI?

Yes – DOE approval required prior to implementing, or discovered condition remedied in accordance with the Section 6.4 of PS-C-ESH-PRC-002, *Unreviewed Safety Issue Determination Procedure*.

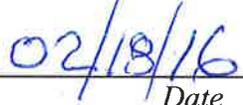
No – Proposed activity may be implemented with appropriate internal review, or no further action is required to address the discovered condition's impact on accelerator safety (other actions may be required to meet other PSD or Laboratory requirements).

Despite the reliance on specific previously established ASE Credited Controls, these new Beamlines do not include any new hazards requiring additional Credited Controls nor do they expand the Safety Envelope already agreed to (which contains and relies upon the use of the established Credited Controls to assure adequate safety of personnel, public, and the environment).

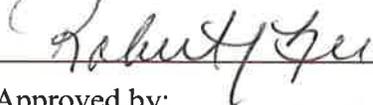
*According to the SBMS Subject Area, *Accelerator Safety; Section 8 – Unreviewed Safety Issue (USI) Process; Step 6*: If the USI Process determination is that the discovery or planned change will impact credited controls, existing MCIs, create new MCIs or cause an increase in the risk classification as per the SAD risk table, it is a USI.



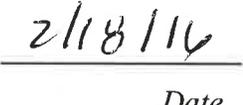
Prepared by: (Qualified Evaluator)



Date



Approved by:



Date

Att. for ABBIX Beamlines Installation/Operation USI Evaluation

Description:

The National Institutes of Health (NIH) provided funding to NSLS-II to design and construct three “best-in-class” insertion device beamlines in order to address NIH mission needs in the biological sciences arena. The project to perform this work at NSLS-II is identified as “Advanced Beamlines for Biological Investigations with X-rays” (ABBIX). All three ABBIX Project beamlines operate in the hard x-ray range, with one (LIX) extending to lower photon energy, down to ~ 2.1 keV. Two beamlines (AMX, FMX) are dedicated to macromolecular crystallography (MX), and one (LIX) is dedicated to small-angle/wide-angle x-ray scattering (SAXS/WAXS). These three-letter acronyms designating ABBIX beamlines stand for:

AMX – Flexible Access and Highly Automated Beamline for Macromolecular Crystallography [17-ID]

FMX – Frontier Macromolecular Crystallography at an Undulator Beamline [17-ID]

LIX – High Brightness Beamline for X-ray Scattering for Life Sciences [16-ID]

Layouts of the standard NSLS-II Undulator beamlines (both canted and non-canted) include the following common subassemblies; Bending Magnet Photon Shutter/Absorber (BMPS), Slow Gate Valve (SGV), Photon Beam Position Monitor (XBPM), Fixed Aperture Mask (MSK), Lead Collimator (CO1), X/Y Slits (SLT), Fast Gate Valve (FGV), Photon Shutter (PSS), Lead Collimator (CO2), Safety Shutters (SSH), and Ratchet Wall collimator (RCO). The LIX beamline uses a non-canted front end while the FMX/AMX beamlines share a canted front end.

In accordance with the requirements of PS-C-CMD-PLN-001, “NSLS-II Process Description: Review Process for Facility Additions and Modifications” [Ref. 5] and PS-C-XFD-PRC-004, “NSLS-II Beamline Radiation Safety Commissioning Plan” [Ref. 6]; the design and construction of the ABBIX beamlines have been analyzed to confirm not only compliance with the NSLS-II Shielding Policy but also fit within the analyzed radiological safety envelope of the SAD [Ref. 2], as determined by NSLS-II Technical Note No. 176, “16-ID LIX Beamline Radiation Shielding Analysis” and NSLS-II Technical Note No. 189, Revised, “17-ID AMX/FMX Beamline Radiation Shielding Analysis”.

Hazard No.	Hazard Type	Pre-Mitigation Risk Category	Post-Mitigation Risk Category	Associated Credited Controls
1	Natural Phenomena	Low	Routine	-
2	Environmental	Moderate	Low	-
3	Waste	Moderate	Low	-
4	Fire	High	Low	-
5	Electrical	High	Low	-
6	Vacuum & Cooling	Moderate	Low	-
7	Noise	Low	Routine	-
8	Cryogenic, including ODH	Moderate	Low	ODH
9	Chemicals & Hazardous Mtls.	High	Low	-
10	Ionizing Radiation	High	Low	ACMIs, PPS, RSCs, ARMs
11	Non-ionizing Radiation	Moderate	Low	-
12	Material Handling	High	Low	-
13	Experimental (Other)	Moderate	Low	-

The Table above was developed from the "Hazard Analysis Report for the National Synchrotron Light Source II Experimental Tools (NEXT) Beamlines and Advanced Beamlines for Biological Investigation with X-rays (ABBIX)" - [LT-C-ESH-RPT-001, Ref. 12 above].

Safety Analysis:

Authorization for a new Beamline or Accelerator component follows performance of a successful review process defined by an approved procedure, "NSLS-II Process Description: Review Process for Facility Additions and Modifications" – [PS-C-CMD-PLN-001, Ref. 5 above]. The review process includes: 1) completion of a Conceptual Design Review (CDR), followed by a Preliminary Design Review (PDR) and culminating with a Final Design Review (FDR); 2) a USI screening and/or evaluation; 3) development and execution of an Instrument Readiness Plan (IRP); and 4) implementation of an Instrument Readiness Review (IRR). With the completion of the Final Design Report of the ABBIX Project Beamlines [Ref. 11 above], adequate technical detail and review results exist to assure that the design of the ABBIX Project Beamlines meet the established beamline safety envelope provided in the "Safety Assessment Document for the National Synchrotron Light Source II" – [PS-C-ESH-RPT-001, Ref. 2 above]. There is another approved procedure, "NSLS-II Beamlines Radiation Safety Commissioning Plan" – [PS-C-XFD-PRC-004, Ref. 6 above] for assuring that the Beamline, as constructed will be commissioned within the bounds of the already established safety envelope before routine beam operations are authorized. See results of the ABBIX Beamline reviews and analyses at the following location [http://www0.bnl.gov/nsls2/project/reviews/150618_ABBIX%20Status%20Review/default.asp].

All the beamline hazards have been reviewed and found to be within the Safety Envelope already described in the SAD, as evidenced by the results presented in References 7, 8, 9, 10, 11, and 12 above.