Attachment B

USI Screening Checklist

A) USI Screening Purpose:	**B) Description of Proposed Activity/Discovered Condition and Sponsor/Condition Owner:**
☒ **Proposed Activity** ☐ **Existing Condition**	Top-Off Radiological Safety Analysis for SIX (02-ID) / M. Benmerrouche, R. Fliller and Y. Li [NSLSII-TOS-RPT-010]
C) USI Screening Outcome:	**USI Screening Performed by/Date:**
☒ **No potential USI** ☐ ***Potential USI***	Steve Moss / January 4, 2017 SA Moss 01/04/17

Qualified Screener answers the following questions; if:

- Any question is answered yes (i.e., "Y"), check "Potential USI" box in Part C, above.
- If all questions are answered no (i.e., "N"), check "No potential USI" box in Part C, above.

Does the proposed change or discovered condition impact or potentially impact:

1) The personnel protection system (PPS)?
Examples: Access doors, fencing, hutches, accelerator enclosures, software change, hardware modifications that are not, "replacement-in-kind."

☐Y or ☒N

2) ODH Monitoring System?
Examples: Hutch ODH monitors, filling station ODH monitors.

☐Y or ☒N

3) Radiation Safety Component?
Examples: Shielding, earthen berms, hutches, concrete walls, beam shutters, scatter shields, burn-through devices, exclusion zones, labyrinths, beam stops, beam masks, collimators, hutch guillotine and beam transport pipes.

☐Y or ☒N

4) Area radiation monitoring system or components?
Examples: Changing instrument position or use of a new type of instrument used for area radiation monitoring, alarms and controls.

☐Y or ☒N

5) Radiological source terms identified in the SAD?
Examples: New insertion devices, change to the maximum synchrotron energy or accelerated charge values, accelerator modifications that are not "replacement-in-kind."

☐Y or ☒N

6) Critical devices
Examples: Safety shutters, dipole magnets, top-off apertures.

☐Y or ☒N

7) PS operating organization?
Examples: Control room operators, support staff responsible for PPS, radiation monitoring or shielding configuration management.

☐Y or ☒N

8) Operational safety limits described in the Authorization Basis Documents?
Examples: Maximum current, beam energy, pulse rate.

☐Y or ☒N

Forward the completed form to the Authorization Basis Manager

Attachment B

USI Screening Checklist

A) USI Screening Purpose: ☒ **Proposed Activity** ☐ **Existing Condition**	**B) Description of Proposed Activity/Discovered Condition and Sponsor/Condition Owner:** SIX (02-ID) Beamline Radiation Shielding Analysis / M. Benmerrouche [NSLS II Technical Note No. 235 dated 01/10/17], as reviewed and approved by Photon Science Radiation Safety Committee on January 12, 2017.
C) USI Screening Outcome: ☒ **No potential USI** ☐ ***Potential USI***	**USI Screening Performed by/Date:** Steve Moss / January 17, 2017 S H Moss 01/17/17

Qualified Screener answers the following questions; if:

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Attachment B

USI Screening Checklist

A) USI Screening Purpose:	**B) Description of Proposed Activity/Discovered Condition and Sponsor/Condition Owner:**
☒ **Proposed Activity** ☐ **Existing Condition**	2-ID Commissioning Readiness / (SIX) NEXT Proposed diagnostic beamlines utilizing EPU sources have already been planned for and analyzed within the SAD and is discussed in Sections 3.3.3.6 – Storage Ring and Section 3.3.3.8 – Photon Sources. See especially Table 3.8 – Insertion Devices Included in the Baseline Configuration of NSLS-II and Table 3.9 – Basic Parameters of NSLS-II Radiation Sources for Storage Ring Operation at 3.0 GeV and 500 mA. Additional analyses are included within negative USI Evaluation No. NSLS-II-EVAL-2014-015, "Confirmation of Shielding Adequacy for EPU49, IVU 21 and 22 Insertion Devices". Supplemental analyses specific to Beamline SIX (02-ID) have been prepared, including: Bremsstrahlung and Synchrotron Ray Trace Drawings; NSLS-II Technical Note No. 235, by M. Benmerrouche, "02-ID SIX Beamline Radiation Shielding Analysis", dated January 10, 2017; and NSLS-II Technical Note No. NSLSII-TOS-RPT-010, by M. Benmerrouche, R. Fliller and Y. Li, "02ID (SIX) Top-Off Radiation Safety Analysis", dated January 6, 2017. The Photon Science Radiation Safety Committee has reviewed all of the documents and confirmed that the design and analysis of SIX beamline complies with the NSLS Shielding Policy (subject to experimental verification by radiation survey) and that the various Radiation Safety Devices as designed and installed are adequate to protect against thermal failure of shielding components.
C) USI Screening Outcome: ☒ **No potential USI** ☐ ***Potential USI***	**USI Screening Performed by/Date:** Steve Moss / January 17, 2017 01/17/17

Qualified Screener answers the following questions; if:

- Any question is answered yes (i.e., "Y"), check "Potential USI" box in Part C, above.
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Examples: Control room operators, support staff responsible for PPS, radiation monitoring or shielding configuration management.

☐Y or ☒N

8) Operational safety limits described in the Authorization Basis Documents?
Examples: Maximum current, beam energy, pulse rate.

☐Y or ☒N

Forward the completed form to the Authorization Basis Manager

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Memo

Date: January 16, 2017
To: Ignace Jarrige, Steven Hulbert, and Paul Zschack
From: Zhong Zhong (chair), Photon Science Radiation Safety Committee
Subject: Review of the radiation safety configuration design of the 2-ID, SIX, beamline

Dear Ignace, Steve, and Paul

The Photon Science Radiation Safety Committee (RSC) conducted review of the design of the SIX beamline, 2-ID, on Thursday January 12, 2017. Subjects reviewed include synchrotron max-fan and Bremsstrahlung drawings, Secondary Bremsstrahlung and synchrotron radiation shielding analysis, top-off safety analysis, and aspects of thermal management that relate to radiation safety.

Written documents

The following documents and drawings were reviewed:

1. SIX assembly drawing, PD-SIX-RAYT-0001 rev. A, by S. Pjerov, sheet 1, "SIX Beamline Ray Tracing".
2. SIX Bremsstrahlung ray-tracing drawings, PD-SIX-RAYT-0001 rev. A, sheets 6 and 7 for horizontal and vertical projections, respectively.
3. SIX max. synchrotron ray-tracing drawings, PD-SIX-RAYT-0001 rev. A, sheets 2 and 4 for horizontal and vertical projections, respectively, and sheet 8 for mirror- mis-steered synchrotron ray tracing. Additional details for the masks and collimators are shown on sheets 3, 5, and 9.
4. Power point presentation "Radiation Safety Committee Meeting for 2-ID" by Ignace Jarrige dated January 12, 2017.
5. NSLS-II technical note, #235, by M. Benmerrouche entitled "02-ID SIX Beamline Radiation Shielding Analysis" dated January 10, 2017. The document presents analysis results of Gas Bremsstrahlung (GB) as well as Synchrotron Radiation (SR) at 500 mA.
6. NSLS-II technical note, #NSLSII-TOS-RPT-010, by M. Benmerrouche, R. Fliller, and Y. Li entitled "02ID (SIX) Top-off Radiation Safety Analysis", dated January 6, 2017.

Oral Presentation

Attendance: Andrew Ackerman, Mo Benmerrouche, Wah-Keat Lee, Steven Hulbert, Ignace Jarrige, Boris Podobedov, Chuck Schaefer, Lutz Wiegart, Emil Zitvogel, and Zhong Zhong

Ignace Jarrige gave the presentation entitled "Radiation Safety Committee Meeting: 2-ID". Following the guideline from the memo by Paul Zschack to the RSC on May 29, 2014, the following were discussed:

1. SIX is a soft x-ray spectroscopy beamlines that operates from 160 to 2300 eV with flux on the sample in the 10^{11} to 10^{13} ph/s range, depending on the gratings. The beamline serves one endstations located in the satellite building. The planar grating monochromator (PGM), housing three Variable Line Space (VLS) gratings, is on the experimental floor. The source is the a 3.5 m long EPU57. Shielding design and simulations assume 7-m long EPU57 to allow for future addition of another un-canted 3.5 m long EPU57.
2. The white beam on the M1 mirror is controlled by the front-end shutter. The pink beam on the monochromator is controlled by shutter at the downstream end of the FOE (First Optical Enclosure).
3. Shielding for the primary Bremsstrahlung x-rays is designed using ray-tracing method. A collimator and beamstop combination, with a horizontally deflecting mirror M1 in between, stops the primary Bremsstrahlung in the FOE. The Lead collimator at 31.540 m is protected by a fixed mask. The Bremsstrahlung beam-stop, at 35.647 m, intercepts all possible primary Bremsstrahlung radiation.
4. Shielding and control of secondary Bremsstrahlung radiation is designed by ray-tracing from possible secondary scattering sources in FOE, and verified by FLUKA analysis performed by Benmerrouche.
5. On the experimental floor, x-rays are shielded by the vacuum chambers and beam transport pipes. Shielding of pink synchrotron x-ray in the special 6.35 mm thick stainless steel transport pipes and PGM chamber is validated by STAC8 simulation of Benmerrouche. The pink beam is terminated by a copper/tungsten beam-stop downstream of the PGM.
6. Thermal protection of the beamline shielding components is designed using ray-tracing method. The design is supported by synchrotron ray-tracing drawings assuming maximum possible synchrotron fan and M1 alignment errors. The masks for thermal protection were designed and fabricated in-house, and were reviewed by design-review process.
7. Similar to the CSX beamline that has been in operation for two years, access to the SIX endstations, monochromator chamber, and pink-beam transport is controlled by PPS (personnel protection system) using SIL-3 rated vacuum switches. Access to the FOE is by standard door interlock and search-and-secure mechanism.
8. The PPS logic diagram for the SIX beamline was reviewed separately by the RSC PPS subcommittee.
9. The SIX front-end ray-tracing was previously reviewed by the RSC ray-tracing subcommittee.
10. Configuration control of the radiation safety component was discussed.

Peet's coffee was served and appreciated by many in the morning hours.

Notes

The following comments are noted for completeness:

1. The aluminum enclosure downstream of the FOE is not transparent. Procedure for verification of the PBM2 and SBC, both housed inside the enclosure, should be similar to that for shielding components inside vacuum chamber.

2. The RSC ray-tracing sub-committee has the following comments on ray-tracing:

- Page 2: (and potentially others): why is the source point labeled as 'center of short straight'? Isn't SIX installed on a long straight section (9m total, 7.xm total space for EPU)? For the horizontal Bremsstrahlung ray traces, the source point is labeled as 'center of long straight' (page 6), for the vertical ones 'short',…

- Page 2: component at 1482.633 [37658.87] is called out as 'Secondary Bremsstrahlung' … (missing 'collimator'?); same on page 4 (and page 8, detail on page 9)

- Page 2: 'ABBREVIZATIONS:' (typo), found on other pages as well

- Page 2: component label at 2300.000 [58420.00] (perpendicular red line) is missing; same on other pages, e.g. 4 (2 locations)

- Page 3: Detail G -> PGM beamstop is not labeled

Page 3, detail B: 'MMAX aperture M1 exit mask' (typo?)

- Page 4: cosmetic: the position of detail label 'L' is not very ideal

- Page 4 (bottom): it appears that the size of the beam footprint on the beamstop takes credit for focusing mirrors and slits…?

- Page 5: what are the green rays that seem to come from the source and end at Pink Beam Mask #1? I cannot find them in page 4…artifact of the 'line issue'?

- Page 5, detail N: I believe "(0.512 [13.00])MAX.DS APERTUREPINK BEAM MASK #3" and "Nom. US Aperture Pink Beam Mask #3" should both be "#4".

- Page 5, detail N: there is a dimension for 'downward clearance PGM entrance mask', but there is no component labeled as 'PGM entrance mask' (neither on page 4), nor are there any other dimensions for 'PGM entrance mask'.

- Page 5, detail N: in the absence of M2, there appears to be only a 0.5mm clearance between the pink beam ray and the aperture of the PGM exit mask. How is pink beam stopped if it makes it through the PGM exit mask? Can M2 be off in angle and reflect the whole beam through the PGM exit aperture?

- Page 6: tube dimensions for SGBC are labeled as BREM. COL. TUBE ID, which is pretty confusing as it is 'sandwiched' to the Primary Bremsstahlung Stop… SGBC TUBE ID would be more clear…

- Page 9: something (in fact A LOT) went wrong between details S and T: according to the dimension labels, Pink beam mask #1 is part of both details, although they don't overlap. I believe the dimension labels 'pink beam mask #1' in detail 'S' should have been 'M1 exit mask'. More mess in 'T': inboard and outboard clearance 'M1 entrance mask' should be 'Pink beam mask #1'. Inboard and outboard clearance 'Pink beam mask #1' -> SGBC tube/aperture/…

- Page 9, detail V: seriously? Just check the labels….M1 entrance mask -> PBM#2; Pink beam mask#1 -> Secondary Bremsstrahlung (Collimator…? See above…label incomplete also on page 8).

- Page 9 detail 'W': M1 entrance mask -> PBM#3

Recommendations

1. The sample chamber and diffractometer, both located in the satellite building, are being fabricated and installed. Thus the sample chamber is not in the scope of current review. Due to the complexity and uniqueness of the sample chamber, we recommend that the SIX team seek RSC review of the sample chamber after its installation, prior to its commissioning.
2. The ray-tracing drawings should be updated to address the comments by the RSC ray-tracing sub-committee.

Conclusions

1. Based on our assessment of the ray-tracing drawings, thermal analysis, and simulation results, the RSC find that the SIX beamline shielding design meets the NSLS-II shielding policy. Subject to experimental verification by radiation survey, we believe the installed shielding will provide adequate personnel protection for normal operation and against failures of synchrotron orbit.
2. Based on our review of the and max. synchrotron ray-tracing drawings, the RSC believes that the SIX masks, mirror, white- and pink- beam-stops are adequately designed to protect against thermal failure of shielding components.

Radiation Safety Committee

Name	*Expertise*	*Directorate*
Andrew Ackerman	Deputy ESH Manager	PS
Dana Beavis	Experimental Nuclear Particle Physics	NPP
Andi Barbour	Beam Line Physicist	PS
Mohamed Benmerrouche	Nuclear and Radiation Physics	PS
Scott Buda	Personnel Protective Systems	PS
Ray Fliller	Accelerator Physicist	PS
Wah-Keat Lee	Beam Line Physicist	PS
Boris Podobedov	Accelerator Physics	PS
Chuck Schaefer	Accelerator SME	ESH
Om Singh	Accelerator Controls	PS
Lutz Wiegart	Beam Line Physicist	PS
Zhong Zhong	Beam Line Physicist	PS
Emil Zitvogel	Accelerator Operations	PS
Ashley Shoemaker-Skokov	Administrative Support	PS

Ray-tracing sub-committee

Andrew Ackerman	Deputy ESH Manager	PS
Mary Carlucci-Dayton	Mechanical Engineer	PS
Wah-Keat Lee	Beam Line Physicist	PS
Chuck Schaefer	Accelerator SME	ESH
Christopher Stelmach	Designer	PS
Lutz Wiegart	Beam Line Physicist	PS
Zhong Zhong	Beam Line Physicist	PS

PPS sub-committee

Dana Beavis	Experimental Nuclear Particle Physics	NPP
Mohamed Benmerrouche	Nuclear and Radiation Physics	PS
Scott Buda	Personnel Protective Systems	PS
Robert Lee	ESH manager	PS
Zhong Zhong	Beam Line Physicist	PS