National Synchrotron Light Source

Building 743, National Synchrotron Light Source
Brookhaven National Laboratory
Upton, NY 11973-5000
Phone 631 344-2117
Fax 631 344-3238
zhong@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

Date: June 25, 2016
To: Elio Vescovo, Steven Hulbert, and Paul Zschack
From: Zhong Zhong (chair), Photon Science Radiation Safety Committee
Subject: Review of the radiation safety configuration design of the 21-ID, ESM, beamline

Dear Elio, Steve, and Paul

The Photon Science Radiation Safety Committee (RSC) conducted review of the design of the ESM beamline, 21-ID, on Friday June 3, 2016. Subjects reviewed include synchrotron max-fan and Bremsstrahlung drawings, Secondary Bremsstrahlung and synchrotron radiation shielding analysis, and aspects of thermal management that relate to radiation safety.

Written documents

The following documents and drawings were reviewed:

1. ESM assembly drawing, PD-ESM-RAYT-0001 rev. A, by S. Pjerov, sheet 1, "ESM Beamline Ray Tracing".
2. ESM Bremsstrahlung ray-tracing drawings, PD-ESM-RAYT-0001 rev. A, sheets 6 and 7 for horizontal and vertical projections, respectively.
3. ESM max. synchrotron ray-tracing drawings, PD-ESM-RAYT-0001 rev. A, sheets 2 and 3 for horizontal and vertical projections, respectively, and sheet 6 for mirror- mis-steered synchrotron ray tracing.
4. Power point presentation "Radiation Safety Committee Meeting: 21-ID Overview" by Elio Vescovo dated June 3, 2016.
5. NSLS-II technical note by V.J. Ghosh and M. Benmerrouche entitled "21-ID ESM Beamline Radiation Shielding Analysis" dated June 24, 2016. The document presents analysis results of Gas Bremsstrahlung (GB) as well as Synchrotron Radiation (SR) at 500 mA.

Oral Presentation

Attendance: Andrew Ackerman, Mo Benmerrouche, Mary Carlucci-Dayton, Vinita Ghosh, Wah-Keat Lee, Michael Lucas, Christie Nelson, Steven Hulbert, Kristen Rubino, Chuck Schaefer, Chris Stelmach, Ashley Showmaker-Skokov, and Zhong Zhong

Elio Vescovo gave the presentation entitled "Radiation Safety Committee Meeting: 21 ID Overview". Following the guideline from the memo by Paul Zschack to the RSC on May 29, 2014, the following were discussed:

1. ESM is a soft x-ray spectroscopy beamlines that operates from 15 to 1500 eV with flux on the sample in the 10^{10} to 10^{12} ph/s range. The beamline serves two endstations, ARPES and XPEEM, which along with the planar grating monochromator (PGM) are on the experimental floor. The sources, un-canted, are EPU57 and EPU105.
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). Monochromatic soft x-ray beams to the ARPES and XPEEM chambers are controlled by shutters located upstream of the endstations.
3. Shielding for the primary Bremsstrahlung x-rays is designed using ray-tracing method. A collimator and beamstop combination, with a horizontally deflecting mirror in between, stops the primary Bremsstrahlung in the FOE. The Lead collimator at 26.969 m is downstream of, and in close proximity to, a fixed mask. The Bremsstrahlung beam-stop, at 31.106 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 Ghosh and Benmerrouche. The simulation shows that exclusion outside of the FOE is not necessary.
5. On the experimental floor, x-rays are shielded by the vacuum chambers and beam transport pipes. Shielding of synchrotron x-ray in the transport pipes and endstations on the experimental floor is supported by analytical calculation of scattered x-ray flux and attenuation of these x-rays by steel chamber. These are documented in the Vescovo presentation. STAC8 simulation by Ghosh and Benmerrouche further validates effective shielding of synchrotron pink beam by the 8-mm PGM chamber.
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 was designed and fabricated in-house.
7. Similar to the CSX beamline that has been in operation for two years, access to the ESM 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 ESM beamline was reviewed separately by the RSC PPS subcommittee.
9. The ESM 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 in the kitchen outside of the meeting room. Many did not "smell the coffee" and missed it.

Notes

The following comments are noted for completeness:

1. EPU testing mode is to be administratively controlled to 100 mA ring current. This restriction is needed for equipment protection only. This mode has no radiation safety implications even at 500 mA.
2. Please spell out the "PB" as "Pink Beam" on page 8 of the presentation.
3. Please clarify the unit of the flux density as being ph/s/cm2 in the table on page 22 of the presentation.

Recommendations

There are no recommendations from the RSC at this time.

Conclusions

1. Based on our assessment of the ray-tracing drawings, thermal analysis, and simulation results, the RSC find that the ESM 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 ESM 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
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