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: February 15, 2018
To: Daniel Fischer, Joseph Woicik, Cherno Jaye, Conan Weiland, Howard Robinson, Andrew Broadbent, and Paul Zschack
From: Zhong Zhong (chair), Photon Science Radiation Safety Committee
Subject: Follow up of recommendations from the RSC on the radiation shielding design of the 7-ID, SST, beamline

Dear Dan, Joe, Cherno, Conan, Howard, Andy and Paul,

I would like to thank you for inviting the ray-tracing subcommittee of the Photon Science Radiation Safety Committee (RSC) yesterday to discuss actions the SST team took to address the recommendation from our recent review of the SST beamline, and to clarify details for M2 angle hardstop. The updated SST ray-tracings along with survey results of the white-beam stop and the M2 details were e-mailed to the subcommittee beforehand.

The following documents and drawings were reviewed:

1. SST assembly drawing, PD-SST-RAYT-0001 rev. B, by J. Fabijanic, sheets1 to 3, "SST Beamline Raytrace" showing plan and elevation view of both the tender and the soft branches, and how the soft branch monochromatic beam can feed into the tender experimental endstation via a transfer line.
2. SST Bremsstrahlung ray-tracing drawings, PD-SST-RAYT-0001 rev. B, sheets 7 and 8 for horizontal and vertical projections, respectively. Details for Bremsstrahlung lead and tungsten stops are included on sheet 8.
3. SST max. synchrotron ray-tracing drawings, PD-SST-RAYT-0001 rev. B, sheets 4 for horizontal projection, sheet 5 for vertical projections of M branch, and sheet 6 for vertical projections of L branch. Additional details for the beam mis-steering considerations and beam stop are shown on sheet 9 for M branch, and sheet 10 for L branch.
4. Vertical synchrotron max fan – M branch detail with FM1 and WBS survey updates, 2/13/2018. The drawing based on survey results shows 2.3 mm clearance at the top of the white-beam stop, and 1.5 mm clearance for the tapered part on the bottom.
5. E-mail from Scott Coburn concerning the robustness and the angular range of the new hard limit for the angle of M2. M2 is inside the PGM for the soft branch.
6. Detailed consideration of M2 mis-steering for incident angles from 1 degree to 11 degrees. The range considered is within that defined by the hard-stop.

The following were discussed:

1. Andy Broadbent explained the updates to the ray-tracing for the M2 mis-steering considerations.
2. M2 hard-stop limits the incident angle of M2 to above 1 degree. Sunil Chitra's simulation shows that reflected x-rays at all angles above 1 degree are adequately shielded by existing PGM chamber, beam pipe, and bellow shields.
3. The recent final RSC review of SST recommends that the team analyze the survey results to determine the actual clearances on the M branch white-beam stop. Andy Broadbent presented the survey results.
4. For the M branch white-beam stop, edge of WBS to white beam distance (clearance) based on survey results is 2.3 mm at the top of the white-beam stop, and 1.5 mm for the tapered part on the bottom. We consider this acceptable for the following reasons:
   a) The small distance (2.49m) between the WBS (at 29.142m) and the fixed mask (at 26.652m) means that it is unlikely for the relative heights of the WBS and fixed mask to change by 2 mm in the future.
   b) The small peak power of EPU60, at 6.7 kW/mr^2, results in the un-tapered part of the beam stop on the bottom and the cooled copper scatter shield on the top both being adequate for less than 0.7-1.5 mm of worst-case white-beam exposure. An FEA calculation performed for a similar situation for the PDF beamline, where 1.5 mm of worst-case white beam at a power density of about 27 kW/mr^2 (damping wiggler beam with 2 mm diamond filter) showed a maximum temperature of 280 deg. C, below the 300 deg. C suggested max. temperature. With a factor of 4 lower angular power density produced by the SST EPU60 source (6.7 kW/mr^2),we expect the un-tapered part of the beam-stop and the scatter shield to be safe for the EPU60 power.

Attendance: Andrew Ackerman, Andy Broadbent, Mo Benmerrouche, Sunil Chitra, Dan Fischer, Steve Hulbert, Wah-Keat Lee, Cherno Jaye, Chris Stelmach, Lutz Wiegart, Conan Weiland, and Zhong Zhong

Peet's coffee, served in lieu of lunch, was enjoyed by many, Chuck Schaeffer was missed by all.

Recommendation

Even though we believe that the EPU60 beam can be safely stopped by un-tapered cooled copper blocks based on the FEA results of PDF beamline for a similar condition, we recommend that the team perform the following two simulations for completeness:

1. 0.7 mm of EPU60 beam spills above the tapered white-beam stop on the top, and strikes the scatter shield at normal incidence.
2. 1.5 mm of EPU60 beam spills below the tapered white-beam stop on the bottom, and strikes the un-tapered part of the white-beam stop.

Note that these simulations are recommended for completeness, not for addressing radiation safety concerns. Thus commissioning of the SST beamline does not require the simulations.

Notes

Andi Barbour and Mo Benmerrouche reviewed the updated SST configuration control checklist yesterday, and conducted a walk-through of the SST beamline. I recommend approval of the checklist based on input from Andi and Mo.

Conclusions

1. As a result of the RSC ray-tracing sub-committee review, and the review of the configuration control checklist today by the RSC checklist subcommittee, we conclude that our prior recommendation shown above is satisfactorily addressed. We recommend approval of the ray-tracing drawings and closing of the recommendation from our recent final RSC review memo.
2. Subject to experimental verification by radiation survey, we believe the SST beamline shielding will provide adequate personnel protection for normal operation and against failures of synchrotron orbit.

Radiation Safety Committee

Name	*Expertise*	*Directorate*
Andrew Ackerman	Deputy ESH Manager	PS
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
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
Steven Hulbert	Interim Beamline Engineering Group Leader	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

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

RSC checklist sub-committee

Andi Barbour	Beam Line Physicist	PS
Mohamed Benmerrouche	Nuclear and Radiation Physics	PS
Ray Fliller	Accelerator Physicist	PS