National Synchrotron Light Source

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Memo

Date: July 13, 2017
To: Danny Padrazo, Bernard Kosciuk, WeiXing Cheng, David Siddons, and Sushil Sharma
From: Zhong Zhong (chair), Photon Science Radiation Safety Committee
Subject: Review of the ray-tracing design of the 3PW pinhole camera beamline in the frontend of Cell 22.

Dear Danny, Bernie, XeiXing, Pete and Sushil,

The Photon Science Radiation Safety Committee (RSC)'s ray-tracing subcommittee concluded review of the shielding design of the pinhole camera beamline in the frontend of Cell 22 on July 12. Subjects reviewed include the synchrotron max-fan and Bremsstrahlung drawings and aspects of thermal management that relate to radiation safety.

Written documents

The preliminary drawings were submitted to the RSC this March for preliminary review and feedback. Review requirements were discussed with Andrew Ackerman at that time. The following approved drawings were submitted on July 11, 2017 for final review:

1. Cell 22 front-end assembly drawing, SR-DG_BL-8001, Rev. A by J. Tuozzolo, March 2017.
2. Cell 22-BM, pin-hole camera bramline front-end Bremsstrahlung ray-tracing, SR-DG_BL-8001, Rev. A, sheets 4 and 5 for horizontal and vertical projections, respectively.
3. Cell 22-BM pin-hold camera beamline front-end max. synchrotron ray-tracing, SR-DG_BL-8001, Rev. A, sheets 2 and 3 for horizontal and vertical projections, respectively.
4. Power-point presentation "Overview of C22 TPW X-ray Pinhole Diagnostic Beamline", by Weixing Chen, July 19, 2017.

Notes

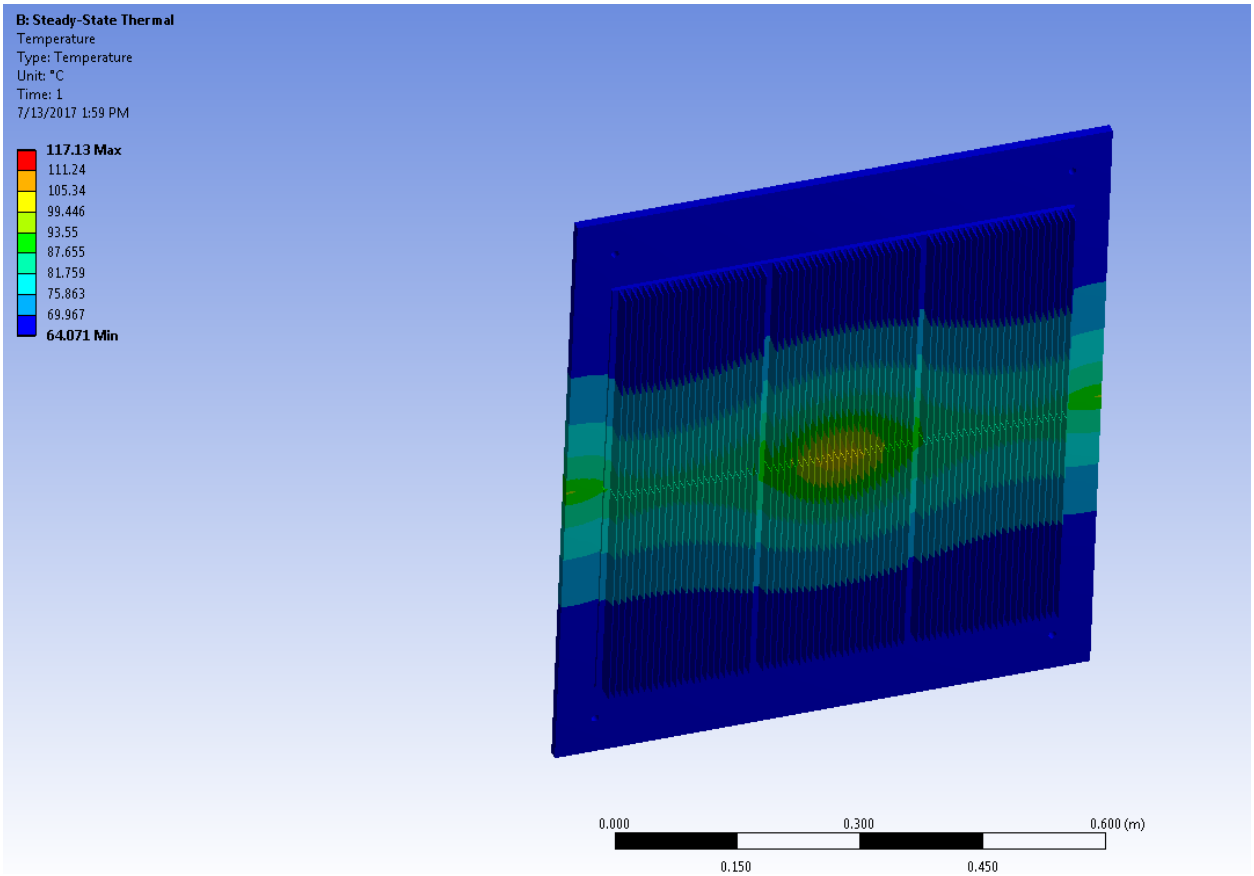
The following comments are noted for completeness:

1. Cell 22 is being purposed to be a diagnostic pinhole camera, using 3PW as x-ray source. The beamline is all contained inside the shielded wall.
2. Shielding for the primary Bremsstrahlung x-rays is designed using ray-tracing method. A collimator (shadow-shield, at 6.44 m) and beam-stop (at 22.14 m) combination stops the primary Bremsstrahlung in the frontend, upstream of the shielded wall. We noted that the beam-stop is 250 mm thick, instead of 300 mm typical beam-stop thickness. The standard ratchet-wall collimator, reviewed by the RSC in 2014, uses 250 mm lead thickness in the region overlapping with the concrete. Thus the 250 mm thickness is sufficient since there is concrete shield-wall behind the beamstop.
3. Since the pinhole camera beamline is located completely in the frontend, inside the shielded wall of the storage ring, procedure for reviewing front-end designs is used for reviewing this beamline. This was discussed with Andrew Ackerman in March. We note that the current ray-tracing procedures for front-end differs slightly from that of beamline at the NSLS-II.
4. The beamline uses a 3PW as source through the pinhole and Diamond windows (500 microns upstream of the pinhole, and 75 microns downstream of the transport pipe). The pin-hole can be retracted and thus is not taken credit for in the ray-tracing, nor should it be configuration controlled. The mask uses the standard mask design for NSLS-II 3PM frontends.
5. The lead beam-stop is protected by a half-inch thick sheet of aluminum with cooling fins. At our request, Bernie Kosciuk provided FEA result, attached below, for 950 Watts of power on the aluminum. The final design review for the aluminum plate was positive. Considering that the three-pole wiggler power is less than 300 W, there is no thermal risk to the shielding.
6. The beamline has a diamond window in the front-end separating the beamline vacuum from the ring vacuum.
7. The radiation shielding components checklist for the beamline was previously reviewed by the RSC checklist sub-committee members, Mo Benmerrouche and Ray Fliller, as part of Pentant-2 checklist.

Conclusions

1. Based on our assessment of the ray-tracing drawings the RSC finds that the cell-22 pin-hole camera 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 max. synchrotron ray-tracing drawings, the RSC believes that the cell-22 pin-hole camera beamline's mask, white-beam transport, and white-beam stop are adequately designed to protect against thermal failure of shielding components.
3. Based on our review of the beamline layout, the RSC finds that all Radiation Safety Components meet NSLS-II design requirements.

FEA result for the aluminum plate with heat sink cooling fins at 950 W power



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Andi Barbour	Beam Line Physicist	PS
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