INTRODUCTION AND SCOPE OF REVIEW [1] (S. Rokni)

The committee was first requested for its advice on the approval of the LCLS NEH hutch 1 shielding for experiments in the soft X-ray line and for the radiation protection aspect of the design of the AMO instrument. In addition, the committee was asked to review the results of the recent B4C tests, and the proposed plans for next measurements and an update on the proposed mitigation for LCLS electron and photon stopper BTMs failure modes. The latter two topics (B4C, and BTM) were follow up reviews on previous committee meeting. S. Rokni stated that the RSC will be requested to review the NEH HPS/PPS and the Operational Radiation Safety Program for photon beam lines operation in a later meeting prior to the AMO commissioning and are excluded from the scope of this review.

RADIATION SAFETY ANALYSIS FOR THE AMO [2,3] (A. Prinz)

A. Prinz presented the radiation safety analysis related to the operation of the AMO experiment inside the first hutch of the NEH considering no-access mode and the hutch shutters of the two other beamlines in FEE in a locked-closed position. The radiation source which was used in the past for the assessment of the shielding requirements in the NEH appears to be conservative now that the properties of the mirrors and collimators inside the FEE have been specified. Thin layers of metal (less than 1 mm lead) or concrete are sufficient to attenuate the soft X-ray beam. Due to the focusing capability of the instrument, the FEL beam can potentially burn-through the B4C apertures which are implemented along the beamline for machine protection purpose. For the containment of the FEL beam, a ray trace was performed considering all possible beam trajectories.

[1] Acting committee chair
[2] Nonvoting member due to potential conflict of interest
beam stop, consisting of an air volume and a steel plate, large enough to cover all those trajectories is proposed to contain the beam inside the hutch considering that in abnormal situation the beam could drill a hole through the vacuum chamber. A calculation was performed to show that for any focusing condition the beam is sufficiently attenuated by air before reaching the steel absorber on the concrete wall. Members of the committee asked about possible mechanisms which could occur while the FEL beam travel into the air reducing the expected attenuation. As those phenomena are well known for Laser light, (bleaching) the committee asked for further investigation of this effect (Action Item 1).

Radiation Safety Analysis for the AMO (J. Bozek) [4,5,6,7]

J. Bozek presented the physics capabilities and the layout of the AMO instrument and the different operational mode (with or without KB mirrors). More detailed on the assumptions used in the ray trace analysis were provided to the committee. S. Rokni mentioned that per his request, the ray trace was reviewed by M. Rowen [8] who concluded that the proposed plan for using the hutch shielding is very safe as long as personnel are excluded from the hutch during beam operations in AMO. The systems in place to ensure that the instrument is operating in its intended mode (e.g. proximity sensor, differential pumping B₄C aperture) were also presented. It was made clear that while those devices are implemented to contain the beam in its intended path (as part of machine protection system), they are not part of Radiation Safety Systems. More details on the assumptions used to assess the attenuation provided by air were provided and the same comments were repeated by the committee (see action item 1).

B₄C Survivability Test, Phase 3 (S. Moeller) [9,10]

Descriptions of Phases 1 and 2 of the test were previously provided to the committee. Phase 1 was completed and several measurement techniques were used before concluding that the B₄C sample exposed to 3 million pulses at 830 eV did not experience any damage besides a discoloration of the surface. It was mentioned that the YAG screen which is being monitored as part of the procedure ensuring that the stoppers are not exposed to potentially damaging beam was accidently damage at low energy when an attenuator was not inserted up-beam of the screen. Phase 2 of the test (with ST1/ST2 stoppers enabled) was presented, based on the commissioning planning, it is estimated that the B₄C sample will be exposed to 9 million pulses before the removal of the temporary dump. The committee asked for clarification on the beam conditions during the test, the FEL beam has to be tuned in a way that maximizes the photon fluence at the location at the sample (using the last undulators to reach saturation for example). It was agreed that conditions of the test had to be discussed with LCLS commissioning team (Action item 2). Measurements of the beam size and pulse energy with the FEE diagnostics were also identified as critical parameters. The phase 2 test results and the phase 3 testing plan using focused beam in AMO are required to be presented and review by the RSC before AMO operation.
LCLS Stopper BTMs update (D. Schultz) [11]

Since the possible failure modes of the BTMs were presented to the RSC, a mitigation plan including short-term modification of the BTMs plumbing, long term modifications of the design and PLC code as well as tests of the BTM system response time for a hole matching the typical FEL beam size was proposed for the ST1 and ST2 stoppers [12]. S. Rokni thanked T. Rabedeau for his thorough review [13] of the proposed plan. It was found that the photon stoppers (including S1, S2 and SH1) had the same weaknesses as the photon-electron stoppers (ST1/ST2) and consequently a similar mitigation plan is being implemented. Response time of BTM for different sizes of hole will be measured in the coming weeks. It was indicated that results of those measurement may be necessary prior to the removal of the temporary dump when the FEL beam will be parked on the photon stoppers. S. Rokni stated that he has approved the proposed plan and asked for updates on the status of completion of action items.

Other related items

S. Rokni thanked T. Rabedeaue and Peter Stefan for their follow up work in completing ray-traces for LCLS FEE and associated documentation [14].

S. Rokni that the LCLS electron beam operation was still limited to 120 W pending successful commissioning of p-p comparator.

Summary

The committee recommended approval for the shielding of the hutch 1 for AMO experiment subject to completion of action items listed in this memo. The methodology for the containment of the FEL beam based on the attenuation provided by air needs further clarification to account for potential phenomena due to the characteristics of the FEL beam (see Action Item 1). The committee asked to evaluate what undulator setting would lead to the highest photon fluence at the location of the B4C sample used for Phase 2 of the B4C test (See Action Item 2). The importance of controlling the FEL pulse characteristics was outlined for Phase 2 and the proposed Phase 3 experiment. The mitigation plan for BTMs failure mode appeared reasonable to the committee. Results of Phase 2 of the B4C test and results of the BTM response time were necessary prior to the removal of the temporary dump inside the FEE. PPS /HPS and operational radiation safety programs will need to be reviewed and approved prior to beam operations.
Attachments:
(available at https://slacspace.slac.stanford.edu/sites/esh/committees/rsc/):