Refer to Photon Sources Directorate procedure "Design Reviews" in the Photon Sciences Document Center for complete details and requirements for completing design reviews. Contact the PSD Quality Representative for further guidance.

PHOTON SCIENCES DIRECTORATE
BROOKHAVEN NATIONAL LABORATORY

Report No. PS-DRR-1067
(Obtain from Quality Group)

DESIGN REVIEW REPORT

EDP Report No. (if applicable)

The Design Review Report shall include at a minimum:

- The title of the item or system;
- A description of the item;
- Design Review Report Number;
- The ESH&Q risk level;
- The design parameters;
- The type of design review;
- The date of the review;
- The names and association of the reviewers;
- The major comments and concerns of the reviewers;
- Any reference not appearing in the EDP used to support the design during the Design Review meeting;

TYPE OF REVIEW:

☐ **INITIAL** ☐ **INTERMEDIATE** ☒ **FINAL**

Prepared By: Wen Hu

Review Date: 5/31/2018

TITLE of ITEM/SYSTEM: 23-ID-1 (CSX) Holography Chamber Final Design Review

PRESENTED BY: Wen Hu (CSX Beamline Scientist) and Daniel Bacescu (CSX Beamline - Mechanical Engineer)

ESH&Q Risk Level: **A-3**
(Application of the Graded Approach Table)

PURPOSE/DESCRIPTION:
This is a final design review for the 23-ID-1 (CSX) holography chamber which will be the experimental chamber for x-ray holography experiment in transmission geometry. The new chamber will be connected to the end of current CSX beamline downstream TARDIS end station. The new chamber is based on an 8" 5-way cross with fast CCD detector in-line and in-vacuum electromagnet for an in-situ magnetic field.

REVIEWERS - ASSOCIATION: A. Ackerman, L. Stiegler, R. Lee, M. Benmerrouche, S. Chitra, G. Ganetis
Attendees: A. Ackerman, L. Stiegler, R. Lee, M. Benmerrouche, S. Chitra, G. Ganetis, S. Hulbert, S. Wilkins, C. Mazzoli, D. Bacescu, W. Hu.

DISTRIBUTION:
All reviewers and presenters.

Attachments: ☐ **Data Sheets** ☐ **Calculations** (Checked and countersigned) ☒ **Support documentation**
☐ **See Continuation Page** ☐ **Design Checklist**

MAJOR COMMENTS & CONCERNS OF REVIEWERS

An overview was provided by Wen Hu and Daniel Bacescu explaining how the upstream chambers will be in place but will be used as a transport pipe to propagate the beam to the CSX holography chamber. CSX beamline already have experience in aligning beam pass through a small diagnostic chamber, which is located downstream of TARDIS chamber. It is expected that the new end station will be used for CSX user experiment start August 11, 2018.
Refer to attached documentation (PPT) for details of the topics discussed.

Wen Hu and Daniel Bacescu provided an Overview of the holography chamber, including holography chamber assembly, holography setup overview, in-vacuum electro-magnet and fast CCD (FCCD) assembly, radiation protection, PPS and EPS.

Wen Hu mentioned proposed holography experiment has been first carried out in TARDIS chamber at the end of last cycle (April, 2018). However, require a precise control of magnetic field (=<0.5 T) and shorten detector-sample distance. The current TARDIS chamber has a fix sample-detector distance and takes 8 hours for changing sample of holography experiment. The new holography chamber will have these capability and in-vacuum electromagnet in

chamber. Experimental setup except in-vacuum magnet has been tested during last beamtime in April, 2018. The detector for this new chamber is a fast CCD camera, which is an identical one as the one used in current TARDIS chamber and will be operated in same way. In-vacuum magnet is new component and fabricated in house, magnet coils by superconducting magnetic division and magnetic core by central shops. The magnetic field is low and to be tested in Lab 6 of LOB1 before installation.

Daniel Bacescu provided a detailed presentation of the chamber design. This chamber is based on an 8" 5-way cross, top port is connected with a manipulator for sample transfer, upstream port is connected to the end of current beamline, downstream port is connected to fast CCD camera in transmission geometry, two side-ports are for in-vacuum magnet installation and a Pfeiffer HiPace 400 turbo molecular pump (TMP). The support frame of the chamber is originally used for support of gas cell at CSX. Daniel Bacescu will adjust the support based on this existing frame structure.

Sample transfer is using a 2.75" manipulator (part number BLT27S-20), purchased from vendor Mcallister technical services. Pulsed electrical field will be applied on sample board, and all equipment passed NSLS-II EEI inspection and tested in last holography beamtime.

Fast CCD camera will be in-line with x-ray beam and will use L. N_2 for cooling, which is general operation used for current TARDIS chamber. This fast CCD camera is identical to the one used as primary detector in current TARDIS chamber for user operation.

The end of current CSX beamline is a 2.75" blank flange, which is also working as a beamstop for soft x-ray beamline. The new chamber will be connected directly to CSX beamline by removing this blank flange and connecting to upstream beam pipe with a bellow. The FCCD camera of the new chamber will be the new synchrotron beamstop for CSX. Namely, there is all copper inside FCCD and there is no mono soft x-ray beam can pass through FCCD detector in transmission geometry. There is a minimum 3.56 mm thick Cu block covered whole FCCD plus a whole Cu made cold figure behind it. To arrive FCCD position, beam will first pass through electromagnet in transmission geometry. Namely, there is all metal pieces except a <10 mm hole for x-ray to pass. Beamline in-line laser will be used for alignment. CSX beamline already have experience to use laser for beamline alignment and guide soft x-ray beam to pass 2 mm hole.

The in-vacuum magnet is designed for a maximum field of 0.8 T. Normal operation is 0.1 T during measurement with precisely field control and will need up to 0.5 T for few seconds to saturate sample at beginning of each sample measurement. For reference, a permanent small ring magnet can provide 0.8 T magnetic field. The electromagnet is inside 8" 5-way cross, the stray magnetic field is very small. Two coils of magnet are being winded onsite at superconducting magnet division and then cured in vacuum performed by NSLS-II vacuum group. Vacuum will provide RGA test of the coils and other vacuum components. The electromagnet coils will be water cooled (process chilled water), not cryogen, and no connector of water tube in vacuum. Magnet will be assembled (coils and core) and tested in Lab6 of LOB1 before installing at CSX beamline.

FCCD & Feedthrough assembly, liquid nitrogen cooling for FCCD as standard operation at CSX beamline. The FCCD camera is an in-vacuum camera mounted on 2.75" port of the 8" FCCD feedthrough. Cold figure of FCCD was welded by NSLS-II vacuum group. No liquid helium for new chamber. Burst disk will be used in this new holography chamber for pressure relief/safety.

There is a 2 ¾" gate valve (GV) between holography chamber and current beamline. Personnel Protection System (PPS) vacuum switch pair has been wired and to be installed to new chamber close to this GV and tested before connecting new holography chamber to current beamline. Chamber vacuum to be monitored by EPS.

The current beamstop (2.75" blank flange) is under configuration control. The 8" FCCD feedthrough flange of the new chamber can be under configuration control. This is the most downstream vacuum flange of the new holography chamber. There is no way to remove FCCD camera from the new chamber without dismount this flange. Moreover, PPS vacuum switch will be installed for the new chamber.

<u>Vacuum, Safety, and EPS:</u>
Wen Hu and Daneil provided a presentation in the areas of Safety, Vacuum, and EPS

Safety:

- Vacuum – MDC burst disk will be used. Located on chamber where FCCD camera will be operated.

- Vacuum layout was presented illustrating pneumatic/manual valves, pressure sensors, pumps, cold cathode gauges going into the system. The pneumatic valves are connected to the EPS system.
- Load lock sample chamber is interfaced with the EPS so that it cannot be close during measurement or sample transfer.
- Venting of chamber is completed manually and only ABS is authorized to perform this work.

- Electrical – Endstation will undergo electrical equipment inspection.
  - All equipment will pass EEI inspection and will working with G. Ganetis group for testing magnet operation and electrical safety.
- Cryogens – LN2 will be used to cool FCCD camera, standard and established operation will be used.
  - Procedure for the operation of the system is already part of the ESR
  - LN2 filling line is installed at CSX beamline.

EPS:

- Logic of the EPS was discussed (refer to attached support documentation)
- Required logic has been already developed for TARDIS chamber and plan has been discussed with Garrett Bischof, and will be installed.

PPS:

- Installation PPS hardware and certified

Actions resulting from this review are identified below and will be included in the NSLS-II Family ATS.

Action Item 1: Provide minimum thickness of beam stop for radiation safety analysis. – COMPLETED (3.56 mm).
Bacescu Due: 7/25/2018

Action Item 2: Provide beam stop analysis based on minimum thickness of beam stop. – Mo Benmerrouche
Benmerrouche. Due: 7/25/2018

Action Item 3: A Traveler for the installation needs to be created for the 23-ID-1 holography endstation
Bacescu Due: 7/25/2018

Action Item 4: Provide CSX beamline ESR update to L. Stiegler.
Hu Due: 7/25/2018

Action Item 6: Update CSX beamline configuration control check list.
Hu Due: 7/25/2018

REVIEWED DRAWINGS / SPECIFICATIONS

Presentation Material:

- CSX holography chamber Mechanical Design and setup

APPROVAL: Review Committee Chairperson: A. Ackerman	Date:

Please forward completed original to the PSD Quality Assurance Group.