INSTRUMENT READINESS REVIEW

OF

NSLS–II CELL 4-BM BEAMLINE, THE X-RAY FLUORESCENCE MICROBE AND 7-BM BEAMLINE, THE QUICK X-RAY ABSORPTION AND SCATTERING

September 2017

NSLSII-PSD-RPT-001

BROOKHAVEN
NATIONAL LABORATORY

To ensure that commissioning of the Cell 4-BM Beamline (XFM) and Cell 7-BM (QAS) can be performed in a safe and effective manner, an Instrument Readiness Review (IRR) was conducted on August 30 and September 11, 2017 with NSLS-II staff. The review team found no pre-start findings for either beamline, one post-start item for both the XFM and QAS beamlines, and two additional post-start findings for the XFM beamline.

INSTRUMENT READINESS REVIEW

OF

NSLS-II CELL 4-BM BEAMLINE,

THE X-RAY FLUORESCENCE MICROPROBE

AND

7-BM BEAMLINE,

THE QUICK X-RAY ABSORPTION AND SCATTERING BEAMLINE

TEAM MEMBERS

TEAM LEAD	Lee Hammons	10/16/17
MEMBER	Mario Cubillo	10/25/17
MEMBER	Asher Etkin	10/25/2017
MEMBER	Richard Farnsworth	10/25/2017
MEMBER	Michael Hauptmann	10/18/17
MEMBER	Jeffrey Keister	10/25/17
MEMBER	Thomas Nehring	10.26.17
MEMBER	Charles Schaefer	10/19/17

TABLE OF CONTENTS

Summary 1
1. Introduction 3
   1.1. Purpose and Scope of Instrument Readiness Review 3
   1.2. Review Process and Method 3
   1.3. Composition of the IRR Team 5
2. Findings/Conclusions 6
   2.1. Pillar I – Documentation 6
   2.2. Pillar II – Hardware and Physical Plant 10
   2.3. Pillar III – Personnel 16
3. Readiness Determination 18
4. Summary of Pre-Start and Post-Start Findings 19
Appendix A Charge and Review Team 20
Appendix B Review Agenda 21
Appendix C Readiness Plan for 4-BM (XFM) 23
Appendix D Readiness Plan for 7-BM (QAS) 30

SUMMARY

This report provides a summary of the Instrument Readiness Review (IRR) completed at Brookhaven National Laboratory (BNL) for the Cell 4-BM beamline (The X-Ray Fluorescence Microprobe [XFM]) as well as the Cell 7-BM beamline (the Quick X-Ray Absorption and Scattering Beamline [QAS]). A team of BNL Subject Matter Experts (SMEs) was assembled to complete this review. The team members are identified in section 1.3.

The scope of this review was defined in Instrument Readiness Plans (IRP) developed specifically for XFM (NSLSII-4BM-PLN-001) and QAS (NSLSII-7BM-PLN-001). These documents were developed to assure completion of the documentation, hardware, procedures, and personnel qualification requirements associated with installation and the planned commissioning of these devices.

The review team first met on 30 August 2017 to receive presentations delivered by NSLS-II staff discussing the scientific and technical features of each beamline as well as their readiness for commissioning. These presentations were followed by tours of each of the beamlines for visual inspection. The review was completed on a second day, 11 September 2017, during which documentation was inspected, selected interviews were conducted with various NSLS-II staff members, and final inspections of the beamlines were conducted. The separation between the first and second days of the review allowed the NSLS-II staff to complete final readiness items including repair of a vacuum leak in the photon shutter for the 4-BM beamline. During the period between the first and second day of the review, members of the review team continued to probe readiness areas and prepare for the final day of the review. The goal of these efforts was to sample a sufficient number of elements representing the processes, equipment, and personnel qualifications necessary to assure the safe and effective commissioning of these beamlines and verify the readiness of the facilities based on the plan developed by NSLS-II.

The team has concluded that the NSLS-II Department is ready for the commissioning of the XFM and QAS beamlines, having observed no pre-start findings. In addition, the review team agreed on several post-start findings.

Among the post-start findings, one was observed at both the XFM and QAS beamlines: the cables and conduits directly behind the racks on the hutch roofs for both beamlines are not covered, posing a trip hazard and hindering safe access to the rear of the racks. The review team also identified two additional post-start findings for the XFM beamlines. The first was a radiation shielding analysis (FLUKA) report that did not clearly indicate the dose requirement for shielding, leading to some confusion among team members in interpreting some of the data in the report. The second was a lack of FLUKA simulation data for the transport line beyond the first optical enclosure and the secondary enclosures in the same report.

In addition to these findings, the team made numerous observations and compiled several recommendations and opportunities for improvement that are detailed in the report. These include the following:

- Labelling of cables for both beamlines
- Clarification of the Centrally-Controlled LOTO procedure (NSLSII-ESH-PRC-006) to account for two signatories on several LOTO tags on safety elements in both beamlines
- Inclusion of references to the appropriate procedures on work-permit documentation
- Inclusion of references to the appropriate work-permits for tags designed to indicate that certain configuration-controlled components are not in their nominal configuration due to work being performed under a work permit.

The team appreciated working with counterparts that were responsive to requests and worked diligently to locate documents and provide additional information as quickly as possible. The team thanks NSLS-II staff for their assistance in completing this review.

1. INTRODUCTION

1.1. Purpose and Scope of Instrument Readiness Review

The purpose of this Instrument Readiness Review (IRR) was to verify the readiness of the Cell 4-BM beamline (The X-Ray Fluorescence Microprobe [XFM]) as well as the Cell 7-BM beamline (the Quick X-Ray Absorption and Scattering Beamline [QAS]) for safe and effective commissioning. The IRR team was charged with ensuring that the required processes, procedures, equipment, and personnel qualifications were adequate and completed in accordance with the readiness plans established by NSLS-II for both beamlines. The plans are detailed in the following documents:

- NSLSII-4BM-PLN-001, *Instrument Readiness Plan (IRP) for the NSLS-II 4-BM (XFM) Beamline, Front End and Three Pole Wiggler*
- NSLSII-7BM-PLN-001, *Instrument Readiness Plan (IRP) for the NSLS-II 7-BM (QAS) Beamline, Front End and Three Pole Wiggler*

The scope of the review included the Cell 4-BM beamline, front end, and three-pole wiggler as well as the 7-BM beamline, front end, and three-pole wiggler. The process for conducting an IRR has been established by NSLS-II and is defined by procedure PS-C-ESH-PRC-001, *Instrument Readiness Review Procedure*.

1.2. Review Process and Method

To verify the readiness of the review, the team was guided by the lines of inquiry detailed in the NSLS-II document PS-C-XFD-PLN-006, *Instrument Readiness Review for BNL National Synchrotron Light Source II – Project Beamline, Front Ends, and Insertion Devices Lines of Inquiry (LOIs)*. These LOIs are organized along the three 'pillars' of readiness defined in the readiness plan for NSLS-II beamlines: documents, hardware and physical plant, and personnel.

A collection of documents was made available to the review team in advance of the review to allow the team to begin inspection. The documents included the readiness plans for the two beamlines; PowerPoint overviews of each beamline including functional descriptions, scientific, and technical goals; radiation survey plans; design documents and drawings; procedures; reports; and checklists.

The review was held for a full day on 30 August 2017 and for a second full day on 11 September 2017. On the first day, overviews of each beamline were presented to the review team by members of the NSLS-II staff, followed by tours of each of the beamlines. The team conducted visual inspections and asked questions during these tours. Members of the teams focused on various functional areas including:

- Accelerator safety
- Beamline design
- Commissioning plans
- Configuration control
- Cryogenic/ODH safety
- Electrical safety
- Equipment protection systems
- Industrial safety
- Instrument controls
- Pressure vessel safety
- Personnel protection systems
- Procedures
- Quality assurance
- Radiological controls and safety

The interval between the first day and the second day of the review allowed NSLS-II to finish readiness activities that were not completed on the first day of the review. These activities largely concerned processing of reports and approvals, and the team was assured that the physical layout had been completed and was not expected to change. Nonetheless, it was noted that two work permits for the 4-BM beamline were outstanding for a repair of a leak in the photon shutter and disconnection of the PPS system from the photon shutter to effect the repair. During the period between the review days, members of the review team continued their inspection of documents and posed questions to members of the NSLS-II staff. On the second day, members of the review team re-visited each of the beamlines to inspect the physical layout and note any changes that occurred since the first day of the review. It was observed that both work permits for the 4-BM beamline had been closed and the repair of the photon shutter completed. Additional minor changes were also noted that had been discussed and recommended by the review team on the first day of the review and are noted among the observations that follow. Team members also conducted interviews with selected NSLS-II staff members and continued document reviews, sampling as many elements of the processes, procedures, and staff qualifications as possible within the time available to verify the readiness of the beamlines according to the instrument readiness plans for each facility.

At the end of first day of the reviews, each member of the review team reported their preliminary observations and plans for follow-up on the second day and during the interim period. By the end of the review period, the team reported on their final observations, assembling pre- and post-start findings. The team leader collected these findings and prepared a preliminary statement. A written preliminary report followed, and the review culminated with a final report.

1.3. Composition of the IRR Team

The members of the Review Team:

- Lee Hammons, Team Lead, Collider-Accelerator Department
  Review Areas: Procedures, Conduct of Operations, Training

- Mario Cubillo, Safety and Health Services Division
  Review Areas: Cryogenics/ODH, Industrial Safety, Pressure Safety, Utilities

- Asher Etkin, Collider-Accelerator Department
  Review Areas: Equipment Protection System, Personnel Protection System

- Richard Farnsworth, NSLS-II
  Review Areas: Controls, Personnel Protection System

- Michael Hauptmann, Planning, Performance and Quality Management Office
  Review Areas: Quality Assurance, Travelers, Training, Verification of Action Closure

- Jeffrey Keister, NSLS-II
  Review Areas: Design, Radiological Controls, Commissioning Plan, Configuration Control, Management

- Thomas Nehring, Energy and Utilities Division
  Review Areas: Electrical Power Distribution, Electrical Equipment Inspection

- Charles Schaefer, Radiological Control Division
  Review Areas: Radiological Controls, Shielding; Radiological Survey Plans, Unreviewed Safety Issues

2. FINDINGS/CONCLUSIONS

2.1. Pillar I – Documentation

2.1.1. Pre-Start Finding

2.1.1.1. 4-BM Beamline (XFM)

None.

2.1.1.2. 7-BM Beamline (QAS)

None.

2.1.2. Post-Start Findings

2.1.2.1. 4-BM Beamline (XFM)

Post-Start 1 Condition: A review of the radiation shielding (FLUKA) report indicated that the gas bremsstrahlung (GB) from the XFM M1 mirror that enters the beam transport and secondary optics enclosure is contained within the provided enclosures, as implied by the "summary of the dose rates expected outside the FOE *[first optics enclosure]*" of the report as reproduced below:

TABLE 1: Ambient dose equivalent rates outside the FOE with GB as source (*04 (XFM) Beamline Radiation Shielding Analysis*, ¶ 2.5, p. 15)

Beam incident on	**Ambient dose equivalent rate outside the FOE (mrem/h)**		
	Side wall	Roof	Downstream wall
FOE slits	< 0.05	< 0.05	< 0.05
US edge of M1	<0.05	< 0.05	< 0.05
Center of M1	<0.05	< 0.05	< 0.05
MSK1 upper edge	**0.06***	< 0.05	< 0.05
MSK1 on aperture	<0.05	<0.05	**0.3***
MSK2 upper edge	**0.06***	< 0.05	< 0.05
MSK2 closest to aperture	< 0.05	< 0.05	< 0.05
MSK1 on aperture (rectangular beam)	<0.05	< 0.05	< 0.05

* The dose rate falls below 0.05 mrem/h at 30 cm distance.

The table indicates that the dose resulting from GB impinging in a single extreme "edge" location on mask 1 or 2 minimally exceeds the 0.05 mrem/h contact threshold, whereas GB "on aperture" satisfied the requirement.

- ***Post-Start 1 Finding:*** While there does not appear to be any risk of significant dose, the value of the "edge" simulations is unclear, and

the 30 cm distance reference does not appear to be relevant for side walls. Furthermore, it is unclear that these results are consistent with the NSLS-II shielding requirements as articulated in the *Photon Sciences Shielding Policy* (PS-C-ASD-POL-005) and the *NSLS-II Issue and Decision Paper: ALARA Analysis for Installation of Secondary Bremsstrahlung Shields in the First Optics Enclosure* (PS-C-ESH-STD-005).

Post-Start 2 Condition: The XFM Radiation Shielding Report discusses the expected radiation fields for GB striking a variety of scattering targets within the FOE in section 2.3. One example is shown below:

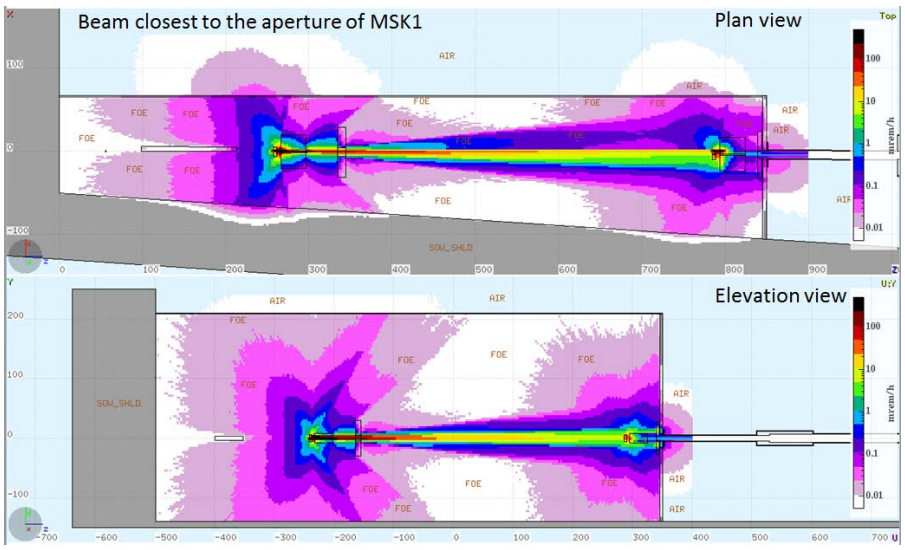

Figure 1. The dose rate plot showing the results when the GB hits a point close to the aperture of the fixed mask 1.
(*04 (XFM) Beamline Radiation Shielding Analysis*, ¶ 2.3.1, p. 6)

However, scattering results in the transport line beyond the downstream end of the FOE and the secondary optics enclosures are not discussed in the report.

- ***Post-Start 2 Finding:*** Radiation scattering fields in the transport line beyond the downstream end of the FOE and in the secondary optics enclosures are not discussed in the report. The review team expected that these fields would also be discussed in the report to determine conformance with the NSLS-II shielding policy.

2.1.2.2. 7-BM Beamline (QAS)

None.

2.1.3. Observations

2.1.3.1. Design documentation was inspected for the three-pole wigglers for both beamlines.

2.1.3.2. The search paths for all hutches (both beamlines) are reasonable and consistent with documentation.

2.1.3.3. Inspected documentation and received responses from both beamlines regarding heat load analysis and temperature control for the monochromators for both beamlines. The documentation and responses were found to be acceptable.

2.1.3.4. Section 7.2 the commissioning reports for both beamlines include a list of items to be completed in advance of first light. A brief inspection indicated that these are largely completed, sufficient to begin commissioning with beam (including EPS and motion controls via CSS at the control station).

2.1.3.5. Most design documentation is well-organized and stored in Sharepoint and Vault. Both beamline engineers were able to find and provide the requested documents and drawings quickly. However, some gaps in documentation are noted (see **Opportunities for Improvement and Recommendations**, ¶ 2.1.5.1.)

2.1.3.6. Reviewed USI screenings for commissioning and operation of both beamlines. Each USI package contained recent Radiation Safety Committee review memorandums and a copy of the applicable portion of the SAD to demonstrate traceability.

2.1.3.7. Verified that Front End and beamline bremsstrahlung and synchrotron ray-trace drawings for both beamlines have been reviewed by the NSLS-II Radiation Safety Committee and approved by management (August 2017).

2.1.3.8. Reviewed RSC survey data for several elements in both beamlines and compared this to the model data used in the FLUKA analyses. No instances of gross disagreement were identified. Survey data was available in the travelers.

2.1.3.9. Reviewed the shielding simulation (FLUKA) reports for both beamlines and found them to provide an adequate basis for safely performing commissioning surveys.

2.1.3.10. Observed that TOSS beamline listing includes both XFM and QAS as required.

2.1.3.11. Observed that TOSS beamline reports are completed and approved as required for both beamlines.

2.1.3.12. Sampled RSC drawings for XFM (i.e., Collimator #1 and Fixed Mask #1). Drawings were approved, released in the Vault, and contained appropriate dimensional data and QA-1 ratings.

2.1.3.13. Beryllium window assembly documentation for XFM was reviewed. The documentation was approved by Safety Engineering and thoroughly tested by the vendor (Moxtek).

2.1.3.14. Observed that leak test documentation forms are not always accurately and fully completed. Some forms were missing gauge information, description of the system tested, or the acceptance criteria. For example, the XFM monochromator/HRBV/MS mirror cooling pressure test.

2.1.3.15. The range of beam positions delivered by the QAS focusing mirror is limited by the photon shutter aperture (as indicated in the ray trace, particularly the version included in the radiation simulation report).

2.1.3.16. The secondary bremsstrahlung from the QAS collimating mirror that enters the first optics enclosure (FOE) is largely stopped by the bremsstrahlung radiation shielding at the upstream end. The radiation simulation report shows that the FOE contains all the radiation.

2.1.3.17. ODH certification and installation was reviewed and found to be in order.

2.1.3.18. Beryllium window design information for the QAS beamline was reviewed along with the proposed kapton window. (See **Opportunities for Improvement and Recommendations**, ¶ 2.1.5.1.)

2.1.4. Noteworthy Practices

2.1.4.1. None.

2.1.5. Opportunities for Improvement and Recommendations

2.1.5.1. Design presentations and information is not always updated for both beamlines. The front end beryllium windows were reviewed according to the latest guidelines developed in 2016, but the design documentation supplied for the review was dated June 2015 and did not mention any additional review or changes after that. After the question was raised, the Chief Mechanical Engineer confirmed that the windows were reviewed. One of them had to be modified, but it now meets the latest requirements.

2.2. Pillar II – Hardware and Physical Plant

2.2.1. Pre-Start Findings

2.2.1.1. 4-BM Beamline (XFM)
None.

2.2.1.2. 7-BM Beamline (QAS)
None.

2.2.2. Post-Start Findings

2.2.2.1. 4-BM Beamline (XFM)
Post-Start 3 Condition: Observed wire trays and conduits that lead directly from the racks on top to the 4-BM-B and C hutches as shown below:

Figure 2: Example of wire trays and conduit at rear of racks on top of 4-BM hutch.

- ***Post-Start 3 Finding:*** Wire trays and conduits directly from rear of racks on top of 4-BM hutches make access to rear of rack difficult and may pose a trip hazard.

2.2.2.2. 7-BM Beamline (QAS)
Post-Start 4 Condition: Observed wire trays and conduits that lead directly from the racks on top of the 7-BM-B and C hutches. (See example of condition in Figure 2.)

- ***Post-Start 4 Finding:*** Wire trays and conduits directly from rear of racks on top of 7-BM hutches make access to rear of rack difficult and may pose a trip hazard.

2.2.3. Observations

2.2.3.1. Reviewed the beamline RSC component checklists (XFD-CHK-020 and XFD-CHK-021) and confirmed that all RSCs were captured on the checklists, including the late addition of the monochromator vacuum vessel for XFM.

2.2.3.2. Cable design and installation was found to be acceptable for beamline hutches for both beamlines.

2.2.3.3. All appropriate electrical components were found to have been NRTL-certified for both beamlines.

2.2.3.4. Conduit installation for both beamlines was inspected and found to be acceptable for both beamlines.

2.2.3.5. All stands, racks, and cable trays for both beamlines were found to be appropriately bonded to ground.

2.2.3.6. Cables for both beamlines were found to be appropriately labelled.

2.2.3.7. All electrical hazards for both beamlines were found to be appropriately labelled.

2.2.3.8. Observed that electrical terminations for voltages greater than 50 V were appropriately inaccessible through the use of covers or guards for the QAS beamline. No such terminations were observed for the XFM beamline.

2.2.3.9. Configuration control stickers for the DCM chamber for the XFM beamline were placed on the movable portion of the flange rather than the fixed flange as intended (captured in the RSC report). By the second day of the review, the placement of the sticker was corrected as shown below:

Figure 3: DCM chamber for XFM beamline with configuration control sticker placed in proper position on fixed flange.

2.2.3.10. LOTO of shutters for both beamlines observed to be in place as required. It is noted that Centrally-Controlled LOTO tags bear two signatories. This may cause confusion. (See **Opportunities for Improvement and Recommendations** 2.2.5.1)

2.2.3.11. Observed caution tags on BMPS for both QAS and XFM Front Ends.

2.2.3.12. On the first day of the review, 8/30/17, two safety system work permits, #1473 and #1474, for XFM were observed to be in place. Work permit #1473 was for the replacement of the 4-BM-B photon shutter due to a vacuum leak and affected the configuration control of a radiation safety component. Work permit #1474 was for disconnection of the PPS switches from the 4-BM-B photon shutter to allow replacement of the shutter, affecting the configuration of the PPS system. By the second day of the review, 9/11/17, both of the work permits had been successfully closed. It was noted that the electronic control room shift log properly indicated that the permits had been opened and closed as required. It was also noted that the operators appeared

to be well-versed in the procedure for handling work permits. (See **Opportunities for Improvement and Recommendations** 2.2.5.2 and **Observations** 2.3.3.2.).

2.2.3.13. With regard to the above-mentioned work permits, it was observed that tags were applied to components whose configuration was affected by the work permit. However, these tags did not reference the work permit directly as shown below (See **Opportunities for Improvement and Recommendations** 2.2.5.3):

Figure 4: Configuration control status tag applied due to repair work being conducted under a work permit. However, the tag does not directly reference which work permit applies. (See **Opportunities for Improvement and Recommendations** 2.2.5.3.)

2.2.3.14. LN_2 installation and testing documentation (by Technifab) was reviewed and found to be complete and acceptable for the QAS beamline. All piping is labeled and properly supported.

2.2.3.15. Observed that LN_2 shutoff switch for QAS beamline was not labeled. Signage was quickly added after the observation, and the issue was resolved.

2.2.3.16. All control systems and displayed interfaces observed, including vacuum system and motion control interfaces were found to functioning and adequate to support commissioning.

2.2.3.17. Inspected PPS testing sequence and test checklist with members of ESH organization responsible for testing (R. Chmiel and T. McDonald).

2.2.3.18. Travelers for the XFM beamline were reviewed and found to be complete and in order. However, when travelers are revised, the revision description is not always completed. For example, traveler BM-XFM-004, Rev. B does not describe differences with Rev. A.

2.2.3.19. Inspection of top-level traveler all-component drawing (PD-XFM-PFM-1000) at QA level A2 was found to be "released and effective" according to procedure requirements.

2.2.3.20. The M1 mirror component drawing (PD-XFM-BL-LAY-0150) at QA level A2 was found to be "released and effective" including fiducials measurement locations and allowed tolerances. No specific survey report is needed in this instance because this is not a radiation safety component. Signatures on the traveler show installation was performed to tolerances and drawings.

2.2.3.21. The XFM collimator assembly all-components traveler (PD-XFM-BL-1000) was checked and found to be complete according to procedure requirements.

2.2.3.22. The collimator-specific component drawing (PD-XFM-BL-LAY-0300) was found "released and effective" at QA level A1.

2.2.3.23. The collimator-specific layout drawing (PD-XFM-BL-LAY-1060) was found "released and effective" at QA level A1. This drawing shows the fiducial measuring locations and required tolerances.

2.2.3.24. A check of XFM Mask 1 (PD-XFM-MSK-1101) survey report attached to the top-level traveler showed the measured tolerances to be within specified limits.

2.2.3.25. XFM Front End (FE) top-level traveler (FE-022 Rev B) was found to be complete with signatures and dates according to procedure requirements.

2.2.3.26. Drawing for the entire XFM FE (SR-FE-3PW-6000 Rev A) was reviewed and found "released and effective".

2.2.3.27. Safety shutter traveler (SR-FE-3PW-SS-4000) for the XFM FE was reviewed for lead brick dimension measurements and was found to be acceptable according to procedure.

2.2.3.28. At Op 250, the survey report for the XFM FE noted some out-of-tolerance measurements for the exit absorber. These were addressed in DR 1704 and determined to be "use as is". Top-level traveler (FE-022 Rev B) was found to be complete with signatures and dates according to procedure requirements.

2.2.3.29. Verified that the Area Radiation Monitor (ARM) required for XFM, based upon analysis in the TOSS Report showing the potential for >100 mrem/h outside the FOE during a missteer of primary injected electrons, is installed in the correct location and is in current calibration.

2.2.3.30. The beamstops in QAS hutches B and C bear a lead thickness of 12 mm, well in excess of the shielding required.

2.2.3.31. Travelers for the QAS beamline were reviewed and found to be complete and in order.

2.2.3.32. The QAS beamline top-level traveler BL-QAS-005-Rev A was found to be complete with signatures and dates according to procedure requirements.

2.2.3.33. The QAS beamline component sublevel traveler, which covers most components, was checked.

2.2.3.34. The monochromator component (CPD-QAS-MONO-1000) assembly and installation at step 70 was further checked and found to be complete according to procedure requirements including signatures and dates.

2.2.3.35. The drawing for this monochromator was found in Vault properly labeled “released and effective” with a QA level of A3.

2.2.3.36. The QAS pink beam stop sublevel traveler was checked and found to be complete according to procedure requirements.

2.2.3.37. The QAS second-level traveler (BL-SRVY-001-Rev A) for the survey of fiducial points was checked. Model drawing at QA level A1 (PD-QAS-MSK-1300) for these points was found “released and effective”.

2.2.3.38. Survey layout drawing for the QAS beamline (PD-QAS-BL-LAY-1060) shows mechanical survey alignments and expected tolerances. Further check of the Survey Group report for these tolerances showed that they were measured within the expected tolerances.

2.2.3.39. QAS Front End (FE) top-level traveler (FE-022 Rev B) was found to be complete with signatures and dates according to procedure requirements.

2.2.3.40. The components layout drawing for the QAS FE (SR-FE-3PW-4000) was found to be “released and effective” at QA level A1.

2.2.3.41. The water-cooled QAS front-end mirror sublevel traveler (BL-QAS-003 Rev A) refers to the survey results at Op 60. The drawing for these survey points (PD-QAS-PCM-1000) Rev C was found “released and effective” with QA level A2. The survey results at Op 60 were found to be within specified limits.

2.2.3.42. At Op 250 for the QAS FE, the top-level traveler shows DR 1707 for the survey group from 8/29/17 indicating that the exit absorber measurements were out of tolerance for QAS. The resolution of the DR 1707, dated 8/31/17, resulted in a "use as is" determination because this is not a radiation safety device.

2.2.4. Noteworthy Practices

2.2.4.1. Excellent housekeeping evident on both beamlines and front ends.

2.2.5. Opportunities for Improvement and Recommendations

2.2.5.1. Consider clarifying the Centrally-Controlled LOTO procedure (NSLSII-ESH-PRC-006) to explain circumstances that required two signatories. Perhaps the indications of a "designee" in the procedure would make the process clearer. This practice should be clarified. Logbook entries should also be consistent with entries on the LOTO tag.

2.2.5.2. Consider adding a reference to the Procedure for Safety System Work Permits (PS-ESH-PRM-3.4.1) on the Safety System Work Permit form to clearly indicate the governing procedure.

2.2.5.3. Consider adding a field to Configuration Control Status Tags (see Figure 4) that indicate the applicable work permit(s) that cause configuration control status changes. The tag observed in the present review did not make the applicable work permit clear. It may also be desirable to indicate the number and location of such tags on the work permit form in order to properly account for the tags once work is completed and the tags should be removed.

2.3. Pillar III – Personnel

2.3.1. Pre-Start Findings

2.3.1.1. 4-BM Beamline (XFM)

None.

2.3.1.2. 7-BM Beamline (QAS)

None.

2.3.2. Post-Start Findings

2.3.2.1. Cell 22 Beamline

None.

2.3.2.2. 6-BM Beamline (BMM)

None.

2.3.3. Observations

2.3.3.1. Training and qualification records were inspected for beamline staff for XFM and QAS beamlines. All training records for required staff were available in BTMS, up-to-date, and complete.

2.3.3.2. Main control room staff were interviewed regarding appropriate disposition of Safety System Work Permits. Staff appeared to be knowledgeable of procedure.

2.3.4. Noteworthy Practices

None.

2.3.5. Opportunities for Improvement and Recommendations

None.

3. Readiness Determination

The review team has concluded that the NSLS-II Department is ready for the commissioning of the 4-BM beamline (XFM) and the 7-BM beamline (QAS) having found no pre-start findings for either beamline.

NSLS-II staff may progress in obtaining authorization to begin technical commissioning for XFM and QAS.

In addition, the IRR team identified several post-start findings and offered several recommendations to enhance the instrument readiness process.

4. Summary of Pre-Start and Post-Start Findings

Identifier	Review Area	Finding
Post-Start 1	Pillar I – Documentation: Radiological controls	***Post-Start 1 Finding:*** At XFM, while there does not appear to be any risk of significant dose, the value of the "edge" simulations is unclear, and the 30 cm distance reference does not appear to be relevant for side walls. Furthermore, it is unclear that these results are consistent with the NSLS-II shielding requirements as articulated in the *Photon Sciences Shielding Policy* (PS-C-ASD-POL-005) and the *NSLS-II Issue and Decision Paper: ALARA Analysis for Installation of Secondary Bremsstrahlung Shields in the First Optics Enclosure* (PS-C-ESH-STD-005).
Post-Start 2	Pillar I – Documentation: Radiological controls	***Post-Start 2 Finding:*** Radiation scattering fields in the transport line beyond the downstream end of the FOE and in the secondary optics enclosures are not discussed in the Radiation Shielding Analysis report for XFM. The review team expected that these fields would also be discussed in the report to determine conformance with the NSLS-II shielding policy.
Post-Start 3	Pillar II – Installation: Electrical safety	***Post-Start 3 Finding:*** Wire trays and conduits directly from rear of racks on top of 4-BM hutches make access to rear of rack difficult and may pose a trip hazard.
Post-Start 4	Pillar II – Installation: Electrical safety	***Post-Start 4 Finding:*** Wire trays and conduits directly from rear of racks on top of 7-BM hutches make access to rear of rack difficult and may pose a trip hazard.

APPENDIX A
CHARGE AND REVIEW TEAM

AUGUST 24, 2017

NSLS II IRR READINESS TEAMS: XFM & QAS BEAMLINES

ACKERMAN

Review Team

Charge:

The review team is charged with verifying readiness to begin technical commissioning of the instruments listed above through review of documentation, physical instrument inspection, and personnel interviews. Scope specifics are defined in the Instrument Readiness Plan.

The assigned topics below are to provide review structure. Review team members are encouraged to collaborate on all of the readiness criteria.

Members and assigned topics:

Mario Cubillo
- Cryo/ODH; utilities; industrial safety; vacuum

Asher Etkin
- EPS and PPS

Richard Farnsworth
- Controls; PPS

Lee Hammons
- Team leader

Michael Hauptmann
- QA; travelers; training; verify action closure

Jeff Keister
- Commissioning plan; design; radiological controls; configuration control; management

Thomas Nehring
- Electrical power distribution; EEI

Charles Schaefer
- Radiological controls; shielding; radiation survey plans; USI

Readiness Preparation Team

Acerbo, Alvin
Ackerman, Andrew
Amundsen, Christopher
Bassan, Harmanpreet
Bebon, Michael
Benmerrouche, Mo
Boerner, Al
Breitfeller, Mark
Buckley, Michael
Carlucci-Dayton, Mary
Cheswick, Ed
Chitra, Sunil
Chmiel, Robert
Corwin, Mary Anne
DePaola, Frank
DeSilva, Chanaka,
Doom, Lewis
Steve Ehrlich
Fliller, Raymond
Fries, Gregory
Ganetis, George
Gosman, John
Haas, Edwin
Heneveld, Brian
Hetzel, Charles
LaMarra, Steven
Lee, Robert
Lein, Bruce
Ma, Jun
Moss, Steven
Padrazo, Danny
Rank, James
Rubino, Kristen
Shaftan, Timur
Sharma, Sushil
Shoemaker-Skokov, Ashley
Stebbins, Christopher
Stiegler, Lori
Tanabe, Toshiya
Tappero, Ryan
Todd, Robert
Vescovo, Elio
Wang, Guimei
Wilkins, Stuart
Woicik, Joe
Zhong, Zhong
Zipper, Joseph
Zschack, Paul

APPENDIX B
REVIEW AGENDA

MEETING DATES: AUGUST 30, 2017

NSLS II IRR: XFP AND QAS BEAMLINES

ACKERMAN

Review Scope: This meeting time is scheduled for completion of an Instrument Readiness Review for the subject instruments. A detailed scope is defined in Instrument Readiness Plans for each instrument.

Day 01; August 30
LOB3, Rm. 156

08:30 – 09:00	Review Team Executive Session	Review Team
09:00 – 09:30	3PW and FE Overview (both beamlines)	All
09:30 – 10:15	XFM Overview	All
10:15 – 10:30	Break	All
10:30 – 11:30	Front End Tour (both beamlines)	Review Team Breitfeller, Doom, DePaola, Ehrlich, Fries, Ganetis, Gosman, Padrazo, Rank, Tappero. (All are welcome)
11:30 – 12:30	XFM Tour	Review Team Bassan, Ganetis, Gosman, Ma, Tappero. (All are welcome)
12:30 – 1:30	Lunch (no host)	All
1:30 – 2:15	QAS Overview	All
2:15 – 3:15	QAS Tour	Review Team Bassan, De Silva, Ehrlich Ganetis, Gosman. (All are welcome)
3:15 – 3:30	Break	
3:30 – 5:00	Review Team Executive Session	Review Team

MEETING DATE: SEPTEMBER 11, 2017

NSLS II IRR: XFM AND QAS BEAMLINES

ACKERMAN

Review Scope: This meeting time is scheduled for completion of an Instrument Readiness Review for the subject instruments. A detailed scope is defined in Instrument Readiness Plans for each instrument.

Day 02; September 11, 2017
LOB3 Rm. 156

8:30 – 9:00	Review Team Executive Session	Review Team
9:00 – 2:00	Discussion, document review, interviews	Review Team NSLS II staff as needed
2:00 – 3:00	Review Team Executive Session	Review Team
3:00 – 3:30	Close-Out with preliminary findings	All

APPENDIX C
READINESS PLAN FOR 4-BM (XFM)

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Functional Description** An overview presentation is prepared that defines the scope of the IRR and includes the following FE, 3PW and Beamline specific information: - Primary capabilities - Physical layout and location (includes Beamline location on the experiment floor) - Design reviews and performance parameters - Source characteristics - Photon beam performance goals - Radiation Safety Committee reviews - Self-identified pre-start findings - Description and status for each item listed in this Instrument Readiness Plan	R. Tappero Lead Beamline Scientist	• Develop the presentation and document described	Beamline: • Presentation • Functional Description Document	Signature (Beamline):
		G. Fries Accelerator Division Liaison Engineer	• Develop the presentation described	FE and 3PW: • Presentation	Signature (FE and 3PW):
	Beamline, FE & ID Design Beamline, FE & 3PW components are designed in accordance with PS-QAP-0412, *Design Reviews* and PS-C-XFM-PRC-010, *Engineering Design by Others*.	R. Tappero Lead Beamline Scientist	• Complete Engineering Design Reviews for the Beamline, FE and 3PW that address thermal management, mechanical support, configuration control, and vacuum	Beamline: • Internal and contractor supplied design review documents and reports	Signature (Beamline):
		S. Sharma Mechanical Engineering Group Leader		FE: • Requirements, Specifications, and Interface report (RSI) Internal and contractor supplied design review documents	Signature (FE): Greg Fries for S. Sharma
		T. Tanabe Insertion Devices Group Leader		3PW: • Requirements, Specifications, and Interface report (RSI) Internal and contractor supplied design review documents	Signature (3PW): J. RANK FOR T. TANABE 8/25/17

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Radiation Safety Components Design** Radiation Safety Components for the Beamline and FE are designed in accordance with NSLS-II requirements, PS-QAP-0412, *Design Reviews* and PS-C-XFM-PRC-010, *Engineering Design by Others*.	R. Tappero Lead Beamline Scientist	• Complete requirements analysis and design of radiation safety components for the Beamline	Beamline: • Internal design review documents and reports • RSC Report	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Complete requirements analysis and design of radiation safety components for the FE	FE: • Internal design review documents • RSC Report	Signature (FE): for M. Breitfeller
	Top-Off Safety System (TOSS) FE has been analyzed for Top-Off Safety in accordance with PS-C-ASD-PRC-183, *Approval of New and Modified NSLS-II Beamline Front Ends for Top Off Safety.*	R. Fliller Coordinator for Top Off Safety	• Complete TOSS analysis	• TOSS Analysis Report • Updated FE layout drawings • Updated *Beamlines Approved for Top-Off Operations* list	Signature:
	Ray Traces Bremsstrahlung and Synchrotron Ray Traces generated in accordance with PS-C-XFD-PRC-008, *Synchrotron and Bremsstrahlung Ray Trace Procedure.*	R. Tappero Lead Beamline Scientist	• Prepare the Ray Traces for the Beamline	Beamline: • Approved Primary Bremsstrahlung Ray Traces • Approved Maximum Synchrotron Ray Traces	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Prepare the Ray Traces for the Front End	FE: • Approved Primary Bremsstrahlung Ray Traces • Approved Maximum Synchrotron Ray Traces	Signature (FE): for M. Breitfeller

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Secondary Radiation Scatter Analysis** Secondary Bremsstrahlung and Synchrotron scatter is analyzed in accordance with LT-C-ESH-STD-001, *Guidelines for the NSLS-II Beamline Radiation Shielding Design.*	S. Chitra Health Physics	• Complete FLUKA analysis • Complete STAC8 analysis	• BNL Technical Note Report	Signature:
	National Environmental Protection Act (NEPA) Evaluation NEPA requirements evaluation completed.	L. Stiegler ESH Operations Group Leader	• Complete a NEPA evaluation	• NEPA Evaluation Report	Signature:
	Unreviewed Safety Issue (USI) Evaluations/ Screenings Authorization basis hazard identification is managed through USI evaluation/screening.	S. Moss Authorization Basis Manager	• Verify that the SAD and ASE accurately cover the hazards associated with the subject Beamline, FE and 3PW; including temporary systems	• SAD and ASE USI screenings/evaluations • Applicable waivers	Signature (Beamline): Signature (FE and 3PW):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Resolution of Open Action Tracking System (ATS) Actions** Instrument specific action items from previous internal and external oversight groups (e.g., RSC, Design Reviews, etc.) are addressed. Previous IRR action items are addressed.	J. Zipper QA Engineer	• ATS action items for the instrument are satisfied. • ATS action items from previous IRRs are evaluated for impact to the instrument	Beamline: • ATS	Signature (Beamline): E. Cheswick for J. Zipper
		E. Cheswick QA Engineer	• ATS action items for the FE and 3PW are satisfied. • ATS action items from previous IRRs are evaluated for impact to the instrument	FE and 3PW: • ATS	Signature (FE and 3PW)::
	Procedures Procedures needed for safe, secure, and environmentally sound commissioning have been developed, reviewed, validated (where applicable), and approved. Existing procedures are verified as sufficient for new hazards introduced by this Beamline, if any.	K. Rubino Procedure Support	• Develop any system specific procedures • Verify that existing procedure are sufficient for any new hazards introduced	• 4-BM Radiological Interlock Test Checklist • Search and Secure Sketch • 3PW LOTO Procedure (NSLSII-ID-PRC-003) • Gallium Fill SOP	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Commissioning Plans** Commissioning plans have been generated for the Beamline and FE and 3PW to address the task sequence required for technical commissioning (safe photon transport).	R. Tappero Lead Beamline Scientist	• Prepare a Beamline Commissioning Plan to define technical objectives and operational readiness requirements	Beamline: • Approved Beamline Commissioning Plan	Signature (Beamline):
		G. Wang Accelerator Coordination Group Leader	• Verify that NSLS-II ID and Front End Commissioning Sequence (PS-C-ASD-PRC-166) adequately covers commissioning for the FEs and IDs	FE and 3PW: • NSLS-II ID and Front End Commissioning Sequence (PS-C-ASD-PRC-166)	Signature (FE and 3PW):
	Radiation Survey Procedures A survey procedure has been generated for the Beamline in accordance with PS-C-XFD-PRC-004, *NSLS-II Beamlines Radiation Safety Commissioning Plan* and the existing NSLS-II Insertion Devices and Front End Radiation Survey Plan (PS-C-ESH-PRC-061) has been reviewed and updated as necessary for the FE and 3PW.	S. Chitra Radiation Physicist	• Prepare the Radiation Survey Procedure for the Beamline • Obtain RSC review of the procedure	• Approved Beamline Radiation Survey Procedure	Signature (Beamline):
		M. Benmerrouche Radiation Physicist	• Verify that the NSLS-II ID and Front End Radiation Survey Plan (PS-C-ESH-PRC-061) adequately covers commissioning for the FEs and IDs	• NSLS-II Insertion Devices and Front End Radiation Survey Plan (PS-C-ESH-PRC-061)	Signature (FE and 3PW):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Experiment Safety Review** An Experiment Safety Review has been submitted, executed and approved within the BNL ESR system.	R. Tappero Lead Beamline Scientist	• Complete submission and pursue approval of an Experiment Safety Review through use of the BNL electronic system	• Approved BNL ESR	Signature:
	Proposal Allocation Safety & Scheduling (PASS) The instrument is active within PASS with approvals to proceed with Technical Commissioning.	R. Tappero Lead Beamline Scientist	• Assure that PASS is configured to administer the instrument	• Defined resource within PASS • Submitted Technical commissioning proposal • Submitted Safety Approval Form	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Safety Critical Hardware (Installation)	**Radiation Safety Components: Installation** Radiation Safety Components, including Top Off components are installed in accordance with the Traveler.	R. Tappero Lead Beamline Scientist	• Generate and execute Traveler	Beamline: • Completed Traveler	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Generate and execute Traveler	FE: • Completed Traveler	Signature (FE):
		L. Doom Accelerator Coordination	• Generate and execute Top-Off Traveler	Completed Traveler	Signature:
	Radiation Safety Components: Configuration Control A Radiation Safety Component Checklist template is generated in accordance with PS-C-ESH-PRC-025, *NSLS-II Radiation Safety Component Inspection Procedure.*	R. Tappero Lead Beamline Scientist	• Develop Radiation Safety Component Checklist	Beamline: • Approved beamline specific Radiation Safety Component Checklist w/ RSC review	Signature (Beamline):
		L. Doom Accelerator Coordination	• Verify that the existing checklist adequately covers the subject FE and ID	FE: • Approved Storage Ring Radiation Safety Component Checklist Template	Signature (FE):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Safety Critical Hardware (Installation)	**Area Radiation Monitors (ARMs)** ARMs are installed in accordance with PS-C-ESH-ARN-SPC-001, *NSLS-II Area Radiation Monitor (ARM) System Description* and PS-C-ESH-STD-002, *Technical Basis Document for Interlocked Area Monitors Placement Outside the Accelerator and Beamlines Enclosures.*	M. Benmerrouche ARM Technical Authority	• Install, calibrate, and test (EPICS integration) ARMs • Certify (PPS)	• ARM Layout Drawing • ARM calibration certificates • ARM EPICS Interface Integration Test Sheet • ARM PPS Test checklist	Signature:
	Personnel Protection System (PPS) Interlocks: Installed and Certified Hardware/Software installed in accordance with PS-C-XFD-SPC-PPS-001, *Beamline Personnel Protection System (BLPPS) and Front End Personnel Protection System (FEPPS) Design Description.*	G. Ganetis Electrical Engineering Group Leader	• Generate system schematics and logic diagrams • Install PPS components • Certify PPS	• Overall PPS Checklist • Executed Beamline Radiological Interlock Certification Checklist	Signature:
	Hutch Structures Hutch structures installed with adequate provision for life safety issues (egress and fall protection) in accordance with LT-SOW-XF-HU-0001, *Statement of Work for NSLS–II Beamline Shielding Enclosures ("Hutches")*, LT-C–XFD-SPC-HU-001, *NSLS-II Lead/Steel Beamline Shielding Enclosures*, and LT-C-XFD-SPC-HU-002, *NSLS-II Steel Beamline Shielding Enclosures.*	E. Haas/L. Lienhard Beamline Engineer	• Generate and execute Traveler for inspection	• Completed Traveler	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Safety Critical Hardware (Installation)	**Electrical Power** SBMS electrical power distribution requirements are satisfied. SBMS Electrical Equipment Inspection (EEI) requirements are satisfied.	A. Boerner Electrical Distribution Engineer	• Generate and approve one-line drawings • Complete system electrical inspection • Complete needed EEI inspections	• Approved AC Power one–line drawings • EEI database entries	Signature:
	Utilities Permanent facility and beamline utility systems are installed and tested (i.e., Compressed Air, DI Water, Gaseous Nitrogen, Process Chilled Water) in accordance with design, labeling, and attachment requirements.	J. Gosman Mechanical Utilities Group Leader	• Generate system schematics • Perform pressure test • Assure SBMS and NSLS-II labeling and hardware attachment requirements are met.	• Approved system schematics • System pressure testing reports	Signature (FE):
		R. Tappero Lead Beamline Scientist			Signature (Beamline):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Other Hardware (Installation)	**Other FE Components, Photon Transport Components, Optics, and Diagnostics** FE and Photon transport components that are not radiation safety components are installed and tested in accordance with the Travelers. Diagnostic equipment needed to begin technical commissioning is installed and tested.	R. Tappero Lead Beamline Scientist	• Generate and execute Traveler • Complete acceptance inspections	Beamline: • Completed Traveler • Acceptance inspection documentation, as needed	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Generate traveler and drawing • Execute Traveler • Perform pressure test	FE: • Completed Traveler • System pressure testing reports	Signature (FE):
		J. Rank Insertion Devices Engineer	• Generate traveler and drawing • Execute Traveler	3PW: • Completed Traveler	Signature (3PW):
	Equipment Protection System (EPS) Interlocks Hardware/Software installed and tested in accordance with the Traveler.	H. Bassan Controls Infrastructure Group Leader	• Generate and execute Traveler • Verify EPICS integration • Test system performance	Beamline: • Test Report • Completed Traveler	Signature (Beamline):
	Front End Equipment Protection System (FEEPS) (Installation needed for beamline operation) Hardware/Software installed and tested in accordance with the traveler.	G. Ganetis Electrical Engineering Group Leader	• Verify integration • Test system performance	FE and ~~3PW~~ • Test Report	Signature (FE and 3PW):

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Other Hardware (Installation)	**Controls** Hardware/Software installed and tested in accordance with NSLS-II requirements.	J. Ma Controls Engineer	• Test system performance • Complete integral testing	Beamline: • Performance and integral testing documentation	Signature (Beamline):
		H. Bassan Controls Group Engineer	• Test system performance • Complete integral testing	FE and 3PW: • Performance and integral testing checklist	Signature (FE and 3PW):
	Vacuum Vacuum hardware has been installed and tested in accordance with the Traveler and has the capability of achieving full vacuum needed during commissioning.	R. Todd Vacuum Engineer	• Generate and execute Top Level Traveler • Identify overpressure devices • Test system performance	Beamline: • Completed Top Level Traveler • Test Report	Signature (Beamline):
		C. Hetzel Vacuum Group Leader	• Generate and execute Top Level Traveler • Identify overpressure devices • Test system • performance	FE and 3PW: • Completed Top Level Traveler • Test Report	Signature (FE and 3PW):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Other Hardware (Installation)	**Controls** Hardware/Software installed and tested in accordance with NSLS-II requirements.	D. Padrazo Deputy Instrumentation Group Leader	• Test system performance • Complete integral testing	FE and 3PW: • Performance and integral testing checklist	

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar III Personnel	**Lead Beamline Scientist (LBS) / Cognizant Space Manager (CSM)** LBS and CSM personnel are assigned and Trained/Qualified.	B. Lein Training Group Leader	• Assign JTA for LBS and CSM	• BTMS record	Signature: Bruce Lein
	Authorized Beamline Staff Sufficient personnel to begin commissioning are assigned and Trained/Qualified.	B. Lein Training Group Leader	• Assign JTA	• BTMS record • Sufficient Staff Documentation	Signature: R. Bruce Lein Ryan Tappero
	Support Staff Other, non-beamline dedicated personnel needed to begin commissioning (e.g., Beamline Engineers and Controls Personnel) are assigned and Trained/Qualified for the Beamline.	B. Lein Training Group Leader	• Assign JTA	• BTMS record	Signature: Bruce Lein
	Lead Operators, Scientific Operators & FLOCOS (Accelerator Division) Trained/Qualified to: – Execute the Beamline Enable procedure – Perform roles assigned in any Beamline-specific procedures – Perform tasks related to FE and ID commissioning	B. Lein Training Group Leader	• Train Operators	• BTMS record	Signature: Bruce Lein

* Readiness Certification	R. Tappero - Lead Beamline Scientist	Signature: Ryan Tappero
* Readiness Certification	S. Sharma - Mechanical Engineering Group Leader	Signature: S. Sharma
* Readiness Certification	T. Tanabe - Insertion Devices Group Leader	Signature: J. PANK FOR T. TANABE 8/5/19

	Readiness Criteria	Responsible Person	Documented Evidence	Certification of Readiness*
IRR Pre–Start Findings	**No Pre-Start Findings Identified (Beamline)** No pre-start findings associated with the 4-BM Beamline have been identified by the Review Team and therefore the following lines do not require sign-off.	R. Lee ESH Manager	• IRR Preliminary Report	Signature:
		M. Hauptmann Independent Verifier		Signature:
	No Pre-Start Findings Identified (FE and 3PW) No pre-start findings associated with the FE and 3PW have been identified by the Review Team and therefore the following lines do not require sign-off.	R. Lee ESH Manager	• IRR Preliminary Report	Signature:
		M. Hauptmann Independent Verifier		Signature:
	Pre-Start Actions Complete (Beamline) All actions associated with the 4-BM Beamline IRR pre-start findings are complete.	J. Adams IRR Technical Authority (Beamline)	• Pertinent closure evidence	Signature:
	Pre-Start Actions Complete (FE and 3PW) All actions associated with the FE and 3PW Beamline IRR pre-start findings are complete.	T. Shaftan IRR Technical Authority (FE & 3PW)	• Pertinent closure evidence	Signature:
	Pre-Start Actions Verified (Beamline) All actions associated with the 4-BM Beamline IRR pre-start findings have been verified complete.	R. Lee ESH Manager	• Pertinent closure evidence	Signature:
	Pre-Start Actions Verified (FE and 3PW) All actions associated with the FE and 3PW IRR pre-start findings have been verified complete.	R. Lee ESH Manager	• Pertinent closure evidence	Signature:
	Pre-Start Actions Independently Verified (Beamline) Actions associated with the 4-BM Beamline IRR pre-start findings have been satisfactorily complete.	M. Hauptmann Independent Verifier	• Pertinent closure evidence	Signature:
	Pre-Start Actions Independently Verified (FE and 3PW) Actions associated with the FE and 3PW IRR pre-start findings have been satisfactorily complete.	M. Hauptmann Independent Verifier	• Pertinent closure evidence	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

APPENDIX D
READINESS PLAN FOR 7-BM (QAS)

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Functional Description** An overview presentation is prepared that defines the scope of the IRR and includes the following FE, ID and Beamline specific information: - Primary capabilities - Physical layout and location (includes Beamline location on the experiment floor) - Design reviews and performance parameters - Source characteristics - Photon beam performance goals - Radiation Safety Committee reviews - Self-identified pre-start findings - Description and status for each item listed in this Instrument Readiness Plan	S. Ehrlich Lead Beamline Scientist	Develop the presentation and document described	Beamline: • Presentation • Functional Description Document	Signature (Beamline):
		G. Fries Accelerator Division Liaison Engineer	• Develop the presentation described	FE and 3PW: • Presentation	Signature (FE and 3PW):
	Beamline, FE & ID Design Beamline, FE & ID components are designed in accordance with PS-QAP-0412, *Design Reviews* and PS-C-QAS-PRC-010, *Engineering Design by Others*.	S. Ehrlich Lead Beamline Scientist	Complete Engineering Design Reviews for the Beamline, FE and 3PW that address thermal management, mechanical support, configuration control, and vacuum	Beamline: • Internal and contractor supplied design review documents and reports	Signature (Beamline):
		S. Sharma Mechanical Engineering Group Leader		FE: • Requirements, Specifications, and Interface report (RSI) Internal and contractor supplied design review documents	Signature (FE): Greg Fries for S. Sharma 8/24/17
		T. Tanabe Insertion Devices Group Leader		3PW: • Requirements, Specifications, and Interface report (RSI) Internal and contractor supplied design review documents	Signature (3PW): J. RANK FOR T. TANABE 8/25/17

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Radiation Safety Components Design** Radiation Safety Components for the Beamline and FE are designed in accordance with NSLS-II requirements, PS-QAP-0412, *Design Reviews* and PS-C-QAS-PRC-010, *Engineering Design by Others*.	S. Ehrlich Lead Beamline Scientist	• Complete requirements analysis and design of radiation safety components for the Beamline	Beamline: • Internal design review documents and reports • RSC Report	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Complete requirements analysis and design of radiation safety components for the FE	FE: • Internal design review documents • RSC Report	Signature (FE): for M. Breitfeller
	Top-Off Safety System (TOSS) FE has been analyzed for Top-Off Safety in accordance with PS-C-ASD-PRC-183, *Approval of New and Modified NSLS-II Beamline Front Ends for Top Off Safety.*	R. Fliller Coordinator for Top Off Safety	• Complete TOSS analysis	• TOSS Analysis Report • Updated FE layout drawings • Updated *Beamlines Approved for Top-Off Operations* list	Signature:
	Ray Traces Bremsstrahlung and Synchrotron Ray Traces generated in accordance with PS-C-XFD-PRC-008, *Synchrotron and Bremsstrahlung Ray Trace Procedure.*	S. Ehrlich Lead Beamline Scientist	• Prepare the Ray Traces for the Beamline	Beamline: • Approved Primary Bremsstrahlung Ray Traces • Approved Maximum Synchrotron Ray Traces	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Prepare the Ray Traces for the Front End	FE: • Approved Primary Bremsstrahlung Ray Traces • Approved Maximum Synchrotron Ray Traces	Signature (FE): for M. Breitfeller

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Secondary Radiation Scatter Analysis** Secondary Bremsstrahlung and Synchrotron scatter is analyzed in accordance with LT-C-ESH-STD-001, *Guidelines for the NSLS-II Beamline Radiation Shielding Design.*	M. Benmerrouche Health Physics	• Complete FLUKA analysis • Complete STAC8 analysis	• BNL Technical Note Report	Signature:
	National Environmental Protection Act (NEPA) Evaluation NEPA requirements evaluation completed.	L. Stiegler ESH Operations Group Leader	• Complete a NEPA evaluation	• NEPA Evaluation Report	Signature:
	Unreviewed Safety Issue (USI) Evaluations/ Screenings Authorization basis hazard identification is managed through USI evaluation/screening.	S. Moss Authorization Basis Manager	• Verify that the SAD and ASE accurately cover the hazards associated with the subject Beamline, FE and 3PW; including temporary systems	• SAD and ASE USI screenings/evaluations • Applicable waivers	Signature (Beamline): Signature (FE and 3PW):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Resolution of Open Action Tracking System (ATS) Actions** Instrument specific action items from previous internal and external oversight groups (e.g., RSC, Design Reviews, etc.) are addressed. Previous IRR action items are addressed.	J. Zipper QA Engineer	• ATS action items for the instrument are satisfied. • ATS action items from previous IRRs are evaluated for impact to the instrument	Beamline: • ATS System	Signature (Beamline):
		E. Cheswick QA Engineer	• ATS action items for the FE and 3PW are satisfied. • ATS action items from previous IRRs are evaluated for impact to the instrument	FE and 3PW: • ATS System	Signature (FE and 3PW)::
	Procedures Procedures needed for safe, secure, and environmentally sound commissioning have been developed, reviewed, validated (where applicable), and approved. Existing procedures are verified as sufficient for new hazards introduced by this Beamline, if any.	K. Rubino Procedure Support	• Develop any system specific procedures • Verify that existing procedure are sufficient for any new hazards introduced	• 7-BM Radiological Interlock Test Checklist • Search and Secure Sketch • 3PW LOTO Procedure (NSLSII-ID-PRC-003)	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Commissioning Plans** Commissioning plans have been generated for the Beamline and FE and 3PW to address the task sequence required for technical commissioning (safe photon transport).	S. Ehrlich Lead Beamline Scientist	• Prepare a Beamline Commissioning Plan to define technical objectives and operational readiness requirements	Beamline: • Approved Beamline Commissioning Plan	Signature (Beamline):
		G. Wang Accelerator Coordination Group Leader	• Verify that NSLS-II ID and Front End Commissioning Sequence (PS-C-ASD-PRC-166) adequately covers commissioning for the FEs and IDs	FE and 3PW: • NSLS-II ID and Front End Commissioning Sequence (PS-C-ASD-PRC-166)	Signature (FE and 3PW):
	Radiation Survey Procedures A survey procedure has been generated for the Beamline in accordance with PS-C-XFD-PRC-004, *NSLS-II Beamlines Radiation Safety Commissioning Plan* and the existing NSLS-II Insertion Devices and Front End Radiation Survey Plan (PS-C-ESH-PRC-061) has been reviewed and updated as necessary for the FE and 3PW.	M. Benmerrouche Radiation Physicist	• Prepare the Radiation Survey Procedure for the Beamline • Obtain RSC approval of the procedure	• Approved Beamline Radiation Survey Procedure	Signature (Beamline):
		M. Benmerrouche Radiation Physicist	• Verify that the NSLS-II ID and Front End Radiation Survey Plan (PS-C-ESH-PRC-061) adequately covers commissioning for the FEs and IDs	• NSLS-II Insertion Devices and Front End Radiation Survey Plan (PS-C-ESH-PRC-061)	Signature (FE and 3PW):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar I Documentation (Planning & Procedures)	**Experiment Safety Review** An Experiment Safety Review has been submitted, executed and approved within the BNL ESR system.	S. Ehrlich Lead Beamline Scientist	• Complete submission and pursue approval of an Experiment Safety Review through use of the BNL electronic system	• Approved BNL ESR	Signature:
	Proposal Allocation Safety & Scheduling (PASS) The instrument is active within PASS with approvals to proceed with Technical Commissioning.	S. Ehrlich Lead Beamline Scientist	• Assure that PASS is configured to administer the instrument	• Defined resource within PASS • Submitted Technical commissioning proposal • Submitted Safety Approval Form	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Safety Critical Hardware (Installation)	**Radiation Safety Components: Installation** Radiation Safety Components, including Top Off components are installed in accordance with the Traveler.	S. Ehrlich Lead Beamline Scientist	• Generate and execute Traveler	Beamline: • Completed Traveler	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Generate and execute Traveler	FE: • Completed Traveler	Signature (FE):
		L. Doom Accelerator Coordination	• Generate and execute Top-Off Traveler	Completed Traveler	Signature:
	Radiation Safety Components: Configuration Control A Radiation Safety Component Checklist template is generated in accordance with PS-C-ESH-PRC-025, *NSLS-II Radiation Safety Component Inspection Procedure.*	S. Ehrlich Lead Beamline Scientist	• Develop Radiation Safety Component Checklist	Beamline: • Approved beamline specific Radiation Safety Component Checklist w/ RSC approval	Signature (Beamline):
		L. Doom Accelerator Coordination	• Verify that the existing checklist adequately covers the subject FE and ID	FE: • Approved Storage Ring Radiation Safety Component Checklist Template	Signature (FE):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Safety Critical Hardware (Installation)	**Area Radiation Monitors (ARMs)** ARMs are installed in accordance with PS-C-ESH-ARN-SPC-001, *NSLS-II Area Radiation Monitor (ARM) System Description* and PS-C-ESH-STD-002, *Technical Basis Document for Interlocked Area Monitors Placement Outside the Accelerator and Beamlines Enclosures.*	M. Benmerrouche ARM Technical Authority	• Perform analysis to prove that no ARM is required	• Analysis and RSC Memo of approval	Signature:
	Personnel Protection System (PPS) Interlocks: Installed and Certified Hardware/Software installed in accordance with PS-C-XFD-SPC-PPS-001, *Beamline Personnel Protection System (BLPPS) and Front End Personnel Protection System (FEPPS) Design Description.*	G. Ganetis Electrical Engineering Group Leader	• Generate system schematics and logic diagrams • Install PPS components • Certify PPS	• Overall PPS Checklist • Executed Beamline Radiological Interlock Certification Checklist	Signature:
	O2 Sensors: Install Oxygen sensors and alarms required to alert personnel to oxygen deficiency hazard (ODH) conditions installed in accordance with the design drawing.	S. LaMarra ODH Technical Authority	• Generate design drawing • Generate and execute Traveler	• Design drawing • Completed Traveler	Signature: for S. LaMarra
	O2 Sensors: Certify ODH monitoring system has been certified in accordance with PS-C-XFD-PRC-005, *Beamline Enclosures and Cryogen Fill Station ODH Monitoring and Alarm System Certification and Inspection.*	B. Heneveld ESH Engineer	• Perform certification	• Certification Report	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Safety Critical Hardware (Installation)	**Hutch Structures** Hutch structures installed with adequate provision for life safety issues (egress and fall protection) in accordance with LT-SOW-XF-HU-0001, *Statement of Work for NSLS–II Beamline Shielding Enclosures ("Hutches")*, LT-C–XFD-SPC-HU-001, *NSLS-II Lead/Steel Beamline Shielding Enclosures*, and LT-C-XFD-SPC-HU-002, *NSLS-II Steel Beamline Shielding Enclosures.*	E. Haas/L. Lienhard Beamline Engineer	• Generate and execute Traveler for inspection	• Completed Traveler	Signature:
	Electrical Power SBMS electrical power distribution requirements are satisfied. SBMS Electrical Equipment Inspection (EEI) requirements are satisfied.	A. Boerner Electrical Distribution Engineer	• Generate and approve one-line drawings • Complete system electrical inspection • Complete needed EEI inspections	• Approved AC Power one–line drawings • EEI database entries	Signature:
	Utilities Permanent utility systems are installed and tested (i.e., Compressed Air, DI Water, Gaseous Nitrogen, Process Chilled Water) in accordance with design drawings.	J. Gosman Mechanical Utilities Group Leader	• Generate system schematics • Perform pressure test	• Approved system schematics • System pressure testing reports	Signature (~~PE~~): FE
		S. Ehrlich Lead Beamline Scientist			Signature (Beamline):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Other Hardware (Installation)	**Other FE Components, Photon Transport Components, Optics, and Diagnostics** FE and Photon transport components that are not radiation safety components are installed and tested in accordance with the Travelers. Diagnostic equipment needed to begin technical commissioning is installed and tested.	S. Ehrlich Lead Beamline Scientist	• Generate and execute Traveler • Complete acceptance inspections	Beamline: • Completed Traveler • Acceptance inspection documentation, as needed	Signature (Beamline):
		M. Breitfeller Mechanical Engineer	• Generate traveler and drawing • Execute Traveler • Perform pressure test	FE: • Completed Traveler • System pressure testing reports	Signature (FE):
		J. Rank Insertion Devices Engineer	• Generate traveler and drawing • Execute Traveler	3PW: • Completed Traveler	Signature (3PW):
	Equipment Protection System (EPS) Interlocks Hardware/Software installed and tested in accordance with the Traveler.	H. Bassan Controls Infrastructure Group Leader	• Generate and execute Traveler • Verify EPICS integration • Test system performance	Beamline: • Test Report • Completed Traveler	Signature (Beamline):
	Front End Equipment Protection System (FEEPS) (Phase 2 Installation needed for beamline operation) Hardware/Software installed and tested in accordance with the traveler.	G. Ganetis Electrical Engineering Group Leader	• Verify integration • Test system performance	FE and ~~3PW~~ 3673 • Test Report Phase 2 Installation	Signature (FE and 3PW):

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Other Hardware (Installation)	**Controls** Hardware/Software installed and tested in accordance with NSLS-II requirements.	C. De Silva Controls Engineer	• Test system performance • Complete integral testing	Beamline: • Performance and integral testing documentation	Signature (Beamline):
		H. Bassan Controls Group Engineer	• Test system performance • Complete integral testing	FE and 3PW: • Performance and integral testing checklist	Signature (FE and 3PW):
	Vacuum Vacuum hardware has been installed and tested in accordance with the Traveler and has the capability of achieving full vacuum needed during commissioning.	R. Todd Vacuum Engineer	• Generate and execute Top Level Traveler • Identify overpressure devices • Test system performance	Beamline: • Completed Top Level Traveler • Test Report	Signature (Beamline):
		C. Hetzel Vacuum Group Leader	• Generate and execute Top Level Traveler • Identify overpressure devices • Test system • performance	FE and 3PW: • Completed Top Level Traveler • Test Report	Signature (FE and 3PW):

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar II Other Hardware (Installation)	**Controls** Hardware/Software installed and tested in accordance with NSLS-II requirements.	D. Padrazo Deputy Instrumentation Group Leader	• Test system performance • Complete integral testing	FE and 3PW: • Performance and integral testing checklist	

	Readiness Criteria	Responsible Person	Actions	Documented Evidence	Certification of Readiness*
Pillar III Personnel	**Lead Beamline Scientist (LBS) / Cognizant Space Manager (CSM)** LBS and CSM personnel are assigned and Trained/Qualified.	B. Lein Training Group Leader	• Assign JTA for LBS and CSM	• BTMS record	Signature: Bruce Lein
	Authorized Beamline Staff Sufficient personnel to begin commissioning are assigned and Trained/Qualified.	B. Lein Training Group Leader	• Assign JTA	• BTMS record • Sufficient Staff Documentation	Signature: Bruce Lein
	Support Staff Other, non-beamline dedicated personnel needed to begin commissioning (e.g., Beamline Engineers and Controls Personnel) are assigned and Trained/Qualified for the Beamline.	B. Lein Training Group Leader	• Assign JTA	• BTMS record	Signature: Bruce Lein
	Lead Operators, Scientific Operators & FLOCOS (Accelerator Division) Trained/Qualified to: – Execute the Beamline Enable procedure – Perform roles assigned in any Beamline-specific procedures – Perform tasks related to FE and ID commissioning	B. Lein Training Group Leader	• Train Operators	• BTMS record	Signature: Bruce Lein

* Readiness Certification	**S. Ehrlich - Lead Beamline Scientist**	**Signature:** Steven W. Ehrlich
* Readiness Certification	**S. Sharma - Mechanical Engineering Group Leader**	**Signature** S. Sharma
* Readiness Certification	**T. Tanabe - Insertion Devices Group Leader**	**Signature** J. PARK FOR T. TANABE 8/25/17

	Readiness Criteria	Responsible Person	Documented Evidence	Certification of Readiness*
IRR Pre–Start Findings	**No Pre-Start Findings Identified (Beamline)** No pre-start findings associated with the 7-BM Beamline have been identified by the Review Team and therefore the following lines do not require sign-off.	R. Lee ESH Manager	• IRR Preliminary Report	Signature:
		M. Hauptmann Independent Verifier		Signature:
	No Pre-Start Findings Identified (FE and 3PW) No pre-start findings associated with the FE and 3PW have been identified by the Review Team and therefore the following lines do not require sign-off.	R. Lee ESH Manager	• IRR Preliminary Report	Signature:
		M. Hauptmann Independent Verifier		Signature:
	Pre-Start Actions Complete (Beamline) All actions associated with the 7-BM Beamline IRR pre-start findings are complete.	J. Adams IRR Technical Authority (Beamline)	• Pertinent closure evidence	Signature:
	Pre-Start Actions Complete (FE and 3PW) All actions associated with the FE and 3PW Beamline IRR pre-start findings are complete.	T. Shaftan IRR Technical Authority (FE & 3PW)	• Pertinent closure evidence	Signature:
	Pre-Start Actions Verified (Beamline) All actions associated with the 7-BM Beamline IRR pre-start findings have been verified complete.	R. Lee ESH Manager	• Pertinent closure evidence	Signature:
	Pre-Start Actions Verified (FE and 3PW) All actions associated with the FE and 3PW IRR pre-start findings have been verified complete.	R. Lee ESH Manager	• Pertinent closure evidence	Signature:
	Pre-Start Actions Independently Verified (Beamline) Actions associated with the 7-BM Beamline IRR pre-start findings have been satisfactorily complete.	M. Hauptmann Independent Verifier	• Pertinent closure evidence	Signature:
	Pre-Start Actions Independently Verified (FE and 3PW) Actions associated with the FE and 3PW IRR pre-start findings have been satisfactorily complete.	M. Hauptmann Independent Verifier	• Pertinent closure evidence	Signature:

*Signature certifies that the readiness criteria are met. The Responsible Person shall not sign prior to completion.